

Original Article

Long Bone Open Fractures among Orthopedic Trauma Patients Presenting in a Tertiary Care Center: A Descriptive Cross-Sectional Study

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ABSTRACT

Background: Management of open fractures often presents a challenge to the treating surgeon due to the complexity of the injury and the risk of infection associated with it. Familiarity with the patterns of open fracture enhances preparedness and thus improves the outcome. Hence, this study aims to determine the prevalence of open fractures among patients presenting in the emergency department of a tertiary care center.

Method: This was a descriptive cross-sectional study conducted at B&B Hospital, Lalitpur, Nepal, from January 2020 to Dec 2023, where data of patients with long bone open fractures were retrospectively retrieved from the hospital's computerized database. Data included Demographic details, location of the fracture, Gustilo Anderson classification, the pattern of fracture, and associated injury. The analyses of different variables were done according to standard statistical analysis.

Results: Of 2572 patients with long bone fractures, 305 had open fractures (11.9%). The mean age was 33.65 ± 16.30 (5-84) years. Males accounted for 84.6% of the cases. Road traffic accidents accounted for 88.2% of cases. Most of the open fractures occurred in the lower limb (84.9%); also, open fractures of the tibia and fibula accounted for 43% of the cases. According to Gustilo Anderson's Classification, Type I accounted for 22.6% of cases, Type II was 31.5%, Type IIIA was 25.2%, Type IIIB was 15.4%, and Type IIIC was 5.2%. Wedge and Comminuted patterns of fracture accounted for 70% of cases. Also, 140 (45.9%) cases had associated other injuries, and 15.1% of cases had associated long bone fractures.

Conclusion: Open fractures had male predominance and were mostly caused by road traffic accidents. This study describes the location, type, and patterns of open fracture, where the tibia and fibula were more usually involved; Gustilo Anderson Type III was the most common type, and the frequently seen fracture pattern was wedge/ comminuted.

Keywords: Gustilo-Anderson Classification, Long Bone, Open Fracture

INTRODUCTION

Open fractures often occur following high-energy trauma that may lead to significant morbidity as well as mortality.¹ In the literature, the incidence has been reported to be around $30.7/10^5/\text{year}$.² The average age has been reported to be around 45.5 years, with male predominance.² However, the prevalence of open fractures in literatures are limited.

Management of open fractures is often challenging because of the complexity of injury and the requirement of a multi-disciplinary team with optimal trauma care facilities.^{3,4} Thus, it is imperative to identify the prevalence of open long bone fractures in trauma patients to enhance preparedness and improve trauma care facilities. In addition, understanding various patterns of open fractures and their frequencies will motivate clinicians to acquire the necessary skills through training to provide satisfactory treatment outcomes.⁴

Hence, this study aims to determine the prevalence of open fractures among patients presenting in the emergency department of a tertiary care center.

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METHODS

This descriptive cross-sectional study was conducted at B&B Hospital, Gwarko, Lalitpur, Nepal, from January 2020 to December 2023 after approval from the Institutional Review Committee (B&BIRC-23-18). The inclusion criterion was any patient with a long bone (Humerus, Radius, Ulna, Femur, Tibia and fibula) open fracture. The exclusion criteria were closed fracture, fracture involving isolated hand and isolated foot injuries, patient who underwent primary treatment at another center, missing data, and transferred cases.

Sample size calculation

The sample size was calculated using the following formula:

$$N = \frac{z^2 pq}{e^2} \\ = \frac{(1.96)^2 \times (0.50) \times (0.50)}{(0.06)^2} \\ = 267$$

Where,

N = minimum required sample size

Z = 1.96 for 95% confidence interval

p = 0.50, 50% to obtain the maximum number of samples

q = 1-p

E = 0.06, margin of error, 6%

The sample size was calculated to be 267 with an estimated 50% prevalence and 6% margin of error. However, all patients eligible during the study time frame were included,

and a non-probability, convenient sampling method was used. The data were retrieved retrospectively from the hospital's computerized database, including Age, Gender, mechanism of injury, Gustilo-Anderson classification of fracture, the pattern of Fracture, and associated injury. The retrieved data were recorded in predesigned pro forma and tabulated in Microsoft Excel 2013. Data was processed and analyzed using the software 'Statistical Package for Social Science' (SPSS) version 25, IBM®, Armonk, USA. The analyses of different variables were done according to standard statistical analysis. Continuous data was reported as mean \pm standard deviation, and categorical data was reported as frequency and percentage.

RESULTS

A total of 2572 patients were admitted with a diagnosis of long bone fracture within the defined period of the study, of which 305 (11.9%) were diagnosed as open fractures.

Table 1: Description of open fracture

Parameter	Frequency	Percentage (%)
Fracture Location		
Both bone Forearm	20	6.6
Humerus	14	4.6
Isolated Radius	7	2.3
Isolated Ulna	5	1.6
Upper Limb	46	15.1
Tibia and Fibula	131	43
Isolated Tibia	61	20
Femur	58	19
Isolated Fibula	9	2.9
Lower Limb	259	84.9
Gustilo Anderson Classification		
Type I	69	22.6
Type II	96	31.5
Type III	140	45.8
Type IIIA	77	25.2
Type IIIB	47	15.4
Type IIIC	16	5.2
Pattern of Fracture		
Wedge	108	35.4
Comminuted	108	35.4
Simple (Transverse/ Oblique/ Spiral)	53	17.4
Segmental	36	11.8

The mean age was 33.6 ± 16.3 years, ranging from 5-84 years. There were 258 (84.6%) males and 43 (15.4%) females. Road traffic accidents accounted for 247 (88.2%) cases, and 22 (8.2%) accounted for high-energy falls, whereas 11 (3.6%) cases accounted for other causes

(sports activity, machinery injury, blunt trauma). The descriptive result of the open fracture has been shown in the table below (Table 1). Also, 140 (45.9%) cases had associated other injuries, and 46 (15.1%) cases had associated long bone fractures.

DISCUSSION

Different literatures have shown that the open fractures are common in younger males.⁵⁻¹⁰ This was relevant to our study, where the mean age was 33.65 years, and 84.6% of cases accounted for males. In our region, men are more likely to suffer open fractures than women due to their active lifestyles and engagement in risky outdoor activities (Construction workers, Military personal, Motorcyclists, Vehicle Drivers). Also, young people are a productive age group and more active than the elderly. Therefore, this increased activity level also increases their risk of getting injured.

In our study, the prevalence of long bone open fracture was 11.9%. If we look at the prevalence in the western part of the world, it is around 2.6%.¹¹ However, according to a study conducted by Pouramin et al. in 17 low and middle-income countries of Asia and Africa, the prevalence of open fractures was 7.6%. Still, looking at only Asian countries, it was as high as 16.7%.¹² In our region, the increase in the incidence of open fractures might be due to a rise in motor vehicle accidents. This statement is supported by our study, where 88.2% of cases were accounted for due to Road traffic accidents (RTA). Further, studies done in India and Africa have also shown RTA is the most common cause of open fracture, accounting for 72-88% of cases.^{7-10,13} The increase in road traffic accidents (RTA) is largely attributed to the high rate of motorbike accidents, where motorbikes are the primary mode of transportation in developing nations.¹⁴ According to a survey conducted by the Nepal Demographic and Health Survey 2022, motorcycles are the most common vehicles involved in road traffic accidents in Nepal. In fact, two-wheeler accidents account for 68 percent of those killed or injured.¹⁵ In our study, lower limb open fracture accounted for 84.9% of cases, where 43% involved the tibia and fibula. These results were comparable with the study done by Alhawas and Alghamdi (76.8%) and Kombate et al. (77.01%).^{5,13} Also, tibia was injured in 44.4%, 40.6%, and 39% of the cases in a study done by Odatuwa- Omagbemi, Kale et al., and Nana et al., respectively.⁸⁻¹⁰ The reason why tibia fractures are more likely to break through the soft tissue covering is because a significant portion of the anterior tibial region is completely subcutaneous along its length, with insufficient tissue or muscle to protect it.

According to Gustilo Anderson's classification, Type I open fractures accounted for 22.6% of cases, Type II for 31.5% of cases, and Type III accounted for 45.8% of cases. Our results were comparable with studies done in India¹⁰ and Bangladesh¹⁶, where the author reported 48-54% type III open fracture, whereas one of the studies done in Nigeria⁹ showed type III grade as high as 84.4%. It appears that type III open fractures are becoming increasingly prevalent in our country, indicating a rise in high-energy injuries and the worsening of injury mechanisms.

LIMITATION

As a retrospective study, the investigator had to rely on a database maintained by the hospital, so some information might be missing. Secondly, as a single-centered study, it may not include the desired study population. Furthermore, the time of presentation at the ER, the description of treatment provided, the patient's outcome, and complications that could have been demonstrated were limited by the data available.

CONCLUSION

The prevalence of open fracture was 11.9%, with male predominance, and it was mostly caused by road traffic accidents. This study describes the location, type and patterns of open fracture, where the tibia and fibula were usually involved. Gustilo Anderson Type III was the most common type, and wedge/ comminuted fracture patterns were frequently seen. Further, a multi-centric prospective study is warranted to co-relate our findings.

REFERENCES

- Halawi MJ, Morwood MP. Acute Management of Open Fractures: An Evidence-Based Review. *Orthopedics*. 2015 Nov;38(11):e1025-33. <https://doi.org/10.3928/01477447-20151020-12>
- Court-Brown CM, Bugler KE, Clement ND, Duckworth AD, McQueen MM. The epidemiology of open fractures in adults. A 15-year review. *Injury*. 2012 Jun;43(6):891-7. <https://doi.org/10.1016/j.injury.2011.12.007>
- Godfrey J, Pace JL. Type I Open Fractures Benefit From Immediate Antibiotic Administration But Not Necessarily Immediate Surgery. *J Pediatr Orthop*. 2016 Jun;36 Suppl 1:S6-10. <https://doi.org/10.1097/bpo.0000000000000766>
- Claireaux HA, Beaumont O, Griffin XL. Open lower limb fractures in the UK trauma system: A multicentre prospective audit of current practice. *Injury*. 2021 Jun;52(6):1374-83. <https://doi.org/10.1016/j.injury.2020.12.038>
- Alhawas A, Alghamdi M. Epidemiology, Etiology, Timing and Severity of Open Fracture-a Five Years Review From a Tertiary Trauma Center, Eastern Province, Saudi Arabia. *Medical Archives*. 2023 Sep 1;77(5):391-5. <https://dx.doi.org/10.5455/medarh.2023.77.391-395>
- Hailu S, Gebreyohanes M. Prevalence Of Delayed Presentation Of Open Long Bone Fracture Patients At Two Ethiopia Tertiary Hospitals. *Ethiopian Medical Journal*. 2020 Dec 16;58<https://emjema.org/index.php/EMJ/article/view/1806>
- Kironde E, Sekimpi P, Kajja I, Mubiri P. Prevalence and patterns of traumatic bone loss following open long bone fractures at Mulago Hospital. *Ota International*. 2019 Mar;2(1).<https://doi.org/10.1097%2FOI9.0000000000000015>
- Nana CT, Pius F, Martin MN, Mbongnu M, Movuh SD, Bombah FM, Henry N, Ngunde PJ, Chichom-Mefire A. Epidemiological and Clinical Pattern of Open Fractures of Long Bones of the Lower Limbs in the South-West Region of Cameroon: A 5-Year Review. *Open Journal of Orthopedics*. 2021 Sep 6;11(9):278-87.<https://doi.org/10.4236/ojo.2021.119026>
- Odatuwa-Omagbemi DO. Open fractures: epidemiological pattern, initial management and challenges in a sub-urban teaching hospital in Nigeria. *The Pan African Medical Journal*. 2019;33.<https://doi.org/10.11604/pamj.2019.33.234.18141>
- Kale AR, Sonawane CS, Waghmare VU, Kalambe H. Open fractures and incidence of infection in tertiary care government hospital. *International Journal of Scientific Study*. 2017;5(5):24-8.https://www.ijss-sn.com/uploads/2/0/1/5/20153321/ijss_aug_oa04_-_2017.pdf
- Court-Brown CM, Aitken SA, Forward D, O'Toole RV. The epidemiology of fractures. In: Buchholz RW, Court-Brown CM, Heckman JD, Tornetta P 3rd, editors. *Rockwood and Green's fractures in adults*. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2010. p. 53-84.
- Pouramin P, Li CS, Sprague S, Busse JW, Bhandari M, INORMUS Investigators. A multicenter observational study on the distribution of orthopaedic fracture types across 17 low- and middle-income countries. *OTA International*. 2019 Sep 1;2(3):e026. <https://doi.org/10.1097/oi9.0000000000000026>
- Kombate NK, Walla A, Akloa K, Amakoutou K, Bakriga B, Ayouba G, Dellanh YY, Abalo A, Dossim AM. Epidemiology of open limb fractures in a country with low-income. *Open Journal of Orthopedics*. 2017 Nov 7;7(11):356-61. <https://doi.org/10.4236/ojo.2017.711036>
- Nantulya VM, Reich MR. The neglected epidemic: road traffic injuries in developing countries. *Bmj*. 2002 May 11;324(7346):1139-41. <https://doi.org/10.1136%2Fbmj.324.7346.1139>
- Ministry of Health and Population [Nepal], New ERA, and ICF. 2023. 2022 Nepal DHS Summary Report. Kathmandu, Nepal: Ministry of Health and Population [Nepal]. p21
- Islam SS, Islam MS, Parvin S, Islam S, Hamid R, Mollah MA. Injury Characteristics, Infection and Resistance Pattern of Open Fracture Tibia in Tertiary Orthopaedic Centre: Antimicrobial resistance open fracture tibia. *Bangladesh Medical Research Council Bulletin*. 2021;47(2):205-11 <https://doi.org/10.3329/bmrcb.v47i2.57781>