International Journal of Research in Orthopaedics
Eroh MU et al. Int J Res Orthop. 2024 Sep;10(5):935-939
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20242385

Timing of surgical interventions for open lower limb long bone fractures as a determinant of the length of hospital stay in a tertiary hospital in Nigeria

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Received: 21 July 2024
Accepted: 17 August 2024

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ABSTRACT

Background: Open fractures are major orthopaedic emergencies with known complications such as infections, amputations and death. Fractures involving the long bones of the lower limb are usually more common. Surgical interventions range from basic debridement to major surgery and vascular repairs. The timing of these interventions is debatable, with medical bodies developing differing standards to improve overall patient outcome. The aim was to determine the effect of the timing of surgical interventions on the length of hospital stay in patients with open lower limb long bone fractures.
Methods: This was a retrospective cross-sectional study of 45 patients who presented in a tertiary facility over a 5-year period with open fractures involving the long bones of the lower limb. Patients' time to presentation/initial debridement, time to surgery, and length of stay post-surgery were evaluated. The obtained data were analysed using the IBM statistical package for social sciences (SPSS) Statistics version 26 for Windows (SPSS Inc., Chicago, IL, USA).
Results: This study revealed that all our patients fell between Gustilo-Anderson I and IIIA. Sixty-nine percent underwent initial debridement within 6 hours of injury. Forty-two percent had surgery within 1–3 days postinjury. Majority (62%) left the hospital within 1 week of surgery. Multivariate analysis revealed no significant correlation between the time of injury to surgical intervention and length of hospital stay (ρ=-0.087; p=0.590).
Conclusions: This study concluded that while the timing of surgical interventions may be important, it did not significantly affect the length of hospital stay.

Keywords: Open fracture, Lower limb, Long bone, Debridement, Surgical intervention, Length of hospital stay

INTRODUCTION

An open fracture refers to an injury where a fractured bone fragment communicates with the external environment due to trauma to the skin and soft tissue.[1] Open fractures involving the lower limb are the most frequently occurring long bone fractures, with the tibia being the most affected, with an annual incidence of 3.4 per 100,000.[2] Similar findings are noted in several studies in Nigeria and Africa as a whole.[2-7]

Most open fractures are usually due to accidents of a high-energy type, such as road traffic accidents, especially in developing countries, and are associated with major soft tissue injury, thus complicating management.[2-8]

Open fractures primarily affecting the lower limb are orthopaedic emergencies, and most patients require some form of surgical intervention with the aim of shortening hospital stays and improving mobility and general patient outcomes. Surgical interventions undertaken for open

fractures include wound irrigation and debridement (I and D), fracture stabilization (including external and internal fixation) and wound closure with or without soft tissue reconstruction. The optimal timing of these surgical interventions for achieving the best patient outcome, however, has long been a topic of debate.[9]

Recommendations from the American college of surgeons trauma quality improvement program (ACS TQIP) on open fracture management as well as the British association of plastic, reconstruction and aesthetic surgeons (BAPRAS) standards for the management of open fractures of the lower limb include irrigation and drainage (I and D) in the theatre by surgeons within 24 hrs and compulsory soft tissue coverage within 7 days of injury.[10,11]

In Nigeria, there is a paucity of data regarding the timing of presentation, surgical interventions, length of hospital stay postintervention and patient outcomes. However, a study in Nigeria showed that the time from presentation to definitive wound debridement significantly affected the prognosis of patients.[3] Another study in Nigeria and Morocco showed that in many cases, many patients with open lower limb fractures developed bone and wound infections with a delay in the union of fractures despite a short period of 6 hours between the primary insult and debridement; other factors included delays in surgical fixation due to financial constraints or the unavailability of surgical fixation materials.[4,9]

The objective of this study was to determine the effect of the timing of surgical interventions on the length of hospital stay in patients with open lower limb long bone fractures.

METHODS

Study setting

The study was carried out at Babcock university teaching hospital, Ilishan-Remo, Ogun State, southwestern Nigeria. The institution is a private tertiary hospital with an array of medical and surgical subspecialties.

Study

This was a 5-year (1st January 2019-31st December 2023) retrospective cross-sectional study involving patients with open long bone lower limb fractures admitted and managed in our facility. All patients who met the inclusion and exclusion criteria were included in the study. Information was obtained from patients' case notes and entered into a computer spreadsheet and a total of 45 patients were recruited for the study.

The data collected included socio-demographics, type of open fracture, fracture pattern, bone affected, time to presentation, time to surgical intervention, length of stay and complications or death.

Fractures were graded according to the Gustilo-Anderson classification for open fractures: Type 1 is a fracture less than or equal to 1 cm in length, type II is a fracture greater than 1 cm but less than 10 cm in length with associated moderate contamination and soft tissue injury, Type III is a wound >10 cm in length with extensive contamination and soft tissue injury, type IIIA is crushed tissue and contaminated but with adequate soft tissue coverage, type IIIB involves soft tissue loss and bone damage and usually requires soft tissue coverage techniques, and type IIIC is vascular injury compromise and requires arterial repair.[12]

Inclusion criteria

Patients aged 18-65 years were included and with open fractures of the long bones of the lower limb (femur, tibia and fibula) were also included.

Exclusion criteria

Age <18 years or >65 years. Those with concurrent joint and small bone fractures, patients with multiple injuries. Immunocompromised patients, patients with a history of peripheral artery disease were excluded.

Data analysis

The obtained data were analysed using the IBM SPSS atatistics version 26 for Windows (SPSS Inc., Chicago, IL, USA). The data were presented in tables and charts. Frequencies and percentages were used to present categorical variables, and correlations were determined using Spearman's rank correlation. The level of significance was set at $p<0.05$.

RESULTS

As shown in Table 1, of the 45 patients included in the study, the majority (73%) were males, and the majority (62.2%) were between the ages of 18 and 40 years. Most (55.6%) were married, and 51.1% had occupations as artisans. The majority (80%) were Christians, and approximately 77.8% were of the Yoruba ethnicity.

As shown in Table 2, tibiofibular fracture was the most common fracture (48.9%), followed by femur-only fracture (35.6%). The majority (35.6%) of the fractures were Gustilo-Anderson type I fractures. There was no associated vascular injury. A total of 66.7% of the surgeries performed were ORIF.

As shown in Table 3, for most patients, the time between injury and debridement was between 0 and 6 hours for approximately 69% of patients. The majority (42%) of patients had an injury to surgery time of 1-3 days. Most (62%) patients were discharged from the hospital between days 0 and 7 after surgery. Approximately 18% of the patients stayed in the hospital for up to 8-14 days post-surgery. Twenty percent of patients stayed in the hospital for more than 14 days.

Table 1: Sociodemographic characteristics of the study participants, (n=45).

Variables	N	Percentage (%)
Sex		
Male	33	73.33
Female	12	26.67
Age (in years)		
18-40	28	62.2
41-60	13	28.9
>60	4	8.9
Marital status		
Single	20	44.44
Married	25	55.56
Separated	0	0.00
Divorced	0	0.00
Occupation		
Artisan	23	51.11
Professional	15	33.33
Academic	7	15.56
Others	0	0.00
Religion		
Christianity	36	80.00
Islam	8	17.78
Others	1	2.22
Ethnicity		
Igbo	3	6.67
Yoruba	35	77.78
Hausa	1	2.22
Others	6	13.33

Table 2: Type of injury and surgery, (n=45).

Variables	N	Percentage (%)
Bone fractured		
Femur	16	35.56
Tibia	3	6.67
Fibula	1	2.22
Tibiofibular	22	48.89
Femur and tibia	2	4.44
Femur and tibiofibular	1	2.22
Gustilo-Anderson classification		
I	16	35.56
II	14	31.11
IIIA	15	33.33
IIIB	0	0.00
IIIC	0	0.00
Type of surgery		
Exfix	15	33.33
ORIF	30	66.67

Exfix=External fixation; ORIF=Open reduction and internal fixation

The bar chart in Figure 1 shows that the vast majority (87%) had no complications postsurgery. However, 2 cases of nonunion, 1 case of amputation, one of fat embolism, one of malunion, and one of necrotizing fasciitis were observed.

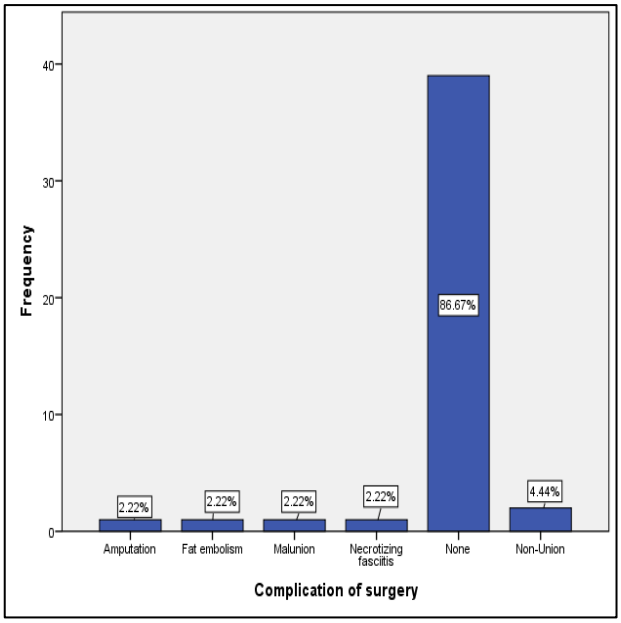

Figure 1: Surgical complications.

Table 3: Time of injury to interventions and duration of hospital stay after surgery, (n=45).

Variables	N	Percentage (%)
Time of injury to debridement (hours)		
0-6	31	68.89
7-12	6	13.33
13-24	4	8.89
>24	4	8.89
Time of injury to surgery (days)		
1-3	19	42.22
3-7	13	28.89
>7	13	28.89
Duration of hospital stay after surgery (Days)		
0-7	28	62.22
8-14	8	17.78
>14	9	20.00

Table 4: Correlations between the time of injury to intervention (debridement/surgery) and the length of hospital stay after surgery, adjusted for the type of bone fracture, fracture classification (Gustilo-Anderson classification), type of surgery performed and presence of postsurgical complications.

Variables	Unadjusted		Adjusted	
	ρ	P value	ρ	P value
Time of injury to debridement	0.140	0.358	0.068	0.674
Time of injury to surgery	-0.089	0.563	-0.087	0.590

ρ=Spearman's rank correlation

As shown in Table 4, no significant correlation was detected between the time from injury to debridement (ρ=-0.068; p=0.670), the time from injury to surgery (ρ=-0.087; p=0.590), and the length of hospital stay after surgery, when controlled for the type of bone fracture, fracture classification, the type of surgery performed or the presence of postsurgical complications.

DISCUSSION

Open fractures of the lower limb still constitute one of the most common yet major orthopaedic emergencies. A number of studies have shown that males are at least three times more likely to have an open lower limb fracture than their female counterparts.[3,13] This finding was similar to that of our study, in which approximately 73% of our patients were males, mostly aged 18-40 years. This could be due to men tending to be involved in somewhat riskier ventures than women. Fifty-one percent of our patients were artisans, reflecting the low socioeconomic status of our study population, as up to 58% of our patients needed at least 1-3 days to undergo surgery, primarily due to financial constraints.

Tibiofibular fractures were the most prevalent long bone fractures in approximately 49% of our patients, followed closely by femoral fractures (36%). This finding did not differ from those of studies performed by Odatuwa-Omagbemi or Sop et al where tibiofibular fractures were the most common open lower limb fractures.[1,2]

Our centre follows the standard of initial irrigation and wound debridement on presentation at the emergency unit, with antibiotic prophylaxis and standard radiological investigations. Definitive surgery in theatre, which includes further debridement and fracture stabilization using either external fixation or ORIF, is usually performed after all necessary financial commitments have been made and after consent is obtained for the procedure.

Ryan et al. reported increased rates of infections and amputations leading to longer hospital stays in patients who underwent wound debridement less than 12 hours after injury. All patients in our study underwent debridement upon presentation to the emergency unit. However, unlike Ryan et al study, our study did not find any significant correlation between the time to debridement and the duration of hospital stay.[14] In their study, Schenker et al also reported that there were no significant differences in infection rates or, hence, length of hospital stays between open fractures after early or late debridement.[15]

Most of the patients in our study underwent surgical intervention between 1- and 3-days following injury, and there was no significant correlation between the time of injury to surgical intervention and the length of hospital stay. This is probably because most of our patients had Gustilo-Anderson type I fractures and none of our patients had vascular injuries. Other factors, such as financial constraints and the unavailability of fixation materials, which delay definite surgical management, may have played a role in the patients' length of hospital stay. Similarly, studies by Pollak et al and Singh et al did not show a significant correlation between the time to surgical intervention (debridement and definitive surgery) and the length of hospital stay, or possibly overall patient outcomes.[13,16] However, Obey et al. reported significantly greater mortality in patients who underwent surgery >48 hours following injury and reported a longer length of stay and more postoperative complications.[17]

Similar to Singh et al work, two-thirds of our patients underwent ORIF compared to Ex-fix. This was due to the type of fracture and the level of contamination of the fractures. Unlike other studies, none of our patients had vascular injuries, which probably also accounted for their early mobilization and quick discharge, as 62% of our patients went home within 1 week of surgery.[13]

In our study, there were 6 cases of postsurgical complications, one each of necrotizing fasciitis, amputation, fat embolism and malunion and two cases of nonunion.

CONCLUSION

Overall, while the timing of surgical interventions for open lower limb fractures may be important for patient outcomes, our study has shown that it does not correlate with patient length of hospital stay. Other factors, such as the type of fracture, wound size and presence of vascular injury, may need to be evaluated in further studies to determine their influence on overall patient outcome.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee of Babcock university teaching hospital granted ethical approval with protocol number BUHREC/922/23.

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Cite this article as: Eroh MU, Obong UI, Oyewumi OM, Ehioghae O, Bassey AS, Adefemisoye GA, et al. Timing of surgical interventions for open lower limb long bone fractures as a determinant of the length of hospital stay in a tertiary hospital in Nigeria. Int J Res Orthop 2024;10:935-9.