

## Epidemiology of Open Tibial Fractures among Trauma Patients Presented to Mansoura Emergency Hospital

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### ABSTRACT

**Background:** Open tibia fractures are notoriously challenging to treat, and the repercussions of these fractures can be seen in a wide variety of aspects of a patient's life. The majorities of fractures to long bones happen in men who are of working age and are typically the consequence of multiple traumas.

**Aim and objectives:** This study aimed to calculate the prevalence of open tibial fractures among cases.

**Subjects and methods:** The current inquiry was a prospective observational study that tracked 350 cases at the Emergency Department of Mansoura University Hospital in Egypt for an entire year, beginning in January 2022 and ending in December 2022. The cases were observed over the course of the study.

**Result:** Tibial shaft was impacted in 49 cases (41.2%), whereas the distal tibia was affected in 43 cases (36.1%). In 27 out of 100 instances (22.7%), the problem was located in the proximal tibia. There were only 18 cases who were admitted to the critical care unit, which is just 15% of the total number of patients who were hospitalized. The majority of cases (85%) were admitted to the ward. Those who suffered from hypertension had the highest prevalence of co-occurring conditions. **Conclusion:** In the cases that were examined, the most common source of trauma was a road traffic accident. Open fractures of the tibia are commonly the result of polytrauma. In the event that a patient with an open tibial fracture does not receive the appropriate medical care, it can result in serious complications or even death.

**Keywords:** Epidemiology, Open Tibial Fractures, Trauma.

### INTRODUCTION

Damage to the bone and soft tissue around an open tibial diaphyseal fracture is almost always severe. Infection, nonunion, and wound complications skyrocket when the fracture site is contaminated and the soft-tissue envelope is devitalized. Both of these factors contribute to rising the potential for problems, thus accounting for them is important. The tibia is a leg bone that is well-known for its considerable size. The tibia is a particularly vulnerable bone to fracture because of its exposed shape <sup>(1)</sup>.

Even if there are no additional symptoms of trauma, an open fracture should always be treated as an orthopedic emergency. This is because more of the bone is visible with an open fracture. Open soft tissue injuries accompany many of these fractures because the sheath covering the soft tissues is so thin. The thin sheath plays a role in this. Accidents involving motor vehicles account for more than half of all open tibial shaft fractures. Most of the rest of the injuries are the result of other causes, such as falling, getting hurt while playing sports, or taking a direct blow to the leg <sup>(2)</sup>.

During surgical debridement, Gustilo and Anderson's damage categorization is used to direct treatment and predict outcomes. Because the classification considers the total amount of damage, this is the case. Gustilo type III injuries, also known as high-energy open injuries, are prevalent because the vast majority of these fractures occur during high-impact occurrences. According to the extensive epidemiologic study conducted by Gustilo and colleagues, type III fractures account for more than 60% of all open tibial shaft fractures <sup>(3)</sup>. Acute blood loss, the time and type of

skeletal fixation, and the related risk for late sequelae (such as non-union and infection) are all affected by the type of fracture and the extent of the open soft tissue injury in these patients. Thus, treatment plans for patients who have sustained severe injuries must consider not just the severity of the injuries but also the individual's general state of health. Individuals with many injuries will benefit greatly from this <sup>(4)</sup>.

The initial evaluation of an individual with an open tibial shaft fracture should adhere to the requirements of the protocol for advanced trauma life support because more than half of these individuals also present with additional injuries. This is because people in this category typically have sustained more than one injury. There is considerable opportunity for error when estimating the long-term prognosis of patients with open tibial shaft fractures <sup>(5,6)</sup>.

The first stage in treating an injury is a thorough examination of the patient and the affected limb. In this process, all the actions take place at once. A precise assessment of the injury's severity is crucial, as is minimizing the risk of infection through prompt administration of antibiotics, prompt debridement, and thorough irrigation. The purpose of this research was to determine how common and how severe open tibial fractures are among patients admitted to Mansoura Emergency Hospital. Individuals whose fractures were gathered had been brought in by ambulance.

### PATIENTS AND METHODS

At Mansoura University Emergency Hospital in Mansoura, Egypt, about three hundred and fifty patients were screened for potential participation in a

prospective observational study between the months of January and December 2022. After the initial round of eliminations, there were a total of 231 cases; however, only 119 remained .

**Inclusion criteria:** Individuals presented with open tibial fractures, Age  $\geq$  18 years to 60 years old and males as well as females were included.

**Exclusion criteria:** Cases with closed tibial fractures, cases with pathological tibial fractures, age less than eighteen, inability to provide informed assent, and patient refusal.

**Ethical consideration:** The complete study plan has been given the go-ahead by the Institutional Review Board (IRB) of the Department of Medicine at Mansoura University. Throughout the course of the study, participants' privacy and confidentiality were protected. Patients should never feel pressured to stay in research against their will and should always have the option to leave at any time without any form of penalties. The information that was acquired has not been used for any other purpose in the future. The participants' consent was gained before they were included in the experiment by obtaining written informed consent from each participant or their families or guardians.

## METHODS

**The primary survey:** The primary assessment and the beginning stages of resuscitation are carried out simultaneously. When a potentially life-threatening issue is identified, prompt action is essential, and the outcomes of that intervention were evaluated before further action was taken. It is recommended that the "ABCDE" method be utilized for the primary evaluation.

When doing cardiopulmonary resuscitation, the first order of business is to open the airway and stabilize the cervical spine. Breathing and ventilation are important for avoiding subsequent brain damage brought on by hypoxia and hypercapnia.

**Circulation and bleeding control:** Adequate cerebral perfusion pressure (CPP) was tried to be maintained by keeping adequate blood pressure and avoiding hypotension.

**Disability and neurologic assessment:** Rapid neurological assessment was performed to define the level of consciousness, using the GCS and pupils' size, symmetry and reaction and any lateralizing signs.

**Exposure and environment control:** in order for individuals to have a complete physical examination, their clothing must be lopped off of them and they must undress to their underwear.

Electrocardiogram (ECG), insertion of a urine catheter (to measure output and color of urine) if there are no contraindications, and placement of a nasogastric tube if one is necessary.

**The secondary survey:** After the initial resuscitation was performed for each patient, a thorough history was

obtained (including age, gender, and the nature of the trauma, the time of the trauma, the time of arrival, and the time of resuscitation).

The work was segmented into its component sections, which included the AMPLE history and physical examination, the clinical examination, the laboratory work, and the radiological work (which included the Focused Assessment with Sonography for Trauma (FAST) scan and X-ray).

**Ethical Approval:** Participants were provided with the necessary trial information and the study was authorized by the Ethics Board of Mansoura University. Every person who took part in the research first gave their informed written consent. The Declaration of Helsinki, a global standard for the ethical conduct of medical research involving human participants, has been followed throughout this project.

**Statistical analysis:** The codes were entered into SPSS (Statistical Package for the Social Sciences) version 26 for Windows® (SPSS Inc., Chicago, IL, USA), and the software was used to process the data, analyze the results, and conduct statistical analysis. To better illustrate the qualitative information, we employed both absolute and relative frequency percentages. The statistical format known as mean  $\pm$  SD (standard deviation), median (range) was chosen to provide an explanation of the quantitative data.

## RESULTS

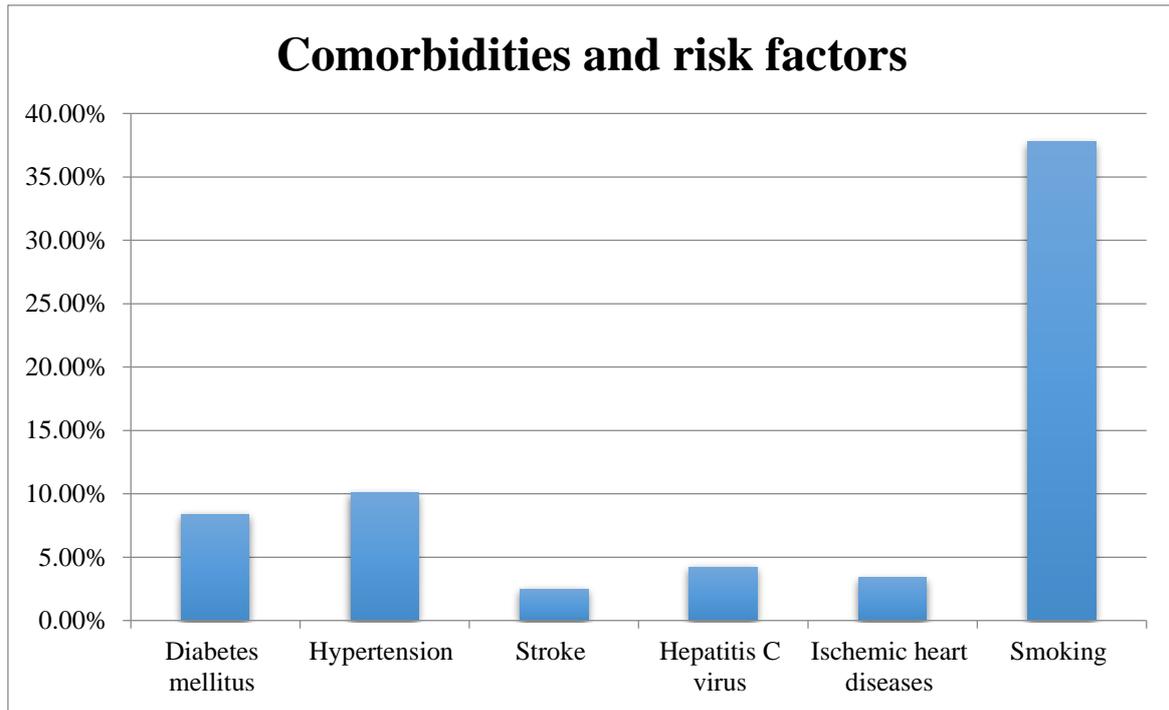
Cases ranged in age from 19 to 60, with a mean age of 34.84  $\pm$  12.29 years. Males accounted for 73.9% of the cases, while females made up only 26.1%. Out of the total, 49 were engaged in heavy labor (41.2%), 41 in manual labor (34.4%), 25 in sedentary pursuits (21%), and 4 were retired (3.4%) (Table 1).

**Table (1):** Demographic data in the cases included in the study

| Items             |               | Number (Percentage)<br>(n= 119) |
|-------------------|---------------|---------------------------------|
| Age (years)       | Mean $\pm$ SD | 34.84 $\pm$ 12.29               |
| <b>Sex</b>        |               |                                 |
| Females           |               | 31 (26.1%)                      |
| Males             |               | 88 (73.9%)                      |
| <b>Occupation</b> |               |                                 |
| Heavy worker      |               | 49 (41.2%)                      |
| Manual worker     |               | 41 (34.4%)                      |
| Sedentary life    |               | 25 (21%)                        |
| Pensioner         |               | 4 (3.4%)                        |

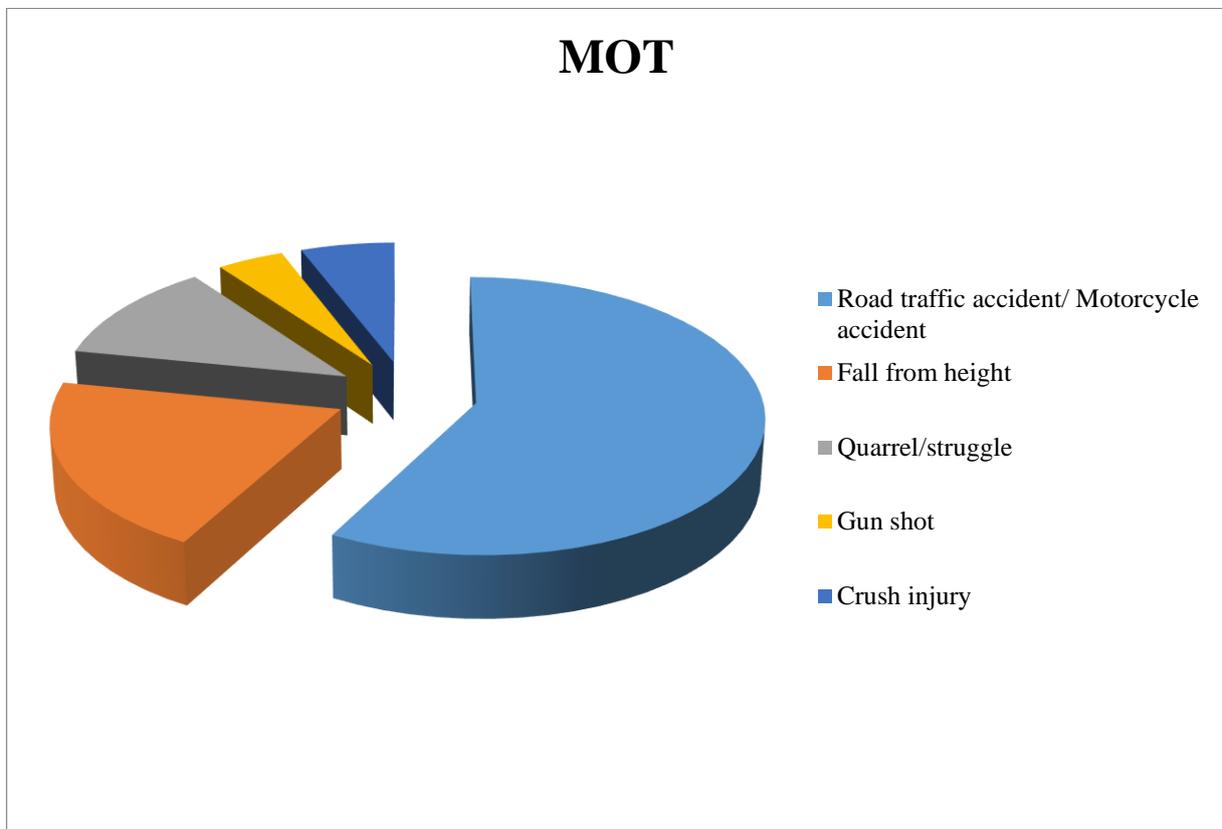
Continuous data expressed as mean $\pm$ SD and median (range) Categorical data expressed as Number (%)

Among the included cases, there were 45 smokers (37.8%). Regarding the associated comorbidities, diabetes mellitus was reported in 10 cases (8.4%), hypertension in 12 cases (10.1%), and stroke in 3 cases (2.5%), hepatitis C virus in 5 cases (4.2%) and ischemic heart diseases in 4 cases (3.4%). **Figure (1)**



**Figure (1):** Associated comorbidities and risk factors

Regarding the mode of trauma, road traffic accident/ Motorcycle accident was the most common type in 69 cases (58%) followed by fall from height in 24 cases (20.2%), Quarrel/struggle in 14 cases (11.8%), gun shot in 5 cases (4.2%) and crush injury in 7 cases (5.9%). **Figure (2).**



**Figure (2):** Analysis of MOT in the cases in the study

According to this table, the right side was affected in 42 cases (35.3%), the left side was affected in 54 cases (45.4%) while both sides were simultaneously affected in 23 cases (19.3%) (Table 2)

**Table (2):** Side of the fractures.

| Side of fracture | Number (percentage) |
|------------------|---------------------|
| Right            | 42 (35.3%)          |
| Left             | 54 (45.4%)          |
| Both sides       | 23 (19.3%)          |

There were 16 instances (13.4% of the total) of type I open tibial fractures, 33 cases (27.7% of the total) of type II fractures, 31 cases (26.1% of the total) of type III A fractures, 26 cases (21.8% of the total) of type III B fractures, and 13 cases (10.9% of the total) of type III C fractures (Table 3).

**Table (3):** Classification of the fractures (Gustilo-Anderson classification for open fractures).

| Classification of the fractures | Number (percentage) |
|---------------------------------|---------------------|
| Type I                          | 16 (13.4%)          |
| Type II                         | 33 (27.7%)          |
| Type III A                      | 31 (26.1%)          |
| Type III B                      | 26 (21.8%)          |
| Type III C                      | 13 (10.9%)          |

11 cases had haemothorax (9.2%), five individuals had subarachnoid hemorrhage (4.2%), 2 cases had subdural hemorrhage (1.7%), six individuals had damage to abdominal organs (5.0%), and twenty-three individuals had additional related bone fractures (19.3%) (Table 4).

**Table (4):** Associated injuries in the cases included in the research.

| Associated injuries            | Number (Percentage) |
|--------------------------------|---------------------|
| Isolated open tibial fractures | 72 (60.5%)          |
| Hemothorax                     | 11 (9.2%)           |
| Subarachnoid hemorrhage        | 5 (4.2%)            |
| Subdural hemorrhage            | 2 (1.7%)            |
| Abdominal organ injuries       | 6 (5%)              |
| Skeletal fractures             | 23 (19.3%)          |

In 101 cases (85%), treatment was started within 24 hours, while in 18 cases (15%), it was started after 24 hours. Six cases (5% of the total) were treated using non-invasive methods, whereas the remaining 113 (95%) required surgical correction (Table 5).

**Table (5):** Treatment in the cases included in the study

| Treatment                    | Number (Percentage) |
|------------------------------|---------------------|
| <b>Time for intervention</b> |                     |
| Within 24 hours              | 101 (85%)           |
| More than 24 hours           | 18 (15%)            |
| <b>Treatment decision</b>    |                     |
| Conservative                 | 6 (5%)              |
| Operative                    | 113 (95%)           |

The majority of those included (85%) were admitted to the ward, while only 18 cases (15%) were admitted to the intensive care unit. Regarding the duration of admission, 73 cases (61.3%) were admitted for a period of no more than seven days, while 46 cases (38.7%) were confirmed for a period of  $\geq 7$  Days (Table 6).

**Table (6):** Outcomes in the cases included in the research.

| Outcomes                     | Number (Percentage) |
|------------------------------|---------------------|
| <b>Site of admission</b>     |                     |
| ICU                          | 18 (15%)            |
| Ward                         | 101 (85%)           |
| <b>Duration of admission</b> |                     |
| < 7 Days                     | 73 (61.3%)          |
| $\geq 7$ Days                | 46 (38.7%)          |

Eighty percent of the surgically treated individuals had no problems, while nine percent exhibited superficial infections, nine percent showed non-union/malunion, five percent showed rotation deformity, and seven percent required additional surgery (Table 7).

**Table (7):** Postoperative complications in the cases included in the study (n=113).

| Outcomes               | Number (Percentage)<br>n=113 |
|------------------------|------------------------------|
| No complications       | 80 (70.7%)                   |
| Superficial infections | 9 (7.9%)                     |
| Nonunion/malunion      | 11 (9.7%)                    |
| Rotation malformation  | 5 (4.4%)                     |
| Reoperation            | 8 (7%)                       |

## DISCUSSION

Open tibial fractures are a particularly difficult surgical challenge in polytrauma situations. The fracture pattern and the level of open soft tissue injury in these people all influence the amount of acute blood loss, the timing and type of skeletal fixation, and the corresponding risk for late sequelae (such as non-union and infection) (7).

Accidents involving motor vehicles and motorcycles accounted for 58% of all injuries reported in this survey, followed by injuries sustained due to falls from a great height (20.2%), physical altercations (11.8%), guns (5.0%), and crushing (5.7%). These results are consistent with **Melo et al.** <sup>(8)</sup> where they discovered that motor vehicle collisions accounted for 58% of all traumatic spinal cord injuries.

Subject ages ranged from 19 to 60 years old in this study, with the mean age being  $34.84 \pm 12.29$  years. The vast majority (73.9%) of the cases were males, while women made up only 26.1%. The mean age was 34, which agrees with the results of **Salama et al.** <sup>(9)</sup> who reported that males outweighed females 92% to 8%. Our results mirror those of **Vargas et al.** <sup>(10)</sup>, who discovered that 60 of their 76 cases (or 79%) were males. People as young as 18 and as old as 82 were included, with the average age being 32 years.

Among the cases analyzed in our study, 42 (35.3% of the total) involved injury to the right side, 54 (45.4% of the total) involved harm to the left side, and 23 (19.3% of the total) had damage to both sides. Some 27% of patients had problems with their proximal tibia, 41% with their tibial shaft, and 36.1% with their distal tibia. Results from a study by **Yousef et al.** <sup>(11)</sup> are congruent with those obtained by the Department of Orthopaedics after successfully treating 58 patients with open tibial fractures and following them for at least a year. There were 31 cases involving the right leg and 27 involving the left. There were thirteen around the knee, twenty in the thigh, and twenty-five towards the lower leg's length. There were 16 cases of type I open tibial fractures (13.4% of total), 33 cases of type II fractures (27.7% of total), 31 cases of type III A open tibial fractures (26.1% of total), 26 cases of type III B open tibial fractures (21.8%), and 13 cases of type III C open tibial fractures (10.9% of total) in the current research.

A meta-analysis was conducted by **Schade et al.** <sup>(12)</sup> found this to be true. Totaling 18 investigations from 10 countries, the outcome scores add up to 18 different possible values. Gustilo I ranked third, Gustilo II ranked second, Gustilo III A ranked third, Gustilo III B ranked fourth, and Gustilo III C ranked fifth. Using the modified Gustilo-Anderson classification, **Yousef et al.** <sup>(11)</sup> observed comparable outcomes, demonstrating that out of 44 open fractures, 4 were graded as grade I, 21 as grade II, 24 as grade III A, and 9 as grade III B. Thirteen instances reported haemothorax (9.2%), five cases reported subarachnoid hemorrhage (4.2%), two cases reported subdural hemorrhage (1.7%), six cases reported abdominal organ injuries (5.0%), and 23 cases reported additional bone fractures (19.3%).

Eighteen of our patients waited longer than the 72 hours recommended by the BOAST 4 standards of care <sup>(13)</sup>. This is so even though the exact timing of the first round of debridement is up for debate. This was because several of our patients needed to remain in the intensive care unit for longer than expected, delaying their

surgeries. Certain studies from the United Kingdom and Singapore found that initial debridement of open tibial fractures within 6 hours after injury did not decrease the incidence of infection for grade III open tibial fractures <sup>(14)</sup>.

Eighty percent of the cases showed no postoperative complications, demonstrating the efficacy of a coordinated multidisciplinary approach and meticulous soft tissue management. However, nine cases (7.9%) showed superficial infections, eleven (9.7%) showed non-union/malunion, five (4.4%) showed rotation malformation, and eight (7.0%) required reoperation. Research on 75 patients with open tibia fractures (26 classified as Gustilo-Anderson 3A, 47 as 3B, and 2 as 3C) treated between 2014 and 2020 provided consistent support for these conclusions. The research revealed that the infection rate was 6.7%, the non-union rate was 4.0%, and the re-fracture rate was 2.7% <sup>(15)</sup>.

## CONCLUSION

Our findings suggest that road traffic accidents (RTA) was the leading cause of trauma among the cases we considered. Polytrauma frequently causes open tibial fractures. Serious consequences, including death, can arise from poorly treated open tibial fractures.

## RECOMMENDATIONS

Treatment of individuals with possible trauma as soon as possible. Research involving a larger sample size of cases is warranted. More extensive prospective trials over longer time periods are needed to evaluate the efficacy of various treatment approaches for open tibial fractures.

## DECLARATIONS

- **Consent for publication:** All authors have agreed to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
- **Funding:** No fund
- **Conflicts of interest:** No conflicts of interest.

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