Original Article

Epidemiology of Open Fractures in a Nigerian Teaching Hospital

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Abstract

Background: The management of open fractures has been of great challenge to surgeons over the years, and these fractures are often associated with considerable patient morbidity and high socioeconomic consequences. Epidemiological studies are of great importance in the management of these conditions as the information obtained will be used to define priorities and enhance the understanding of this challenging subgroup of traumas. **Objective:** The aim of this study was to define the epidemiological profile of patients who were managed for open fractures of the long bones at a teaching hospital in South East Nigeria. **Materials and Methods:** This was a retrospective and descriptive epidemiological study involving open fractures of the long bones managed at a teaching hospital in the southeastern part of Nigeria over a period of 3 years, from January 2014 to December 2016. Data which were collected from patients' case notes were subjected to descriptive analysis, and the results were presented with simple frequency tables, percentages and charts. **Results:** Seventy patients with 73 fractures were treated for open fractures within the period of the study. The male to female ratio was 4.3:1, and the peak age incidence was 20–29 years (30%). The most common cause of the injury was motor vehicle accidents (82.9%), of which 64.3% of cases were as a result of motorbike accidents. The leg bones were the most affected site (63%) while the Gustilo type III fractures were the most common injuries (67.1%). The average time interval from injury to presentation was 10 h. Wound infections were the most frequent complications observed, followed by delayed union. **Conclusion:** Open fractures are challenging conditions which affect mainly the young and active males in our society. The victims often present late which affects the management outcome. The burden of open fractures can be minimised in our society by efforts aimed at reducing the menace of motorbike operators, the latter being the most common cause of the injury.

Keywords: Epidemiology, motorbike accident, motor vehicle accident, open fractures

Introduction

The management of open fractures has been of great challenge to surgeons over the years, and this group of fractures has been associated with considerable patient morbidity.[1] Recently, however, there has been some improvements in the treatment outlook as a result of advances in fracture stabilisation techniques, antibiotic use and plastic reconstructive procedures for soft tissue coverage.[2,3] Open fractures are relatively uncommon with one study showing an incidence of 30 open fractures per 100,000 people every year.[4] However, they usually result from severe injuries, notably motor vehicle accidents, and the young and economically active group in the community are mostly affected.[5] Therefore, the socioeconomic impact of the condition could be enormous.

Epidemiological studies are of great importance in the management of open fractures as the information obtained will be used to plan the treatment, define priorities and enhance the understanding of this challenging subgroup of traumas.[6,7] The present study was motivated by the fact that despite the challenges posed by this condition, there is paucity of information on the epidemiology of open fractures in Nigeria. In this study, we analysed all the cases of open fractures of the long bones that attended a specific tertiary health centre in Nigeria over a 3-year period. We investigated the severity of the condition among the various anatomical sites, demographic distribution, causes of injury and seasonality. We also analysed the treatment modalities and the post-operative complications.

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Materials and Methods

This was a retrospective and descriptive epidemiological study involving open fractures of the long bones managed at a teaching hospital in the southeastern part of Nigeria. It involved patients admitted and managed over a period of 3 years, from January 2014 to December 2016. For the purpose of this study, long bones refer to the following bones: the humerus, radius/ulna, femur and tibia/fibula. Ethical approval was obtained from the ethical committee of the institution to carry out the study.

A pro forma was formulated for the collection of data from patients' case notes. The variables considered were gender, age, type of trauma, classification of the lesion, location of the lesion, seasonality, mode of treatment and complications. We classified open fractures using the Gustilo and Anderson classification[8] as modified by Gustilo *et al*.[9] The class of each fracture as recorded in the case notes at presentation was used for the analysis. The fractures were managed based on the hospital management protocol for open fractures. Type I fractures were treated as closed fractures as soon as soft tissue healing was achieved. The treatment options were casting or open reduction and internal fixation. Type II, IIIA and IIIB fractures were managed by wound debridement, open reduction and external fixation. Each case of internal fixation was done with distraction compression plate and screws while external fixation was done with linear rail external fixator frame. Soft tissue cover in the form of split skin graft or muscle flap was additionally provided for the type IIIB fractures. Therapeutic antibiotic administration is carried out for all case of open fractures in our centre, and this was done for all the cases in this study. The choice is usually between the quinolones and third-generation cephalosporins combined with metronidazole and an aminoglycoside. In addition, each patient received antitetanus prophylaxis.

All patients with open fractures of the long bones which comprise of the femur, tibia/fibula, humerus and radius/ulna and who presented within the period of the study were included in the study. Cases with incomplete data were however excluded. The data obtained were subjected to descriptive analysis, and the results were presented with simple frequency tables, percentages and charts.

Results

In the period under review, 673 patients presented to the hospital with fractures of the long bones. Ninety-five (14%) of these presented with open fractures while the rest presented with closed fractures. Among the patients with open fractures, 25 patients had incomplete data and were therefore excluded from the study. Seventy patients were thus recruited into the study and they presented with 73 fractures. Sixty-seven patients had open fractures at only one anatomical site, two had bilateral open tibia fractures, while one had open fractures of both femur and ipsilateral tibia. The mean age was 40.9 years (ranging from 16 to 86 years), and the standard deviation was 16.9 years. The most affected age group was 20–29 years (n = 21 [30%]) followed by the 30–39 years' age group (n = 13 [18.6%]) while the least number of cases were seen in the 80–89 years' age group (n = 1 [1.4%]) [Table 1]. The male to female ratio was 4.3:1.

The most common cause of injury was road traffic accident which accounted for 82.9% of cases (n = 58), followed by gunshot injuries (n = 6 [8.6%]), assault (n = 3 [4.3%]) and fall (n = 2 [2.8%]) [Figure 1]. Majority of the road traffic accident cases were motorbike related (n = 45 [64.3%]) while the rest were due to car crashes (13 [18.6%]).

There was a remarkable seasonal variation in the incidence of open fractures. Most of the injuries happened in the months of December to March (n = 39 [56%]) [Figure 2]. The leg bones presented the highest proportion of open fractures (n = 46 [63%]) [Table 2]. The thigh was involved in 19.2% of cases, followed by the forearm (11%) and arm (6.8%). The average time interval from injury to presentation was 10 h, with a range of 30 min to 2 weeks.

Open fractures classified as type III, according to Gustilo *et al*., were the most common variety (n = 49 [67.1%]), followed by

Table 1: Age distribution in years

Age range (years)	Frequency (%)
10-19	3 (4.3)
20-29	21 (30)
30-39	13 (18.6)
40-49	11 (15.7)
50-59	10 (14.3)
60-69	8 (11.4)
70-79	3 (4.3)
80-89	1 (1.4)
Total	70 (100)

Table 2: Distribution of frequency of fractures by anatomical region

Anatomical region	Frequency (%)
Thigh	14 (19.2)
Leg	46 (63.0)
Arm	5 (6.8)
Forearm	8 (11.0)
Total	73 (100)

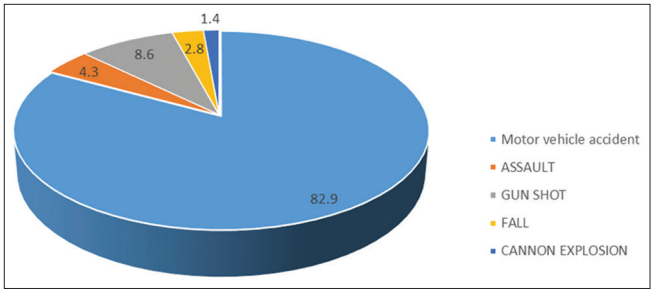

Figure 1: Cause of injury

type I (16 [21.9%]) and type II (8 [11%]) [Figure 3]. Table 3 shows the severity of injury to the various long bones of the body. The leg bones were the most predominantly affected in all the classes of injury.

Table 4 shows the mode of fracture treatment for the various classes of fractures based on Gustilo classification. Fracture union was recorded in all cases of type I and type II fractures. One case of non-union was recorded in the type IIIA fractures (union rate: 91.6%) while five cases of non-union were recorded in the type IIIB fractures (union rate: 82%). All the four cases of type IIIC fractures required amputations. The average time for fracture union in the upper limb was 8 weeks (range: 5–14 weeks); in the tibia, it was 22 weeks (range 10–36 weeks) while in the femur, it was 19 weeks (range: 7–30 weeks). Figures 4-9 show the x-ray images of an index case of Type IIIA open fracture of the tibia/fibula managed within the study period.

Fifty-three complications were observed. The most common were wound infection with 20 cases (37.7%), followed

Table 3: Distribution of anatomical site by severity

Type	Bone affected	Frequency	Percentage
I	Femur	3	21.9
	Tibia/fibula	11	
	Humerus	0	
	Radius/ulna	2	
II	Femur	1	11.0
	Tibia/fibula	7	
	Humerus	0	
	Radius/ulna	0	
IIIA	Femur	4	16.4
	Tibia/fibula	6	
	Humerus	2	
	Radius/ulna	0	
IIIB	Femur	5	45.2
	TIBIA/fibula	19	
	Humerus	3	
	Radius/ulna	6	
IIIC	Femur	1	5.5
	Tibia	3	
Total		73	100

Table 4: Distribution of fractures by mode of treatment

Type	Bone affected	Frequency	Mode of treatment
I	Femur	3	ORIF
	Tibia/fibula	11	ORIF (4), MUA + casting (7)
	Humerus	0	-
	Radius/ulna	2	ORIF
II	Femur	1	DBR + traction + ORIF
	Tibia/fibula	7	DBR + EX. FIX (5), DBR + casting (2)
	Humerus	0	-
	Radius/ulna	0	-
IIIA	Femur	4	DBR + EX. FIX
	Tibia/fibula	6	DBR + EX. FIX
	Humerus	2	DBR + EX. FIX
	Radius/ulna	0	-
IIIB	Femur	5	DBR + EX. FIX + wound cover
	Tibia/fibula	19	DBR + EX. FIX + wound cover
	Humerus	3	DBR + EX. FIX + wound cover
	Radius/ulna	6	DBR + EX. FIX + wound cover
IIIC	Femur	1	Amputation
	Tibia/fibula	3	Amputation

ORIF: Open reduction and internal fixation, MUA: Manipulation under anaesthesia, DBR: Debridement, EX. FIX: External fixation

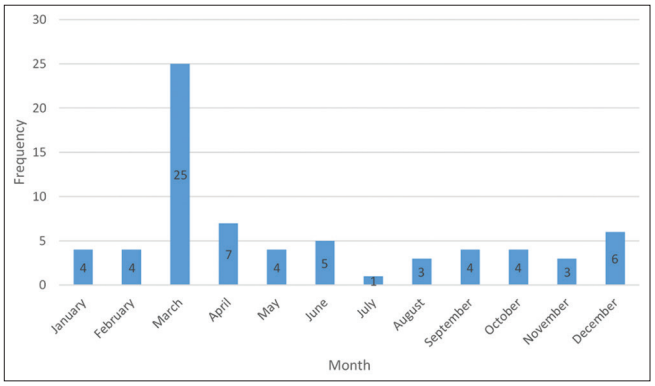

Figure 2: Distribution of open fractures by months

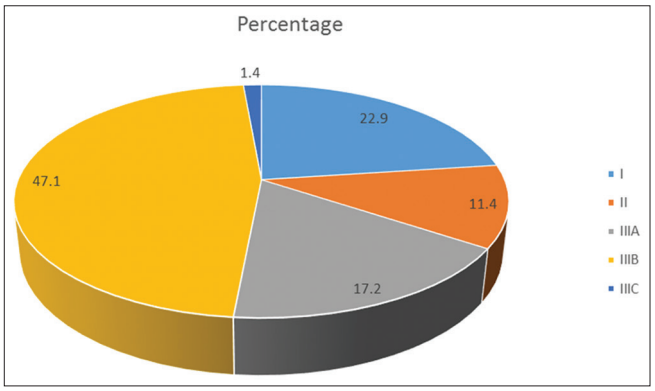

Figure 3: Gustilo and Anderson classification

Figure 4: Pre-operative anteroposterior radiograph of an index case

by delayed union, i.e., 10 cases (18.9%) and non-union, i.e., 6 cases (11.3%) [Table 5].

Discussion

Open fractures accounted for 14% of the fracture cases managed at our centre and affects mainly young males, with most of the cases presenting more than 6 h after the injury. Majority of the cases were due to road traffic crashes while the severe forms of open fractures were the most common variety. Our findings also showed that the leg bones were the most common site for open fractures.

Table 5: Frequencies of complications

Complications	Frequency (%)
Wound infection	20 (37.7)
Delayed union	10 (18.9)
Nerve injury	1 (1.9)
Nonunion	6 (11.3)
Chronic osteomyelitis	4 (7.5)
Malunion	1 (1.9)
Pin-tract infection	8 (15.1)
Joint stiffness	3 (5.7)
Total	53 (100)

Figure 5: Pre-operative lateral radiograph of the index case

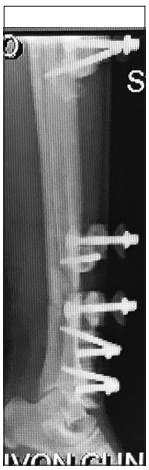

Figure 7: Immediate post-operative lateral radiograph of the index case

The male to female ratio in this study was 4.3:1. The male preponderance is in keeping with the findings of a number of other authors.[10-12] The male prevalence of open fractures is reported to be due to their higher activity and thus higher risk of exposure to trauma.[13,14] Majority of the victims were in the economically active age groups (20–29 and 30–39 years' age groups). In our study, these two age groups constituted 34.3% of the patients. The high incidence of trauma cases in the younger age groups has been widely reported in the literature and further highlights the degree of economic burden posed by the condition in our society.[13,15]

The finding that a large proportion of the injuries were as a result of motor vehicle accidents is in keeping with the reports of other authors in Nigeria and elsewhere.[11,12,16,17] Motorbike accidents accounted for the majority of the road traffic accidents as previously reported in the literature.[10,12]

Figure 6: Immediate post-operative anteroposterior radiograph of the index case

Figure 8: 4-month post-operative anteroposterior radiograph of the index case following fracture union and removal of external fixator

Figure 9: 4-month post-operative lateral radiograph of the index case following fracture union and removal of external fixator

In our study, 64.3% of the cases were related to this form of transportation alone. Motorbikes are a popular means of transportation in our society, and it is our belief that the greater exposure of the lower limbs in this mode of transportation may have contributed to the high incidence of open fractures, particularly of the leg bones. The reason behind the high rate of motorbike crashes has been extensively studied by various authors. The operators are mostly young males between the ages of 18 and 26 years, illiterate to semi-literate who indulge in drug abuse and are ignorant of traffic codes. They further stated that most of them do not have any form of prior training in the use of motorbikes and are uncomfortably rude to other road users.[18-20]

Majority of the cases (56%) were recorded in the period between December and March. This corresponds to the dry season in the catchment area of the study and may be attributed to the fact that the roads are in a better state during this season and the vehicles tend to move at a higher speed. It can also be attributed to the fact that this is the peak period for festivities in our society. Thus, there is a higher risk of recklessness on the part of the drivers and motorbike riders due to impatience and the influence of alcohol. Our findings, however, are at variance with that of a number of authors in Nigeria whose findings show that the peak incidence of open fractures is in the rainy season that extends from April to October.[10,21] They attributed the higher incidence of vehicular accidents in this period to the worsening state of the roads and poor visibility. The reason for this discrepancy in findings cannot be clearly explained form the study.

The leg bones were the most affected bones (63% of cases). This is in keeping with the findings by most other authors as the tibia is mainly subcutaneous and thus open fractures are common in this region of the body.[10,13,15] Type III open fractures are the most common variety of open fractures in our study. This is also in keeping with the findings in other studies in Nigeria and other parts of the world. Ibeanusi and Ekere[10] in Port Harcourt, Nigeria reported 39% incidence of type III open fractures in their study of open tibia fractures while in their study of epidemiology of open fractures, Arruda *et al*.[12] reported a 45.4% incidence of type III open fractures. Our study additionally shows that the most severe form of open fractures (Type III) also occurred in the leg bones. This may be associated with the common mechanism of injury which is motorbike accidents where the legs are prone to high energy trauma. Therefore, efforts targeted at the reduction of incidence of motorbike accidents will go a long way in not only reducing the incidence of open fractures but also will help in drastically reducing the severity of these injuries.

The management of the patients was done using the standard protocol of the reference hospital. The type I fractures were managed by wound debridement, followed by either casting or open reduction and internal fixation. The type II, IIIA and IIIB fractures on the other hand were managed by wound debridement and external fixation with wound cover. The four cases of type IIIC fractures required limb amputation as the limbs could not be salvaged.

With the treatment protocol adopted, fracture union was achieved in all the type I and II fractures, 91.6% of the type IIIA fractures and 82% of the type IIIB fractures. The rate of fracture union was similar to that obtained by Ikem *et al*.[15] in Ile Ife and Mills *et al*.[22] in Scotland.

A total of 53 complications were recorded, with the most common being wound infection, delayed union and nonunion, in that order. It is our belief that the number of complications could have been less if the patients had presented earlier. More than 50% of the patients presented later than 6 h after the injury. These patients presented first to non-specialised centres where proper treatment protocols were not followed and also to traditional bonesetters who mismanaged the cases before presentation to the hospital. This is corroborated by the findings of other authors. Ikem *et al*.[15] in their article on open fractures of the lower limb in Nigeria noted a high incidence of complications which they attributed to delay in presentation. In their paper, the average interval between injury and presentation was 6 h.

Limitations

The small sample size may have affected the outcome of the study, and we advise a future study in this area involving a multicentre collaboration which will ensure a large sample. The retrospective nature of the study is also a drawback as we had a number of missing files and cases with incomplete data which a prospective study would have eliminated.

Conclusion

In our study, most of the open fractures seen were of the lower limbs and particularly the tibia, while the higher grade fractures were the most common variety. We also observed that the most common cause of injury was motorbike accident which accounted for 64.3% of the cases. We additionally established the fact that most of the open fractures resulting

from motorbike accidents affected the lower limbs and were of higher grade injuries. We therefore advocate efforts at training the operators of motorbikes on the proper interpretation of road signs and the dangers of driving under the influence of alcohol and other illicit drugs. Efforts should also be intensified to ensure that they are properly trained before being allowed to operate motorbikes. It is important to highlight that a number of states in Nigeria have passed resolutions banning the use of motorbikes for commercial transportation in the major cities. In the long run, this is expected to drastically reduce the incidence of motorbike-related accidents. We also observed high complication rate which can be attributed to late presentation of the victims to specialised centres. This can lead to prolonged hospital stay, higher cost of treatment and increased loss of man hours at work. Thus, efforts should be geared toward prompt evacuation of accident victims to specialised centres to ensure appropriate treatment and thus the best outcome for open fractures.

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Conflicts of interest

There are no conflicts of interest.

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