

Facial Fracture Management in Northwest Nigeria

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INTRODUCTION

Facial fracture often involves serious morbidity in our community and sometimes fatal consequence. It is a common sequel of blunt and penetrating trauma.^[1] Blunt trauma includes road traffic crash (RTC), altercation, industrial/occupational accidents, sports, and falls.^[1-4] Penetrating injuries are results of gunshots, missiles, stabbing, and explosions. Pathological diseases such as tumors, osteomyelitis, cysts, osteoradionecrosis may also contribute to facial fracture.^[1-5] RTCs have been reported as the most frequent reason for facial fractures in Nigeria, rural and developing world,^[1,5-8] while altercations remains the leading causes in urban and developed countries.^[9,10] However, recent report on the war in Afghanistan by Breeze and associates have identified increasing facial fractures among British troops despite to protective armor worn and advances in on-field resuscitation and critical care that have increased survival in the battle field.^[11] Falls are common in the very young and elderly.^[12] Pattern of facial fracture is predicated on etiology, population density, socioeconomic, cultural, race, and time.^[1,5] Others include types of facilities available, regional government and geography.^[12,13]

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ABSTRACT

Background: Facial fracture is gradually become a public health problem in our community due to the attendant morbidity and mortality. Hence, the aim of this study was to determine the pattern of facial fracture in Dental and Maxillofacial Surgery Department of Usmanu Danfodiyo University Teaching Hospital. This cross-sectional study was undertaken to provide information regarding gender, age, etiology, and diagnosis of patients with maxillofacial fractures. **Materials and Methods:** A 1-year review of patients diagnosed and treated for facial fractures in Usmanu Danfodiyo University Teaching Hospital between January 2011 and December 2011. The diagnosis was based on radiographic data and clinical examination. The main analysis outcome measures were etiology, age, gender, site, and treatment. Data were organized and presented by means of descriptive statistics and Pearson's Chi-square test. The level of significance adopted was 5%. **Results:** A total of 40 patients were treated in this period. Over 95% were male, 81% were caused by road traffic crash (RTC) and 86.4% were in the 21-30 years group. Most patients (52%) had mandibular fractures, and the most common site was the body. Most patients with midfacial fractures had fractures of the zygomaticomaxillary region (36%), while fractures of the parasymphiseal region were more common in the mandible 156 (31%). The most common treatment for jaw fractures was mandibulomaxillary fixation (MMF). Stable zygomatic complex fractures were reduced (elevated) intraorally, and unstable ones were supported by antral packs. **Conclusions:** This study highlights facial fractures secondary to RTC as a serious public health problem in our environment. Preventive strategies remain the cheapest way to reduce direct and indirect costs of the sequelae of RTC. It also bring to the fore the necessity to shift to open reduction and internal fixation (ORIF) of fractures.

Key words: Facial fracture, jaw fixation techniques, mandibulomaxillary fixation, maxillofacial injuries, motorcycle, open reduction and internal fixation, road traffic crash, traffic accidents

Facial fractures and other maxillofacial injuries have high clinical significant because the anatomical specificity of face provides protection to important vital organs such as the brain and eyes and others like the digestive and respiratory systems.^[12] The facial skeleton is one of the most complex arrangements of curving bony structures in the body and consists of bones of the mandible, maxilla, zygoma, bony walls of the nasal cavities, paranasal sinuses, and orbit.^[12,13] Injuries to this region can result in serious dysfunctions

of sight, smell, breathing; eating and talking which impact negatively on the victim's quality of life. Moreover, owing to high premium placed on facial appearance in many societies esthetic disturbance could result in adverse psychological consequence.^[13] Unfortunately, limited specialized manpower needed to treat these injuries and the considerable treatment cost imposes huge burden and demand on the ever dwindling healthcare resources of developing nation like ours.^[5-8]

Owing to the foregoing, it is necessary to explore the etiology and pattern of fractures of facial skeleton. Such periodic verification of the etiology of maxillofacial injuries will facilitate the assessment of proficiency of road safety measures such as speed limit, drunk driving, crash helmets, and seat belt laws. It will also help to identify the behavioral patterns of commuters in the locality and help to recommend ways in which injuries to the face can be averted.^[5]

It will also guide the future funding of public health programs geared towards prevention, provision of facilities, training of manpower; and aid the healthcare provider to optimize treatment of maxillofacial injuries.^[3] However, such information is lacking from northwestern Nigeria especially Sokoto. Hence, this study is aimed at reporting the etiology, pattern, and treatment of facial fractures at our Oral and Maxillofacial Surgery Department in Usmanu Danfodiyo University Teaching Hospital, Sokoto.

MATERIALS AND METHODS

Case records of 40 patients who presented with facial fracture at the Dental and Maxillofacial Surgery Department of Usmanu Danfodiyo University Teaching Hospital, Sokoto between January, 2011 and December, 2011 were retrieved by the first author and the following variables etiology, age, gender, site, and treatment were obtained.

This hospital is the only tertiary and referral center in the state and it is strategically located in the state capital, Sokoto.

Sokoto is a city located in the extreme northwest of Nigeria, near to the confluence of the Sokoto River and the Rima River. Sokoto is the modern day capital of Sokoto State (and its predecessor, the northwestern state). It is situated in northwestern of the country between latitudes 4°N to 14°N and longitudes 2°E and 15°E. Kebbi state border to the southwest, Katsina state to the east, Zamfara state to the southeast, and Republic of Niger to the northwest with a land mass of approximately 25,973 km².^[14]

Sokoto state has a projected population of 3.7 million people based on 2006 census made up of two ethnic groups namely, Hausa and Fulani. Sokoto town, the capital of Sokoto state, has a population of approximately 2.5 million. The population is largely rural with farming, cattle rearing, and fishing as the predominant occupations (>80%).^[14]

The diagnosis of fracture was based on clinical history, signs and symptoms, visual findings, manual examination, and correct interpretation of plain radiographs. The pattern of facial fracture is determined according to the fractures of mandible, midface, and alveolar bone. Fractures of the middle third of the facial skeleton were classified according to the Le Fort classification. Treatment modalities given were highlighted. Fractures including the base of the skull and frontal bone were not included in the present study.

Closed reduction and dental wiring with arch bars, direct wires, and eyelet wires combined with mandibulomaxillary fixation (MMF) were routine mode of treatment for mandibular fractures. Open reduction and internal fixation (ORIF) with intraosseous wire of mandibular fractures were employed when indicated. Fractures of the maxillae/Le Fort fractures were reduced and fixed by eyelets/arch bars combined with MMF and with/without suspension wires. Stable zygomatic complex fractures were reduced (elevated) intraorally, and unstable ones were supported by antral packs.

All patients were placed on oral or intravenous antibiotics for 5-7 days except those with established infections who had their antibiotics regimen appropriately extended. Follow-up period was 6 weeks-6 months.

Data analyses for age, sex, etiology, site of fracture, and treatment given were performed using Analyse-it for Microsoft Excel 2012. Simple frequencies were computed and cross tabulations of some variables were made. Pearson's Chi-square test was used to compare the frequency distribution and statistical significance was set at $P \leq 0.05$.

RESULTS

Patients' age ranged from 8 to 60 years (27.6 ± 10.4 years). There was an overwhelming male dominance in all age groups (male: female (M:F) = 19:1, odds ratio = 380) [Table 1]. The most susceptible age group was 21-30 years (47.5%) and the least were 0-10 years and 51-60 years (2.5%) [Figure 1]. The most common cause of fracture was RTCs (87.5%) of which 58.3% were motorcycles related and mostly involved riders (80.9%) [Table 2]. There was 15.0% associated

head injury ($P = 0.68$). Maxillofacial trauma was highest in the months of October (20%) and June/July (15%) [Figure 2].

Isolated mandibular fractures were most frequent (60%) and least fractured bone was maxilla (7.5%) [Figure 3]. Among mandibular fractures, the body was more regularly involved (36.5%) followed by parasymphyseal (21.2%) [Table 3]. For midfacial fractures, zygomatic bone and arch were most frequently involved (68.4%) [Table 3]. There were associated soft tissue injuries with the lower lip mostly affected (75%) especially in RTCs ($P < 0.05$). In 14 (41.2) cases there were bilateral fractures.

Closed reduction and dental wiring with arch bars, direct wires, and eyelet wires combined with MMF were the most common form of treatment for mandibular fractures [Figure 4]. Wire osteosynthesis is employed for ORIF of mandibular fractures in few cases. Fractures of the maxillae/Le Fort fractures were reduced and fixed by eyelets/arch bars combined with suspension wires and MMF. Zygomatic complex fractures were treated either conservatively or by either closed or open reduction with Gillies' temporal or buccal approaches.

Table 1: Sex and age distribution

Sex	Age group (years)						Total (%)
	0-10	11-20	21-30	31-40	41-50	51-60	
Male	1 (2.5)	7 (17.5)	19 (47.5)	8 (20.0)	2 (5.0)	1 (2.5)	38 (95.0)
Female	0 (0.0)	2 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.0)
Total (%)	1 (2.5)	9 (22.5)	19 (47.5)	8 (20.0)	2 (5.0)	1 (2.5)	40 (100)

Pearson's χ^2 statistic = 7.25, degrees of freedom (df)=5, $P=0.20$

Table 2: Etiology and person distribution

Etiology	Person					Total (%)
	Cyclist	Driver	Passenger	Pillion passenger	Rider	
Altercation	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)
Bicycle	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)
Fall	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)
Gunshot	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.0)
Hit by collapsed building	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)
MBRTA	0 (0.0)	0 (0.0)	0 (0.0)	4 (10.0)	16 (40.0)	20 (50.0)
MVRTA	0 (0.0)	3 (7.5)	11 (27.5)	0 (0.0)	0 (0.0)	14 (35.0)
Total (%)	1 (2.5)	3 (7.5)	11 (27.5)	4 (10.0)	16 (40.0)	40 (100.0)

$\chi^2=120$, degrees of freedom (df)=30, $P<0.0001$; MBRTA – Motorbike road traffic accident; MVRTA – Motorvehicle road traffic accident

DISCUSSION

Facial fracture has become a public health issue in many parts of Nigeria and globally owing to the attendant mortality, morbidity, and huge socioeconomic consequences.^[6] There is paucity of epidemiologic data from Sokoto, northwest region of Nigeria. Hence, this study was primarily undertaken to look at the pattern of facial fracture and treatment modalities at our relative young

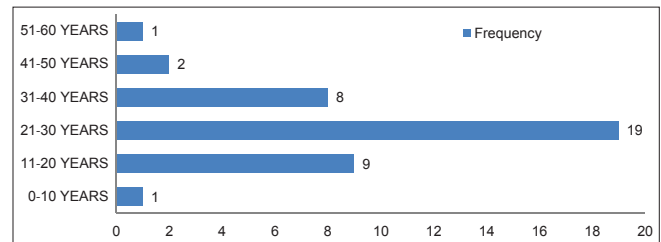


Figure 1: Age distribution of facial fracture patients

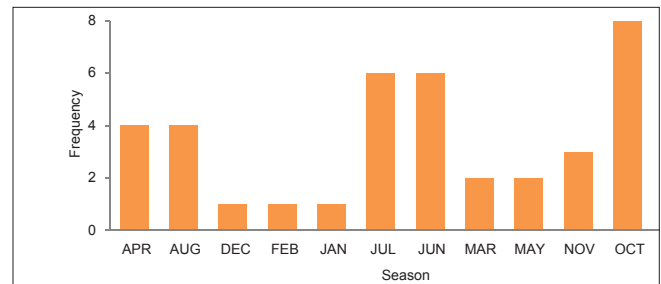


Figure 2: Seasonal variation of facial fractures

Table 3: Summary data of facial fracture patients

Summary of result	Number (%)
Associated injuries	
Lacerations	n=8
Upper	2 (25.0)
Lower	6 (75.0)
Head injury	6 (15.0)
Fractured side	
n=34	
Right	8 (23.5)
Left	12 (35.3)
Bilateral	14 (41.2)
Anatomical site	
n=52	
Mandible	19 (36.5)
Body	11 (21.2)
Parasymphysis	7 (13.5)
Symphysis	4 (33.3)
Angle	4 (7.7)
Dentoalveolar	4 (7.7)
Coronoid	0 (0.0)
Communitied	3 (5.8)
Maxilla	
n=9	
Dentoalveolar	3 (33.3)
Le Fort I	3 (33.3)
Le Fort II	3 (33.3)
Le Fort III	0 (0.0)

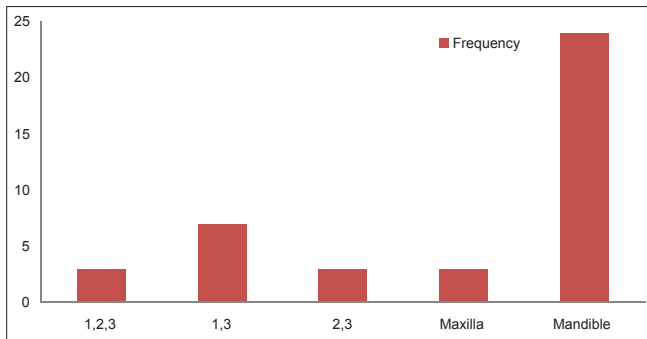


Figure 3: Facial fracture distribution according to involved bone. 1 – Mandible; 2 – Maxilla; 3 – Zygoma

center offering maxillofacial trauma services. We hoped that this will help to provide baseline information to guide in prevention and proper planning of maxillofacial trauma care in our hospital and in the region.

In this present study, more males were affected than females with a very high odd ratio; this is the highest reported figure from Nigeria and worldwide.^[1,3-9] Kadkhodaie; Al Ahmed *et al.*, and other studies from Middle East reported similar high ratio.^[15-19] Our finding, is however, not in concordance with most studies from Nigeria, western Europe, and Japan that showed much narrower gender ratio.^[5-12,20,21] Fasola *et al.*, and Tanaka *et al.*, found a 3:1 male-to-female ratio.^[7,21] There had been several postulations in the literature regarding the high male bias. Sing *et al.*, suggested that higher level of physical activities among males might be the reason.^[13] Others include more male exposure to certain risky situations, for example, there are more male drivers on the roads, especially on highways; men are more likely to practice contact sports; and men attend bars more often and consequently are more likely to use alcohol and other drugs prior to driving.^[3,5] In addition, culturally in many traditional African and Islamic societies, male are often the bread winner of the family and women predominantly take care of the home and only occasionally involved in other activities outside. In works with narrower or equal gender ratio, the female lived a more outdoor life and share similar jobs with their male counterpart, thereby being exposed to similar risk factors.^[5-11]

Maxillofacial fracture incidence in the present study was highest in October followed by June and July. Kontio *et al.*,^[9] in his study found an increase in incidents in June and August, while Ravindra and Ravindra Nair^[1] reported significant high in April and May. Ogundare *et al.*, and Paes *et al.*,^[3,22] suggested that increased maxillofacial trauma during summer holiday is due to availability of more leisure time and high alcohol consumption. However, our own data indicates that the months of June and July are peak of raining season, while October is the harvesting time.

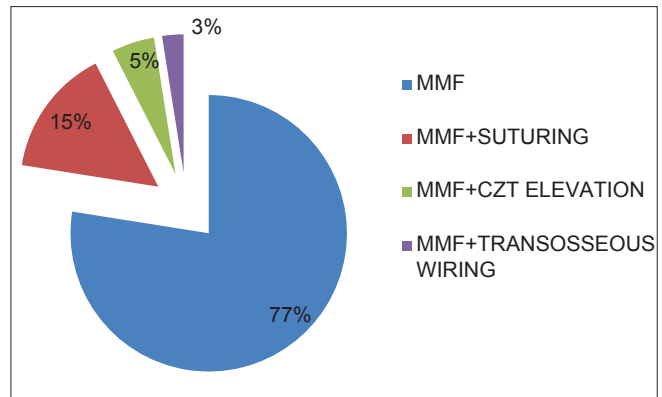


Figure 4: Treatment of facial fracture's patients. MMF-Mandibulomaxillary fixation, CZT-zygoma

Hence, road travel might be compromised especially with increased density of people plying these roads.

The modal age group of 21-30 years seen in this present cohort is consistent with the literature.^[1-10,13] Paes *et al.*, pointed out that this age group reflects people at the prime of their life. They have zest, increased physical energy, and adventurousness, but lack experience and often impetuous; hence, are likely to disregard traffic regulations.^[2,5,6,23] In the present study, the maximum age was 60 years. The reason in this cohort is unknown; however, we speculate that owing to preponderance of RTC and its severity, elderly patients might not have survived. We wish to examine this observation in future prospective study.

The etiology of maxillofacial injuries varies from one country to another and even within the same country depending on the prevailing socioeconomic, cultural, and environmental factors.^[5,6] Recent works had established RTC as the leading agent of facial fractures in most developing countries of Africa, Middle East, Asia, and some parts of Europe.^[5-9,16,18-20,24] In contrast to Zimbabwe, South Africa; northeastern Nigeria and economically advance nations of Europe, Australia, and United State of America;^[1,2,17,21,23,25-27] interpersonal violence in the form of physical assaults and gunshots has replaced RTC as the predominant cause of facial fracture. According to Taher and Olosoji *et al.*, fractures caused by firearm bullets and assault appear to be the most usual cause of facial fracture in Iran and northeastern Nigeria.^[20,28]

RTCs are among the major factor of maxillofacial injuries and according to the results of previous studies the reason of 14.8-90.2% of all the skeletal and soft tissues injuries of the face.^[1-10,12,20] Adeyemo *et al.*, and Fasola *et al.*, noted that RTCs were major cause of death and injury, especially in low and middle-income countries.^[6,7] It is estimated that road traffic injuries will have risen from ninth to third in world

disease burden rankings by 2020, accounting for 2.3 million deaths globally. In developed nations, progress in technology has resulted in more personal and vehicle protective measures being implemented coupled with access to proper medical care, good road and transport facilities; and regular enforcement of traffic rules and regulations.^[9,10,23] The reverse scenario exists in developing countries especially of sub-Saharan Africa which has led to an increase in mortality and morbidity associated with RTCs.^[5,16-18]

The other significant etiologic factors of injuries to the maxillofacial region are assaults/interpersonal violence, falls, sport, industrial, gunshot/warfare, animal, iatrogenic, and suicide/self-inflicted.^[1,2,5,23,29]

Reported frequency of facial fractures due to RTC varies from 14.8 to 90.2%.^[1-9,16-18] The current study finding of 87.5% of road traffic collision is similar to that of Kadkhodaie^[15] in a recent Iranian study that found 91% of their facial fracture attributed to RTC. This result also comparable with many Nigerian^[5-8] and Middle Eastern studies^[16-18] that demonstrated RTCs as the most frequent cause of facial fractures.^[1,2,5,6] Our finding of over 50% of RTC involved head-to-head collision of motorcycles and is reflected by the high frequency of riders involved than pillion passengers which confirmed the works of Oginni *et al.*,^[30] and Ramli *et al.*^[27] In Sokoto metropolis and state as a whole, there is no established public transport system. Transport within the city (when not by foot) is mainly by motorcycles which operate as one-person taxis. This is quite lucrative and required low start-up capital and has subsequently, attracted many; particularly unskilled, illiterate, and unemployed youth who flock the city from many rural areas. Huelke and Compton stated that motorbike accidents are usually more serious than car accidents.^[24] Increase in the use of motorbikes has led to a greater number of accidents and, consequently, multiple facial fractures. Adeyemo *et al.*,^[5] and other Nigerian authors^[7,30,31] have raised alarm on the increasing menace of commercial motorcyclists on Nigerian roads. Saheeb and Etetafia and earlier Nigerian studies repeatedly cautioned that many commercial motorcyclists and motorists ignore the crash helmets/seatbelt regulations^[5,7,30,32] despite Nigerian Traffic Code imposition of stiff penalties against noncompliance with seat belts and crash helmet use. Additional problems mentioned are the overloading of passengers/pillions and goods, high speed, and imprudence among commercial motorcyclists (Okada) and motorists.^[5,30]

A recent Brazilian study^[2] attributed their high frequency of RTCs to the fact that their population are largely rural and are farmers. Therefore, they travel great distance to

transport their produce to the city most often in vehicles overloaded and not road worthy. We also face a similar scenario with our study population. Buses and taxis are infrequent and are generally only used for transport between cities. Other reasons postulated for the high frequency of RTCs include lack of street lights, inadequate road safety awareness, unsuitable road conditions without expansion of the motorway network, violation of speed limits, and old vehicles without safety features such as anti-burst locks and energy absorbing materials.^[33] Furthermore, entry into opposite traffic lane without regard, violation of the right of the way, violation of the highway code, use of alcohol or other intoxicating agents, behavioral disorders, and poor socioeconomical conditions of some drivers.^[2,5,23] Street lighting has been suggested as a relatively low cost intervention with the potential to prevent traffic crashes.^[34]

In this study, for diagnosis of facial fracture we relied on clinical examination and conventional plain radiography. Adeyinka *et al.*, noted that midfacial skeleton is much more difficult to assess using plain films than is the mandible.^[35] The presence of thin bones, fluid-filled spaces (e.g., congested sinuses), and soft tissues (e.g., orbital contents) make accurate assessment difficult with images that do not offer a high degree of contrast.^[5,6] Our low utilization of advance imaging for maxillofacial fractures (e.g., computed tomography (CT) scan) is due to poor socioeconomic condition of the study population as health is paid for out of pocket. An average CT scan in Sokoto costs 25,000 Naira (about \$160) which is quite exorbitant for most categories of our patients who are predominantly low socioeconomic class.

Reports in the literature noted that the pattern, incidence, and severity of facial fractures due to RTC often depend on mechanism of injury and mode of transportation predominant in that region.^[2,5] Over half of the proportion of facial fractures in this study were mandibular fractures followed by fractures of the zygomatic complex and maxillary bones. This is in agreement with most studies,^[2-9] but contradicts that of Ravindra and Ravindra Nair^[11] and others from economically advanced countries where midfacial fractures were more frequently diagnosed.^[9,10,12,36] It is mentioned in the maxillofacial literature that the mandible is more vulnerable to fracture owing to its mobility, open arch, atrophy after dental loss and conspicuousness in the lower part of the face.^[5,13] Hence, it takes part in the mechanism of hyperextension and hyperflexion of the head in traffic crashes.

The present series showed that the body is the most fractured site in the mandible followed by parasymphysis.

This is in accordance with recent Nigerian studies,^[5-8] but at variance with that of Ogundare^[22] and elsewhere^[13] that demonstrated angle and parasymphseal fractures as the most common jaw fracture. This has been linked to the changing trends of etiology of facial fractures globally.

Analysis of our finding showed that the zygoma was the more commonly fractured midfacial bone which is comparable to the literature.^[5,7,36] However, it contradicts the works of Gassner *et al.*, that reported Le Fort and orbital fractures as the most frequently affected midfacial bone.^[26] It should be highlighted that our result might be affected by the limitations of plain film in assessing midfacial fracture due to low contrast owing to presence of thin bones, fluid-filled spaces (e.g., congested sinuses), and soft tissues (e.g., orbital contents).

We found in this study high multiple facial injuries and concomitant head injury which is similar to the study of Posnic *et al.*, but contrary to that of Singh *et al.*^[13,37] Severity of craniofacial injuries are directly related to the etiological agents.^[1] RTCs have potentially lead to multiple facial and system injuries.

Our study revealed that the mandibular fracture treatment is by closed reduction with MMF and on a few occasion open reduction with transosseous wiring was employed. Stable zygomatic fractures were reduced by elevation, and unstable ones supported by antral packs. This treatment modality was chosen as in previous Nigerian reports^[5-8] based on affordability, availability, simplicity, and safety; and plethora of skill and armamentarium. Titanium plate osteosynthesis for facial fracture treatment has gained popularity worldwide and is the gold standard.^[38-41] In resource challenged environment however, adopting this trend has been quite difficult owing to the low socioeconomic status of our patients, high cost of acquisition, specialized training and skilled needed, and limited theater space for treatment under general anesthesia especially with other competing surgical specialties.^[5,42,43] However, a recent review by Akadiri and Omitola^[44] demonstrated that despite the drawbacks of closed reduction results obtained are satisfactory and quite comparable with titanium plate osteosynthesis of ORIF.

Limitations of the study

We had included in our study only those patients who were treated by the Oral and Maxillofacial Surgery unit. Those patients who were fatally injured did not figure in our study. Isolated nasal fractures are treated by the ear, nose, and throat (ENT) surgeons in our hospital which resulted in is

none featuring in this article. Other parameters pertaining to maxillofacial injuries such as malocclusion, infections, and pseudoarthrosis were missing from our records; hence, making their analysis impossible. This we hope to correct in a future long-term cohort study.

CONCLUSION

In summary, RTC was the most frequent cause of facial fracture in our study cohort. A preponderance of male aged 21-30 years is in agreement with the literature. Furthermore, this current study highlights mandibular fractures as the most common in our environment and low utilization of ORIF in facial fracture treatment.

For a developing economy like ours, the burden of management of facial fractures can be enormous and unbearable. Hence, prevention is the best measure to reverse this scenario. These include road safety and traffic education to create awareness among our road users with the desire to achieve paradigm behavioral shift that will reduce accidents and carnage on our highways.

Transportation and traffic services affect all parts of the society and all individuals daily. Therefore, a multisectoral strategy that will involve the media, road safety and traffic managers, engineers, town planners, politicians, policy makers, road and motorcycle workers' unions, private companies, nongovernmental organizations, and civil associations will facilitate these preventive measures and help to educate road users to be thoughtful and conscious in traffic and to have a responsible and civil attitude to avoid accidents.

Recommendations

This study recommends the following:

- Establishment of functional and affordable intra- and intercity public transport system
- Incorporation of teaching of traffic rules and regulations in our school curriculum at all level of our educational system
- Education and training of road users on adoption of road safety measures such as seatbelt, crash helmet, drunk/drug driving, speeding; and strict reinforcement of road traffic regulations
- Making computer tomography scan more affordable to the generality of the public and extending health insurance coverage both in scope and persons
- Increasing facilities and provision of theater spaces for facial fractures management. Making titanium plates and screws affordable; thereby, facilitating the adoption of ORIF in the treatment of facial fractures.

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