

Short Report

Determinants of management outcome in open tibia fractures in ile-ife

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Abstract

Background: Fracture of a normal tibia shaft constitutes a major trauma mostly sustained by young adults during high-energy injuries. Its superficial location and the subcutaneous characteristics of its anteromedial aspect easily causes open fracture. The objectives of this study were to determine the pattern of presentation, and determinants of management outcome in open fractures of the tibia.

Methods: This is a prospective hospital based study. A total of 89 patients aged 4 to 80 years with open fractures of the tibia with or without fibula involvement were studied. All the patients received anti tetanus prophylaxis and intravenous antibiotics as well as wound irrigation, debridement and skeletal stabilisation.

Results: Students and traders accounted for the majority of the cases (57.3%). Most of the open tibia fractures 69 (77.5%) had above knee Plaster of Paris cast. The majority of the cases were Gustilo and Anderson type II 32 (36.0%) cases and type I 22(24.7%) cases. There was Correlation between the presence of wound infection and (i) Gustilo and Anderson grading (F -.352, P .001); (ii) Injury to Debridement time in hours (F -.304, P .004); (iii) Osteomyelitis (F .397, P .001); (iv) Delayed union (F .253, P .017); and (v) Union time in weeks (F -.350, P .001). There was also correlation between the following: (i) Injury to Debridement time in hours and the distance from the accident scene to the hospital (F .464, P .001); (ii) The fracture pattern and the union time in weeks (F .353, P .001); and (iii) The presence of osteomyelitis and delayed union (F .382, P .001). The commonest complications observed were wound infection 35(39.3%) patients and delayed union 30(33.7%) patients.

Conclusion: This study shows that the higher the Gustilo and Anderson grading of the open fractures of the tibia, the more severe the wound and bone infection that occurred. The interval between injury time and wound débridement time affected the treatment outcome.

Key words: Open Fracture; Tibia; Management; Outcome.

Introduction

An open fracture is one in which there is a break in the continuity of the skin and the underlying soft tissue. It also leads directly into or communicates with the fracture and its haematoma^{1,2}. The fracture of a normal tibia shaft constitutes a major trauma. Most fractures are sustained by young adults during high-energy injuries. Its superficial location and the subcutaneous characteristics of its anteromedial aspect easily cause open fracture³. The wound classification system of Gustilo and Anderson was used for this study. The import of this classification is that it allows comparison of results of scientific analysis, gives guidelines for prognosis and establishes certain principles of treatment^{4,5}.

The goals of treatment include the prevention of infection, fracture healing and full functional recovery of the limb^{6,7}. The essentials of treatment include immediate, meticulous and repeated wound debridement with copious irrigation using normal saline, stabilisation of the fracture, coverage of the wound, early parenteral administration of broad spectrum antibiotics and early bone grafting^{4,6,8,9}. The pattern of fractures would vary within different communities depending on the type and speed of activities in the area. Similarly, the outcome of treatment will depend on the type of care given to the patient^{4,6,8,10}.

The pattern of open fractures seen in a community with respect to the severity and associated injuries depends on the common causes. This in turn determines the management needs and outcome of treatment. The objective of this study was to determine the pattern of presentation, and factors influencing management outcome of the open tibia fracture as seen at the Obafemi Awolowo University Teaching Hospital, Ile-Ife. It is also hoped that problems and aspects of management of these condition will be highlighted.

Patients And Methods

This is a prospective hospital based study carried out in Obafemi Awolowo University Teaching Hospital Ile Ife. The patients were recruited over an 18-month period. All patients presenting with open fractures of the tibia with or without fibula involvement were included except: those who have underlying bone pathology, those who cannot establish the time of their injury, those who had their initial wound débridement before arrival in our hospital, those who have intra-articular fractures, and those who require lower extremity vascular repair. All the excluded patients were treated appropriately.

A total of 92 consecutive patients who fulfilled the inclusion criteria were initially entered into the study. Three patients defaulted and were therefore excluded from the study. Eighty-nine patients fulfilling the diagnostic criteria for established open fracture of the tibia were used for this study. They were those with open fractures of the tibia with or without fibula involvement. The guidelines for the treatment of these fractures were established prospectively and followed with only minor alterations. These guidelines are as follows:

- (i) All open tibia fractures were treated as surgical emergencies.
- (ii) Wound swabs were obtained before the commencement of antibiotics and when there was established suppuration.
- (iii) Plain films were taken of the affected bones after temporary splintage application.
- (iv) Anti tetanus prophylaxis as well as Ampicillin, Cloxacillin and Gentamicin were given in divided doses for 72 hours to cover a broad spectrum of micro-organisms.
- (v) Thorough wound débridement and copious irrigation was emphasised.
- (vi) Wounds that were made clean by surgical débridement were closed primarily. Dirty wounds were closed by delayed primary wound closure once they were made clean following subsequent wound débridement and irrigation.

36(40.4%) cases, while the least was segmental 3(3.4%) cases as shown in table 3.2. The distal third was observed to be the most common site for open tibia fractures 44(49.4%) cases. While the least

- (vii) The wound classification system of Gustilo and Anderson was used (8).
- (viii) Throughout this study, the commonest methods of fracture stabilisation employed were above the knee Plaster of Paris cast and external fixator.

The outcome of treatment was analysed in respect to the speed of fracture union and presence of complications. Fracture union was evaluated by clinical and radiological examinations at six weeks, three months, and subsequently at monthly intervals. The fracture is considered united if there is no pain, tenderness or abnormal movement at the fracture site and bridging callus is visible on radiograph. Delayed union was diagnosed when the fracture unites between four and six months, while non-union was diagnosed when union has not occurred after eight months of treatment. Each patient was followed up for at least twelve months.

Data Analysis

The results of this study were analysed by descriptive statistical methods, such as means and standard deviations. The choice between parametric and non-parametric methods was dependent on the frequency distribution of the data that was analysed. Statistical analysis was done using the SPSS (statistical package for the social sciences) software, release 11.0 ANOVA and Pearson's Correlation were used as appropriate. Significant difference was implied when P is <0.05 .

Results

A total of 92 patients who fulfilled the inclusion criteria were initially entered into the study. Three patients were lost to follow-up. Eighty-nine patients with open tibia fractures were successfully followed up. The age range was between 4 and 80 years. The mean (\pm SD) was 32.7 ± 17.1 years. There were 57(64%) males (M) and 32(36%) females (F). That is a M:F ratio of 1.8:1. Table 1 shows the various occupations of the patients. Traders 28(31.5%) cases and students 23(25.8%) cases were the most common groups affected. Table 2 shows the different causes of trauma in the patients studied. Motor vehicular accident 54(60.7%) cases was the leading cause of open fractures of the tibia.

The characteristics of the open tibia fractures show that there was no difference in the side of the limb affected. In the right tibia, open fracture occurred in 47(52.8%) cases, while in the left tibia it occurred in 42(47.2%) cases as shown in table 3.1. The most common type of fracture pattern on radiograph was comminuted

involved site was the proximal third 16(18%) cases as shown in table 2.3. In the Gustilo-Anderson grading of open tibia fractures, types II and I were the most

frequent 32(36%) cases and 22(24.7%) cases respectively.

Wound debridement was carried out in all the patients' 89(100%) cases. Sequestrectomy and partial fibulectomy were carried out in 10(11.2%) cases each. Skin grafting was carried out in 7(7.9%) cases. Fasciotomy, and bone grafting were the least common procedures employed in this series 3(3.4%) cases each. Partial fibulectomy was done in open tibia fractures with intact fibula. Skeletal stabilisation was done using above knee Plaster of Paris (POP) cast in 69 (77.5%) cases. Out of these 69 cases with above knee POP, 12(13.5%) cases had fracture redisplacement that was treated with remanipulation. External fixator device was used in 20(22.5%) cases. The average bone union time was 16.9 ± 7.6 weeks, range 6 – 36 weeks. The average follow-up period was 15.7 ± 3.7 months, range 4 – 30 months. The average distance from the accident scene to the hospital was 33.2 ± 50.2 kilometres, range 1 – 250 kilometres. The average duration between the time of injury to the time of wound debridement was 6.0 ± 5.9 hours, range 1 – 48 hours. The average duration of hospital stay was 8.3 ± 6.3 weeks, range 6 – 36 weeks.

Gram positive cocci and gram negative rods were isolated. On the whole *Staphylococcus aureus* 19(54.3%) cases and coagulase negative staphylococcus (CONS) 15(42.9%) cases were the most common organisms isolated. The most common gram negative rods that were isolated from the

patients were *Pseudomonas aeruginosa* 10(28.6%) cases, *Klebsiella aerogenes* 8(22.9%) and *Proteus mirabilis* 7(20%) cases. Multiple organisms were commonly isolated from the wounds. All the organisms isolated were very sensitive to Gentamicin, Cloxacillin and Ofloxacin. The sensitivity ranged from 70.5% to 100%. While most of the organisms were resistant to Penicillin, Ampicillin and Tetracycline. Coagulase negative *Staphylococcus* (CONS) showed sensitivity to a wide range of antibiotics.

There was Correlation between the presence of wound infection and (i) Gustilo and Anderson grading (F -.352, P .001); (ii) Injury to Debridement time in hours (F -.304, P .004); (iii) Osteomyelitis (F .397, P .001); (iv) Delayed union (F .253, P .017); (v) Union time in weeks (F -.350, P .001). There was also correlation between the following: (i) Injury to Débridement time in hours and the distance from the accident scene to the hospital (F .464, P .001); (ii) The fracture pattern and the union time in weeks (F .353, P .001); and (iii) The presence of osteomyelitis and delayed union (F .382, P .001).

The observed complications are shown in table3. Wound infection was observed in 35(39.3%) cases. This was followed by delayed union in 30(33.7%) cases. The complications grouped as others 10(11.2%) cases, were due to wasting of the quadriceps, oedema and ankle stiffness. These were controlled with limb elevation, the use of elastic bandage and by active exercises

Table 1

Etiology of open tibia injury

Aetiology	Male n (%)	Female n (%)	Total n (%)
Automobile	33 (37.1%)	21 (23.6%)	54 (60.7%)
Motor Cycle (2-wheel vehicle)	13 (14.6%)	7 (7.9%)	20 (22.5%)
Pedestrian Crossing	4 (4.5%)	3 (3.4%)	7 (7.9%)
GUNSHOT	3 (3.4%)	1 (1.1%)	4 (4.5%)
Fall From Height	2 (2.2%)	-	2 (2.2%)
Collapsed Wall	1 (1.1%)	-	1 (1.1%)
Industrial Accident	1 (1.1%)	-	1 (1.1%)
Total	57 (64.0%)	32 (36.0%)	89 (100%)

Table 2

Some clinical aspects of tibial fractures.

Affected Limb	Male n (%)	Female n (%)	Total n (%)
Right Limb	31 (34.8%)	16 (18.0%)	47 (52.8%)
Left Limb	26 (29.2%)	16 (18.0%)	42 (47.2%)

Total	57 (64.0%)	32 (36.0%)	89 (100%)
2.1			
Fracture Pattern	Male n (%)	Female n (%)	Total n (%)
Comminuted	24 (27.0%)	12 (13.5%)	36 (40.4%)
Transverse	14 (15.7%)	9 (10.1%)	23 (25.8%)
Oblique	13 (14.6%)	9 (10.1%)	22 (24.7%)
Spiral	4 (4.5%)	1 (1.1%)	5 (5.6%)
Segmental	2 (2.2%)	1 (1.1%)	3 (3.4%)
Total	57 (64.0%)	32 (36.0%)	89(100%)
2.2			
Anatomical location	Male n (%)	Female n (%)	Total n (%)
Distal third	30 (33.7%)	14 (15.7%)	44 (49.4%)
Middle third	17 (19.1%)	12 (13.5%)	29 (32.6%)
Proximal third	10 (11.2%)	6 (6.7%)	16 (18.0%)
Total	57 (64.0%)	32 (36.0%)	89(100%)

Table 3

Complications

Complications	Male (n=57)	Female (n=32)	Total (n=89)
Wound infection	23	12	35
Delayed union	25	5	30
Fracture redisplacement	7	5	12
Malunion	10	1	11
Osteomyelitis	8	3	11
Pin tract infection	4	4	8
Non union	4	3	7
Limb length discrepancy	4	1	5
Compartmental syndrome	1	1	2
Others	8	2	10
Total	94	37	131
No complications	14	14	28

Discussion

Patients between 20 years and 50 years of age constituted 70% of the cases. This is probably because they are the active productive age group within the society. At the extremes of age (that is less than 10 years and greater than 60 years), open tibia fractures were observed to be uncommon (18% of the cases). This is presumably due to the fact that people in this age group tend to travel less. Males (M) were more affected than females (F). The ratio was M:F 1.8:1 in this study. Motor vehicular accidents accounted for about 61% of the cases. This is the most common means of inter-state and inter-city transportation. However, it was noted that in patients less than 10 years, pedestrian crossing a busy road unaided was to 20(22.5%) cases that had the application of the external fixator device. The Plaster of Paris cast often makes access to the wound difficult for inspection and dressing. Window made on the Plaster of Paris cast often weakens the cast and this is often compounded by the wet dressing fluid and wound discharges (4,19). These are major problems of the Plaster of Paris cast treatment of severe open tibia fractures especially in the Gustilo and Anderson type III^{1,14,15}.

the most common cause of open tibia fractures. This trend has also been observed by other workers^{6,10,11}.

The most common pattern of the open tibia fractures encountered were comminuted fractures in 36(40.4%) cases and fractures of the distal third in 44(49.4%) cases. Comminution suggested the result of high energy trauma^{4,12,16}

Anatomically, the distal third of the tibia is subcutaneous with precarious blood supply. This may have accounted for the high rate of fracture in 44(49.4%) cases and delayed union in 16(32.5%) cases at this site^{3,12,13,17,19}. In the open tibia fractures, above knee Plaster of Paris cast was applied in 69(77.5%) cases compared to 16(18.0%) cases in the distal third. However, in types I and II open tibia fractures, where wound healing is not a problem, Plaster of Paris cast is still the mainstay of stabilisation in developing countries, where external fixators are not readily available⁹⁻²¹.

It allows the patient to be discharged home early¹⁹.

Prolonged Plaster of Paris cast application caused joint stiffness and quadriceps wasting in about 18.3% cases. Similar findings were also observed by other

workers^{12,14}. . Redisplacement of the fracture fragments was another setback observed with the use of Plaster of Paris cast in 12(13.5%) cases. This was treated by remanipulation^{12,19}.

Meticulous wound débridement and irrigation with copious fluid are essential for the care of all the patients' wounds. The aim is to reduce the bacterial load and increase the chances of early primary wound closure^{4,6,19,21}. The duration of the fracture union was longer in the distal third of the tibia than the proximal third. The probable reasons for this difference could be that the distal third fractures, had higher proportion of severe open fractures compared to the proximal third fractures. These tibia open fractures occurred more in the distal third, which has precarious blood supply^{12,19}.

In this study, the overall wound infection rate is very high. It occurred in 35(39.3%) cases of open tibia fractures. Open fractures of the distal third of the tibia are very often severely comminuted, devitalised and infected. The Gustilo and Anderson grading of open fractures helped to establish the severity of the open fracture. The higher the grade, the more the severity of the injury and the higher the rate of the wound and bone infection that occurred^{8,10,16-19}. Late wound débridement was due to late presentation to the hospital since the hospital has a policy of immediate resuscitation and wound débridement sometimes even without payment. This lateness was associated with higher rates of wound infection. The longer it took the wound to heal, the longer the hospital stay. The delay in wound débridement could result in increased morbidity, cost of care of these patients and loss of working-man-hours^{2,8,15,17,19}.

The Gustilo and Anderson's classification of open fractures is useful and we encourage it should be used routinely by any one involved in the care of open tibial fractures.. This method provides the ability in the statistical comparison and in determining the prognosis of the open fracture. Early wound débridement with copious fluid irrigation is important. Facilities for carrying out the surgery should be made available within a radius of 50 kilometres of each community. External fixator device should be made available in large numbers in each centre, especially in those centres that deal with open fractures.

References

1. Chapman MW. The use of immediate internal fixation in open fractures. *Orthop Clin North AM* 1980; 11: 579 - 591.
2. Chapman MW, Mahoney M. The role of internal fixation in the management of open fractures. *Clin Orthop* 1979; 138: 120 - 131.
3. Wu C, Shih C. Complicated open fractures of the distal tibia treated by secondary interlocking nailing. *J Trauma* 1993; 34: 792 - 796.
4. Gustilo RB, Merkow RL, Templeman D. Current concepts review. The management of open fractures. *J Bone Joint Surg* 1990; 72: 299 - 304.
5. Heim D, Regazzoni P, Perren SM. Current use of fixation in open fractures (external fixation: what next?). *Injury* 1992; 23: S1 - S35.
6. Seligson D, Henry SL. Treatment of compound fractures. *AM J Surg* 1990; 161: 693 - 701.
7. Kellan JF. Open fractures. In: McMurphy YR, McLellam AM, editors. *Management of blunt trauma*. Baltimore: Williams and Wilkins, 1991: 420 - 426.
8. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty five open fractures of long bones. Retrospective and prospective analysis. *Joint Surg* 1976; 58A: 453 - 458.
9. Brown C. Henderson S. Moore S. Surgical treatment of patients with open tibial fractures. *AORN Journal*. 1996 63:875-81, 885-96; quiz 899-906.
10. Onabowale BO, Onuminya JE, Essien IAJ, Ukegbu ND. The management of open tibial shaft fractures: The National Orthopaedic Hospital Experience. *Nig J Surg* 1995; 2: 37-42.
11. De Souza JL. Healing time of tibial fractures in Ugandan Africans. *J Bone Joint Surg* 1987; 1B: 59.
12. Alabi ZO. The pattern of tibial fractures in Ilesa, Nigeria. *Nig Med J* 1981; 11: 22 - 29.
13. Darder-Garcia A, Darder-Prats A, Gomar-Sancho F. Non-reamed flexible locked intramedullary nailing in tibial open fractures. *Clin Orthop* 1998 ;350: 97 - 104
14. Oni OOA, Orhewere FA. Percutaneous pins and external fixation of compound fracture of the tibia. The Benin experience. *Nig Med J* 1982; 12: 255 - 257.
15. Whittle PA, Russel AT, Taylor CJ, Lavelle DG. Treatment of open fractures of the tibial shaft with the use of interlocking nailing without reaming. *J Bone Joint Surg* 1992; 74A: 1162 - 1171.
16. Chapman MW. Open fractures. In: Rockwood Jr. CA, Green DP, Bucholz RW, editors. *Rockwood and Green's fractures in adults*. 3rd edition. Philadelphia: JB Lippincott company, 1991; 223 - 264.
17. Ostermann PAW, Henry SL, Seligson D. Timing of wound closure in severe compound fractures. *Orthopaedics* 1994; 17(5): 397 - 399.
18. Gustilo RB, Gruninger RP, Davis T. Classification of type III (severe) open fractures relative to treatment and results. *Orthopaedics* 1987; 10: 1781 - 1788.
19. Ikem IC., Oginni LM, Bamgboye EA. Open fractures of the lower limb in Nigeria. *International Orthopaedics (SICOT)* 2001; 25:386-388.
20. Holtom PD, Smith AM. Introduction to adult posttraumatic osteomyelitis of the tibia. *Clin Orthop* 1999; 360: 6-13.
21. Grimard G, Naudie D, Laberge LC, Hamdy RC. Open fractures of the tibia in children. *Clin Orthop* 1996; 332:62-70.

