Original Article

Management of Gustilo and Anderson Type I and II Open Tibial Fracture Using Delayed Primary Nailing: An Assessment of Clinical and Radiological Outcome

Kabiru Salisu, F. O. Awonusi[1], N. Isa[2]

Department of Surgery, Barau Dikko Teaching Hospital, Kaduna, [1]Alliance Hospital, Area 11 Garki, Abuja, [2]Department of orthopaedic and trauma, National Orthopaedic Hospital, Dala Kano, Nigeria

Abstract

Background: Open tibial fracture is one of the most common trauma emergencies. Marked delay in presentation is noticed in developing countries, especially sub-Saharan Africa due to poor pre-hospital care, presentation to traditional bone setters and out-of-pocket payment of services. Primary nailing at the time of initial debridement was noticed to have a high prevalence of infection in some series. Delayed primary nailing after a period of debridement and wound care was found to be safe with less complication rate in this study. **Objective:** The objective of this study is to determine the clinical and radiological outcome of management of Gustilo and Anderson (GA) Type I and II open tibial fracture using delayed primary nailing, especially in patient with delayed presentation. **Methodology:** Twenty-one (21) patients with open (GA I and II) tibial diaphyseal fracture were recruited into this study. They had initial debridement and a period of wound care before subsequent nailing. All patients had tibial interlocking nailing 5–9 days post-injury using open technique with aid of the external jig system. The patients were followed up for 9 months. Clinical outcome was assessed using Johner and Wruh's criteria at 6 months. The radiologic outcome was assessed using Radiologic union scale for tibia fracture (RUST). **Results:** The M: F was 4:1 with a mean age of 37.24 ± 13.8 years. Road traffic accident accounted for 85.7% (n = 18). Marked delayed presentation was noted, only four patients (19.1%) presented within 6 h from injury. GA Type II open fracture was the most prevalent fracture type accounting for 81.9% (n = 17). The clinical outcome using Johner and Wuh's criteria at 6 months post-nailing showed 18 patients (86%) had excellent and good outcome. Only one patient (4.8%) had poor outcome. RUST was used to assess the rate of union following the tibial nailing. Fractures were scored at 6 weeks, 12 weeks, 6 months and 9 months. Ten patients (47.6%) were united at 6 weeks, whereas 21 (100%) had achieved union at 9 months. The average time to radiologic union was 17.3 weeks. Seven patients (33.3% n = 7) had complications. Anterior knee pain, superficial surgical site infection (SSI) and delayed union were the complication recorded. **Conclusion:** Delayed primary nailing of open tibial fracture produces good to excellent outcome with acceptable complication rate, especially SSI.

Keywords: Clinical and radiological outcome, delayed primary nailing, open tibial diaphyseal fracture

Introduction

Tibial diaphyseal fracture is the most common long bone fracture. Tibia is prone to high-energy injury and open fractures owing to its subcutaneous nature and anatomical location. Motorcycle accident was found to be the most common cause of high-energy tibial shaft fracture.[1] Different methods of management of tibial diaphyseal fracture have evolved over the years, with locked intramedullary nailing as the gold standard treatment option for displaced closed or open (Gustilo and Anderson [GA] I and II) tibial shaft fractures.[2] Intramedullary nailing provides the biomechanical advantage of being able to control alignment, translation and rotation. Locked intramedullary nailing promotes early motion of adjacent joints, early weight bearing, callus formation and good bone healing.[3] Solid, unreamed nailing was advocated in the treatment of open

Access this article online

Quick Response Code:

Website: www.njotonline.org

DOI: 10.4103/njot.njot_35_20

Address for correspondence: Dr. Kabiru Salisu, Department of Surgery, Barau Dikko Teaching Hospital, Kaduna, Nigeria. E-mail: kbmed2003@yahoo.com

How to cite this article: Salisu K, Awonusi FO, Isa N. Management of gustilo and anderson Type I and II open tibial fracture using delayed primary nailing: An assessment of clinical and radiological outcome. Niger J Orthop Trauma 2021;20:10-4.

Submission: 22.03.2021 **Revision:** 06.05.2021
Acceptance: 27.05.2021 **Web Publication:** 09.07.2021

tibial fracture, this method of treatment uses small size nail and associated with high risk of revision (exchange nailing), delay union and non-union.[4,5] Marked delay in the presentation is noticed in developing countries, especially sub-Saharan Africa, due to poor pre-hospital care, presentation to traditional bone setters and out-of-pocket payment of services.[6,7] Primary nailing at the time of initial debridement was noticed to have a high prevalence of infection in some series. However, in this research, we employed delayed primary nailing using reamed, locked, hollow intramedullary tibial nail following debridement and period of wound care within 5–9 days post-injury.

Methodology

The study was carried out at the National Orthopaedic Hospital Dala, Kano state, Northwest of Nigeria. The study was a hospital-based prospective interventional study. Consecutive patients between the age group of 18 and 62 years with open (GA I and II) tibial shaft fractures were included in the study. It was carried out between May 2016 and November 2017. Ethical clearance was obtained from the hospital as well as informed consent from the patients or their guardian. Patients with risk factors affecting fracture healing and those with sign of infection following debridement were excluded. All patients had resuscitation using advanced trauma life support protocol.[8] Intravenous (IV) fluid and analgesics were commenced. Antibiotics and tetanus prophylaxis were given, wounds irrigated with normal saline and dressed with sterile gauze on presentation at A and E as well as application of a temporary gutter spintage.[9,10] Plain radiographs of the leg (anteroposterior [AP] and lateral views) were obtained after resuscitation. All patients had initial debridement and plaster of Paris back slab application within 24–48 h of presentation at the A and E theatre; they were mobilised non-weight bearing on the affected limb a day after debridement using bilateral axillary crutches. Second look debridement and intramedullary nailing were done using trans-patella, open method by aid of external jig and locked both proximally and distally. All patients had post-operative medications in form of; IV ceftriaxone 1 g bd for 72 h, analgesia using combination of IV pentazocine 30 mg 6 hourly, intramuscular diclopenac 75 mg 12 h and IV Paracetamol 600 mg 8 hourly and IV fluid (normal saline 1 L daily, 5% dextrose in water 2 L daily) 1 L 8 hourly for 24–48 h. Oral analgesics were continued for 2 weeks.

At 24 h post-operative, the check X-rays and packed cell volume were obtained and finding noted. Active knee and ankle exercises were instituted as soon as pain subsides within the first 48 h. Those with stable fracture were commenced on partial weight bearing ambulation using bilateral axillary crutches as soon as pain allows within the first 72 h under the supervision of a physiotherapist. Partial weight bearing was delayed in those with less stable fracture were commenced on non-weight bearing ambulation within the first 48 h and continued until bridging callus was noted. Full weight bearing was started after radiographic evidence of bridging callus was established usually after 8–12 weeks post-operative. Wounds were inspected 48 h post-operative and stitches were removed 2 weeks post-surgery. All patients were followed up for a period of 9 months.

Data were collected during pre-operative period, intraoperative, 6 weeks, 12 weeks, 6 months and 9 months post-surgery using questionnaire. Final measurement of parameters as contained in Johner and Wruh's criteria[11] was done at 6 months post-operative using the questionnaire. This clinical outcome measure takes into account the clinical and functional outcome as well as the complications of tibial diaphyseal fractures. It is the most widely used for the assessment of tibial diaphyseal fracture outcome especially following intramedullary nailing.

Table 1 shows the parameters assessed and outcome ranging from excellent to poor.

Radiographic outcomes using radiologic union scale for tibia fracture (RUST)[12] were obtained on radiograph taken at 6 weeks, 12 weeks, 6 months and 9 months. The RUST is based on the presence or absence of callus formation and of visible fracture line at the 4 cortices visible on the AP and lateral radiographs, as shown in Table 2. Radiologic union

Table 1: Johner and wruh criteria

Criteria	Excellent	Good	Fair	Poor
Nonunion, osteitis, amputation	None	None	None	Yes
Neurovascular disturbances	None	Minimal	Moderate	Severe
Deformity				
Varus/valgus (°)	None	2-5	6-10	>10
Antevertion/recovertum (°)	0-5	6-10	11-20	>20
Rotation (°)	0-5	6-10	11-20	>20
Shortening (mm)	0-5	6-10	11-20	>20
Mobility (%)				
Knee	Full	>80	>75	<75
Ankle	Full	>75	>50	<50
Subtalar	>75	>50	<50	
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Mild limp	Significant limp
Strenuous activities	Possible	Limited	Severely impossible	limited

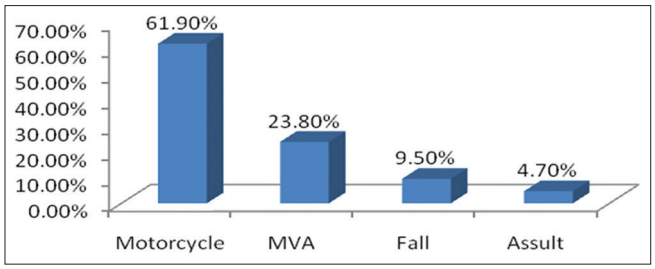

Figure 1: Mechanism of injury. MVA: Motor vehicular accident

Figure 3: A clinical photograph of open left tibial fracture Gustilo and Anderson Type II

Figure 5: Three months post-operative clinical picture, showing healed scar and excellent knee movement

based on RUST score is defined as the presence of bridging callus in at least 3 cortices with score of ≥7.

All post-operative complications (up to 9 months) were recorded in the questionnaire. Data obtained were analysed and presented as table and charts.

Results

From the total number of 21 patients recruited into the study, the result shows that male are more affected according this ratio, M:F of 4:1.

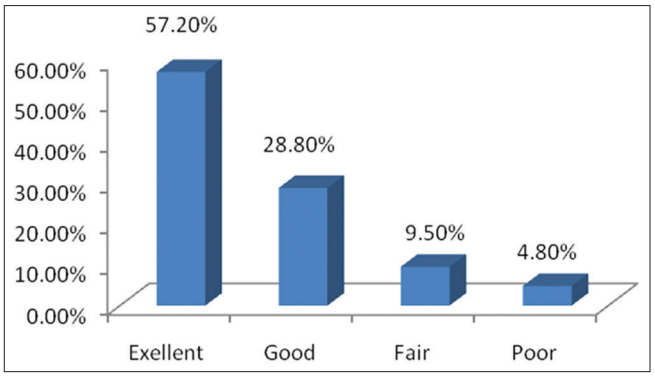

Figure 2: Johner and Wruh's outcome distribution

Figure 4: Pre-operative radiograph anteroposterior and lateral of the studied patient above, showing an oblique fracture of left tibia and fibula

Figure 6: Three months postoperative radiograph RUST score medial cortex = 3, lateral cortex = 1, Posterior corte × 2, Anterior cortex = 2, Total RUST = 8

The age range of the patients was 18–62 years, with a mean age of 37.24 ± 13.8 years. Road traffic-related injuries were the most common mechanism of injury. Motorcycle accident being the most prevalent with 61.9% (n = 13), as shown in

Figure 7: Nine months post-operative radiograph RUST score medial cortex = 3, lateral corte × 3, posterior corte × 3, Anterior cortex = 2, Total RUST = 11

Figure 1. Only four patients (19.1%) presented within the golden hours (<6 h). Most patients (n = 9, 42.9%) presented within 6–48 h [Table 3]. GA Type II open fracture was the most prevalent fracture type accounting for 81% (n = 17), while GA I accounted for 19% (n = 4).

The clinical outcome using Johner and Wuh's criteria was assessed at 6 months post-nailing. Eighteen patients (86%) had excellent and good outcome. Only one patient (4.8%) had poor outcome, as shown in Figure 2.

Ten patients (47.6%) were united at 6 weeks while 21 (100%) had achieved union at 9 months, as shown in Table 4. The average time to radiologic union was 17.3 weeks.

Figures 3 and 4 are the preoperative clinical photograph and plain radiograph of a patient with Gustilo and Andersen type II open left tibial fracture. His post operative clinical photograph [Figure 5] showed healed scars and excellent joint mobility. He also had good radiologic union noticed on plain radiograph [Figures 6 and 7] at 3 months and 9 months following delayed primary nailing respectively.

Seven patients (33.3%) developed various types of complications [Table 5]. Anterior knee pain was the most common complication, accounting for 19.0% (four patients) of the cases. Superficial surgical site infection (SSSI) was seen in two patients (9.5%)

Discussion

Road traffic accident was the most common mechanism of injury. Marked delayed presentation was noted few presented within 6 h from time of injury. GA Type II open fracture was the most prevalent fracture type. These parameters are in keeping with the epidemiological study on open tibial fracture.[13]

Delayed primary nailing defined in this study as nailing following initial debridement and a period of wound care, 5 days post-debridement was chosen as minimal period required to identify the early features of surgical site infection (SSI). The result of this work is compared with related works, as shown in Table 6.

It is noteworthy to mention that all the researches reviewed employed primary nailing at the time of initial debridement. Similar to Kaushik *et al*.[14] who reported 16.4 weeks, time to union in this study was found to be 17.3 weeks but lower than 20.1 weeks reported by Essoh *et al*.[15] Functional outcome was assessed using Johner and Wruh's criteria with good to excellent functional outcome seen in 86% (n = 18) while Kaushik *et al*.[14] and Joshi *et al*.[4] used Kertegian criterion as functional outcome, with almost similar result. Lower incidence of complication is one of the aims of this method, especially SSI. SSSI was seen in only 9.5% (n = 2) of the patients, this result was comparable to those of Ashwin *et al*.[16] and Kaushik *et al*.[14] Our patients in this study had marked delay in presentation, this delay negate the choice of primary nailing because is associated with high risk of infection, thus the choice of delayed primary nailing to lower

Table 2: Radiologic Union Scale for tibia fracture

Score per cortex	Callus	Fracture line
1	Absent	Visible
2	Present	Visible
3	Present	Invisible

All post-operative complications (up to 9 months) were recorded in the questionnaire. Data obtained were analysed and presented as table and charts

Table 3: Time to presentation

Time to presentation	Frequency (%)
<6 h	4 (19.1)
6-<48 h	9 (42.9)
48 h-<7 days	6 (28.6)
7-42 days	2 (9.5)
Total	21 (100.0)

Table 4: Time to fracture union

Healing period	Frequency (%) union
6 weeks	10 (47.6)
12 weeks	18 (85.7)
6 months	20 (95.2)
9 months	21 (100)

Table 5: Post-operative complication

Complications	Frequency (%)
AKP	4 (19.0)
SSSI	2 (9.5)
Delayed union	1 (4.8)
Total	7 (33.3)

AKP: Anterior knee pain, SSSI: Superficial surgical site infection

Table 6: Comparison of outcome of nailing

Author	This study	Ashwin *et al*.[16]	Kaushik *et al*.[14]	Joshi *et al*.[4]	Essoh *et al*.[15]
Number of patients	21	23	34	60	154
Gustillo and anderson classification	I and II	I and II	I and II	I, II and III	I, II and III
Type of nailing	Delayed primary	Primary	Primary	Primary	Primary
Time to union (weeks)	17.3	-	16.4	-	20.1
Fuctional outcome (%)	Johner and Wruh's	Nil	Ketenjian's criteria	Ketenjian's criteria	Nil
Excellent	57.2		61.7	67.9	
Good	28.8		23.5	17.9	
Fair	9.5		14.7	3.6	
Poor	4.8		-	10.7	
Complication (%)					
AKP	19.0	-	-	17.8	4.5
Infection	9.5	8.69	8.8	21.4	19.5
Delay union	4.8	8.69	8.8	10.7	5.3
Non-union	-	-	14.7	10.7	8.5

AKP: Anterior knee pain

the risk of SSI. Joshi *et al*.[4] and Essoh *et al*.[16] reported higher SSI and incidence of chronic osteomylitis (COM) in their studies. Idumagbodi *et al*.[17] reported a result of primary nailing from the population of similar geographical location and sociodemographic variables of both closed and open tibial fracture with resultant SSI and COM of 22.22% their time to presentation and treatment also ranges from 12 h to 2 weeks signifying similar delay in presentation. The result of Idumagbodi *et al*.[17] showed significantly higher infection rate then our study. This is likely due to employment of delay nailing where those patients with high risk of SSI are identified during the period of wound care. Delay union in this study was relatively lower than the studies reviewed.[4,16,15] No incidence of non-union or malunion was found in our study.

Conclusion

Delayed primary nailing of open tibial fracture produces good to excellent outcome with acceptable complication rate especially SSI.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Nayagam S. Fracture of tibia and fibula. In: Solomon L, Warwick D, Nayagam S, editors. Apley's System of Orthopaedics and Fracture. 9th ed. London: Hodder and Arnold 2010. p. 897 905.
2. Canale ST, Beaty JH. Tibial shaft. In: Canale ST, Beaty JH, editors. Campbell's Operative Orthopaedics. 11th ed . Philadelphia: Mosby Elsevier; 2007. p. 3117 46.
3. Kovalk KJ, Zuckerman JD, Joseph D. Tibia and fibula shaft fracture. Hand Book of Fracture. 3rd ed., Ch. 37. Philadelphia: Lippincott Williams and Wilkins; 2006. p. 388 96.
4. Joshi D, Ahmad A, Kriashna L, Lal Y. Unreamed interlocking nail in open fracture of tibia. J Orthop Surg 2004;12:216-21.
5. Hassan AA, Saleh AK, Hassan TG. Unreamed tibial nailing for open fracture tibial shaft. AAMJ 2014;4:243-56.
6. Abang IE, Asuquo J, Ngim NE, Ikpeme IA, Agweye P, Urom SE, *et al*. Reasons for patronage of traditional bone setters. Niger J Surg 2016;22:102-6.
7. Solagberu BA, Ofoegbu CK, Abdur-Rahman LO, Adekanye AO, Udoffa US, Taiwo J. Pre-hospital care in Nigeria: A country without emergency medical services. Niger J Clin Pract 2009;12:29-33.
8. The American College of Surgeons' Committee on Trauma. Advanced Trauma Life Support Course. Chicago, IL: American College of Surgeons; 2004.
9. Yousif A, Theodore M, Emil HS, David T. Antibiotics utilisation in open fractures. OTA Int 2020;1:Pe071.
10. Cross WW 3rd, Swiontkowski MF. Treatment principles in the management of open fractures. Indian J Orthop 2008;42:377-86.
11. Johner R, Wruhs O. Classification of tibial shaft fractures and correlation with result after rigid internal fixation. Clin Orthop Relat Res 1983;178:7 25.
12. Whelan DB, Bhandari M, Stephen D, Kreder H, McKee MD, Zdero R, *et al*. Development of the radiographic union score for tibial fractures for the assessment of tibial fracture healing after intramedullary fixation. J Trauma 2010;68:629-32.
13. Ibeanusi SE, Ekere AU. Epidemiology of open tibial fracture in Teaching Hospital. Port Harcourt Med J 2007;1:156-60.
14. Kaushik SK, Khan A, Gupta U, Pathania VP. Primary Intramedullary nailing of open (Grade I and II) Tibial fracture; A functional outcome. Ijss 2015:352-5.
15. Essoh JB, Bamba I, Kodo M, Kodo M, Kacou DK, Lambin Y. Primary Unreamed and Unlocked intramedullary nailing for open tibial fracture. Niger J Orthop and Trauma 2006;5:29 33.
16. Ashwin S, Rai H, Mathias LJ. Management of open fracture of shaft of tibia in adult using interlocking intramedullary nailing. Int J Bio Med Res 2012;2:1768-7.
17. Idumagbodi A, Micheal OB, Icha OI. Management of tibial fracture using unreamed locked intramedullary nails: Our experience from Jos, North Central Nigeria. J Dent Med Sci 2015;14:33-6.