Section: Orthopedics

Original Research Article

A LONGITUDINAL STUDY TO ASSESS THE CLINICAL OUTCOME OF OPEN TYPE 1 AND TYPE 2 (GUSTILO ANDERSON) TIBIAL FRACTURE TREATED WITH INTRAMEDULLARY INTERLOCKING NAILING BEYOND GOLDEN PERIOD (6 TO 48HOURS) AT TERTIARY CARE CENTRE

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ABSTRACT

Background: Primary intramedullary nailing in open fracture fulfils the objective of stable fixation, biomechanical stability, minimal soft tissue damage, less healing time and early rehabilitation, early weight bearing. As there is data lacking on this, we decided to do this study to assess the clinical outcome of open type 1 and type 2 (Gustilo Anderson) tibia fracture treated with intramedullary interlocking nailing beyond golden hours with respect to, time taken for healing, achievement of range of motion of ankle and knee.

Materials and Methods: A longitudinal study was done from January 2021 to December 2022 on a total of 30 participants at the Department of Orthopedics at the Subbaiah Institute of Medical Sciences, Shimoga, Karnataka, India.

Results: The mean age in the study was 35.26 SD +/- 10.4 years. We noted that evening time the injuries of tibia were more common. We had a positive correlation between the CRP and the degree of contamination of the wound. Males were suffered more than females, 1 case had pain at knee, 4 cases had ankle and screw site pain and 1 case had superficial infection,2 cases had delayed union, 53.33% had excellent outcome, 43.33% had good outcome, 3.33% had fair outcome. At admission the mean m rust score was 5.03 SD +1.47 and at the final follow up mean m rust score was 22.97SD +3.65.

Conclusion: Primary nailing is very useful in the management of open tibia fractures which is treated beyond golden period with a very minimal complication rate and an acceptable clinico- radiological outcome. The results were also found to be satisfactory in terms of the time required for healing and the Range of motion achieved.

Keywords: Complication, Primary nailing, Golden hour, Tibial Fracture.

INTRODUCTION

With the rapid increase in high velocity traumas due to Road Traffic Accidents (RTA), the incidence of fracture of tibia is on the rise, justifying its description as the 'fracture of modern age'.[1] The tibia is the most common bone, to be fractured in orthopaedic practice.[2] Open fractures are almost as common as closed fractures, because one third of its surface is subcutaneous throughout most of its length. Furthermore, the blood supply to the tibia especially at middle 1/3rd and distal 1/3rd is more precarious than that of bones enclosed by heavy muscles.[3]

Fracture of tibia is commonly found in young active males who are between 25 and 40 years of age and is usually the result of motor vehicle accidents, fall from height, sports injury or domestic falls.[2]

Diaphyseal fractures of the tibia are common among these.[5] Many patients sustaining open fractures of the leg present to the McGann hospital casualty. Closed fractures are usually treated at nearby

hospitals but most open fractures are referred to here. As the District referral hospital, we encounter more patients with open fractures of tibia after the golden time- 6 hours. With the recent drastic increase in the number of two wheelers even in rural areas there is an increase in incidence of these fractures.

Open fractures of the tibia are usually treated with an external fixator initially and nailing is done later once the wound heals. However, external fixators are likely to be associated with pin tract infection which precludes definitive fixation, even if the open wound heals. So open tibial fracture is one of the difficult fractures to treat, considering the number of surgeries patient has to undergo and the financial burden for the treatment increases exponentially.[6] Interlocking nailing tibia is done for fracture tibia as a definitive treatment.[7] In literature, numerous studies show excellent results for treatment of open fracture tibia, with interlocking nailing even up to type 3B Gustilo Anderson grading if done within the golden period.[8-12]

Primary intramedullary nailing for open fracture fulfils the objective of stable fixation, biomechanical stability, minimal soft tissue damage, reduced healing time and early rehabilitation as well as early weight bearing.[6-9]

Due to delayed presentation of cases, hemodynamically unstable patients with associated injury to head, chest, spine and abdominal injuries and the non-availability of an operating room definitive treatment cannot be done within golden hours many a time in our setup.[10,11]

With the administration of antibiotics and thorough wound wash at initial presentation, Ameya S Kamat et al in their study reports, no difference with nailing done after the golden hours have passed.[12]

As the data on this is limited, we decided to do a study titled: A Longitudinal Study to Assess the Clinical Outcome of Open Type 1 And Type 2 (Gustilo Anderson) Tibial Fracture Treated with Intramedullary Interlocking Nailing Beyond Golden Period (6 To 48hours) At Tertiary Care Centre"

MATERIALS AND METHODS

This was a longitudinal study, conducted in 30 patients at Department of Orthopedics at the Subbaiah Institute of Medical Sciences, Shimoga, Karnataka, India from January 2021 TO December 2022. Sample size was determined by considering the average number of patients treated for the same condition during the past two years. This was a longitudinal study, conducted at our institution in which patients with open tibia fractures presenting to the Emergency Department were assessed and managed according to the Standard protocol. The details of patients who fulfilled the said criteria were collected when they presented to the Emergency Department of Orthopedics at the Subbaiah Institute of Medical Sciences, Shimoga, Karnataka, India. Case details were recorded in the case record by means of history taking, thorough clinical examination, and appropriate radiological and blood investigations. Patients were categorized according to the Gustilo-Anderson's classification for open tibial fractures.

Inclusion Criteria:

1. Open diaphyseal fractures, both Gustilo Anderson type 1 and type2.
2. Injury to surgery interval of 6 hrs to 48 hrs. Patients giving informed consent

Exclusion Criteria

1. Open diaphyseal fractures (Gustilo Anderson) type 3
2. Purulent discharge from the wound
3. Open physis
4. Pathological fractures
5. Severely contaminated wound
6. Severe co-morbidities
7. Injury to surgery interval more than 48hrs

Pre-Operatively: In the Casualty, all patients were given Injection Tetanus Immunoglobulins and swab were taken for culture before giving a thorough wound wash with a minimum of 5 to 8 litres of normal saline. IV Antibiotics (Ceftriaxone-sulbactam, Gentamycin, metronidazole) was started with adequate analgesics. This was followed by a sterile dressing and the limb was splinted and elevated.

Intra-Operatively: Perioperative antibiotics were given before the procedure; Intraoperative swab was taken for culture and sensitivity. Debridement and stabilization with locked intramedullary nail were performed as early as possible with the time elapsed not exceeding 48 hours.

All the patients were operated under spinal anaesthesia. Patients were positioned supine on a radiolucent operating table. The injured limb was scrubbed using povidone-iodine scrub solution and painted using povidone iodine solution. The injured limb was then appropriately draped using sterile surgical drapes.

Wound debridement

The open wound over the leg was extended, fracture site and medullary canal cleared of any debris. All the contaminants were debrided. Then wound wash was given using 4 to 5 litres of normal saline. Wound was then closed temporarily using a sterile pad.[13]

All the selected patients were treated with debridement and intramedullary interlocking nail. (Figure 2) Postoperatively the operated limb was elevated to prevent oedema.

- Intravenous antibiotics were given for up to 5-7 days postoperatively.
- Oral antibiotics were continued till the day of suture removal.
- Knee, ankle and toe movements were initiated from the first postoperative day
- Non weight bearing mobilization was started immediately and, in some patient's,

weightbearing was determined by fracture patterns.

- Skin sutures were removed on the 12th postoperative day.
- Further follow up was done every 4 weeks till the fracture healed.

Later, the patients were followed up every 6 weeks and a final assessment was done at 8 months from the date of surgery.

The functional and radiological outcomes were assessed using the following charts

Excellent • No pain • Joint motion >75% of normal • No swelling • Normal gait	Fair • Pain with ordinary activity • Joint motion 50% of normal • Small amount of swelling • Slight limp
Good • Occasional pain with prolonged use • Joint motion 75% of normal • Trivial swelling • Normal gait	Poor • Constant pain • Joint motion <50% of normal • Any visible deformity • Limp, gait on cane or crutches

Figure 1: Ketenjian and Shelton Criteria Modified by Yokohama

	Radiographic Criteria		
	Callus	Fracture Line	Score*
RUST	Absent	Visible	1
	Present	Visible	2
	Present	Invisible	3
mRUST	Absent	Visible	1
	Present	Visible	2
	Bridging	Visible	3
	Remodeled	Invisible	4

*A score is given to each of the visible cortices in 2 orthogonal radiographs (anteroposterior and lateral). The final score is the sum of the 4 cortex scores.

Figure 1: mRUST SCORE

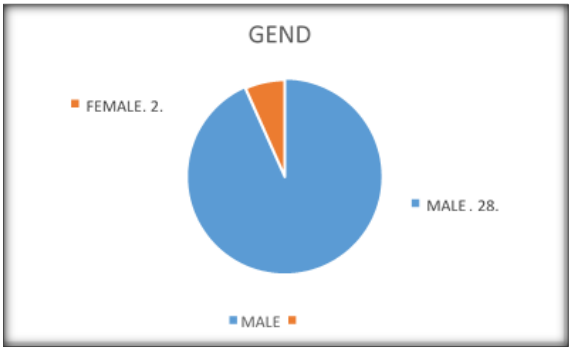
Figure 2: Operative Technique Photograph

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2019) and then exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

RESULTS

A longitudinal study was done from January 2021 to December 2022 on a total of 30 participants in the Department of Orthopedics at the Subbaiah Institute of Medical Sciences, Shimoga, Karnataka, India. The results are as follows:



Graph 1: Gender wise Distribution of Study Participants

In the present study 12 patients (40.00%) belonged to the age group of 21- 30 years, 11 patients (43.67%) belonged to the age group of 31-40 years, 4 patients (41.33%) belonged to the age group of 41- 50 years and 2 patients (46.67%) belonged to the age group of 51- 60 years. (Table 1) On evaluation of gender, 28 patients (93.33%) were males and the remaining 2 cases(6.66%) were

females. Chi square p=0.02 which is highly significant. (Graph 1)

In the present study, 13.33% were shopkeepers, 23.33% were manual labourers, 26.67% were Farmer, 10.00% were Businessmen, 3.33% were Lecturers, 13.33% were Students, 3.33% were Tailors and 6.67% were Retired. The mode of injury of tibial fractures- 50.00% were as a result of RTA,16.67% were as a result of fall from a height,26.67% were as a result of farm accidents, 6.67% were as a result of trivial injury indoors. The duration since injury and presentation was more in those who came after seeking treatment elsewhere. 46.67% the duration since injury was less than 12 hours, in 26.67% the duration since injury was between 12 to 24 hours, in 26.67% the duration since injury was between 24-48 hours. Suturing was done in 13.33% and slab was put in 30% of the study participants before coming to the hospital.

Based on AO classification 4 (13.33%) were A1, 3 (10%) were A2, 7 (23.33%) were A3,4 (13.33%) were B1, 3 (10.00%) were B2 , 6 (20.00%) were B3 , 1 (3.33%) were C1 , 1 (3.33%) were C2 and 1(3.33%) were C3. [Table 2]

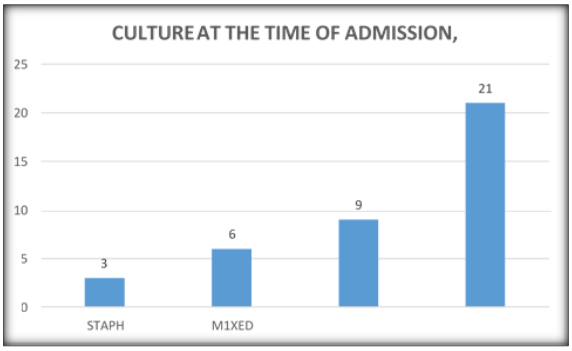
60.00% Type1 Gustilo Anderson classification fractures,40.00%Type2 Gustilo Anderson classification fractures. 63.33% were contaminated wounds and 36.67% were clean wounds. The mean ESR was 45.7 SD +/- 12.53 mm at the end of the first hour and ranged between 17 mm and 77 mm at the end of the first hour. The mean CRP was 51.06 SD +/- 28.96 and 67% of the participants had elevated CRP initially, later serial follow-up CRP was negative. [Table 3]

30% had a positive culture: 20 % showed growth of mixed organisms and 10% showed growth of staphylococcus at the time of admission, before giving wound wash. [Graph 3]

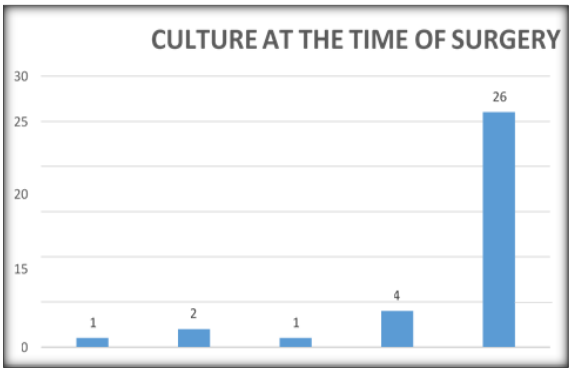
13.33% had a positive culture: 3.33% showed growth of mixed organisms,3.33%were klebsiella and 6.67% were staphylococcus at the time of surgery. Regarding Complications 1 case each had superficial infection and pain at the knee,1case had pain at knee, 4 cases had ankle and screw site pain,2 cases had delayed union. [Table 4]

53.33% had an excellent outcome, 43.33% had a good outcome, and 3.33% had a fair outcome. There was a negative correlation between the time taken to present since injury and the outcome =-0.76, p=0.0001 and this was statistically significant. 80% of the cases were healed in <14 weeks ,13.33% of the cases were healed in 14 -28 weeks ,6.66% of the cases were healed in 48 weeks, mean time of union is 28.2 weeks. [Table 5]

At 6 weeks the mean M-Rust score was 5.03 SD +1.47and at the final follow up mean m rust score was 22.97SD +3.65.



Graph 2: Culture at the Time of Admission, before Giving Wound Wash



Graph 3: Culture at the Time of Surgery

Table 1: Age wise Distribution of Study Participants

AGE	CASE NO	PERCENTAGE
21- 30 YEARS	12	40.00%
31-40 YEARS	11	36.67%
41- 50 YEARS	4	13.33%
51-60 YEARS	2	6.67%
More Than 60 Years	1	3.33%

Table 2: AO Classification

AO CLASSIFICATION	CASE NO	PERCENTAGE
A1	4	13.33%
A2	3	10.00%
A3	7	23.33%
B1	4	13.33%
B2	3	10.00%
B3	6	20.00%
C1	1	3.33%
C2	1	3.33%
C3	1	3.33%

Table 3: Gustilo-Anderson Classification

GUSTILO ANDERSON CLASSIFICATION	CASE NO	PERCENTAGE
TYPE 1	18	60.00%
TYPE 2	12	40.00%

Table 4: Outcome Ketenjian and Shelton Criteria Modified by Yokoyama Et Al

Results	No of patients	%
Excellent	16	53.33%
Good	13	43.33%
Fair	1	3.33%

Table 5: M Rust Score

M RUST SCORE	AT 6 weeks	FINAL ASSESMENT
MEAN	5.03	22.97
SD	1.47	3.65
P value	<0.001	VHS

DISCUSSION

Fractures of the tibia are comparatively common and have been recognized as serious and debilitating injuries for centuries. Open fractures of tibia are amongst the most complex to manage, because of the poor soft tissue cover and blood supply. Although numerous wound management and fixation possibilities have been proposed, problems with infection, delayed healing and prolonged disability still persists. Variables such as comminution, displacement, bone loss, contamination and general condition of the patient are more important prognostic factors in tibial fracture

In the present study, on evaluation of gender 28 patients (93.33%) were males and the remaining 2 cases were females. This is similar to the study that have been described K Padha et al[8] in which it was noted that 22 were males and 8 were female. The mean age in the study was 35.26 SD +/- 10.4 years. The age of the patients in the study ranged between 22 years and 65 years. K Padha et al,[8] noted that the age of the patients ranged from 15 years to 65 years with mean age of 37 years. Akshay Phadke et al,[2] noted that the age of the patients was 46.19 years. In the present study, 60.00% Type 1 Gustilo Anderson classification fractures, 40.00% Type 2 Gustilo Anderson classification fractures. D Joshiet al noted that 13 (53.6%) type-I, 18 (32.1%) type-II, 4 (7.1%) type III A, and 4 (7.1%).[14]

In our study,3.33% of the cases had superficial infection,3.33% had pain at knee ,13.33% had ankle and screw site pain, 6.67% had delayed union. D Joshi et al noted that of 56 patients, 6 had early infection, 6 had delayed union, 6 had infected non-union, 2 had nail breakage, 8 had screw breakage, and 1 0 had anterior knee pain.[14] In our study, based on Ketenjian and shelton criteria modified by Yokoyama et al results were 53.33% had an excellent outcome, 43.33% had a good outcome, and 3.33% had a fair outcome. the mean duration of healing was 28.2 weeks, this is comparable to the studies mentioned below. K Padha et al p[8] noted that the average time required to achieve union of the tibia 7.8 months (6-18 months). Lakhpat et al,[15] A Mahmood et al study shows Average time taken for clinical union was 13.4 weeks while average duration of radiological union was 16.8 weeks, the average time to radiological union was 12.5 weeks for the closed fracture group and 15.1 weeks for the open fractures.

In our study 46.67% of cases were reported in less than 12 hours since injury, 26.67% of the cases were reported between 12 to 24 hours since injury, 26.67% of the cases were reported between 24-48 hours since injury, mean time of surgical debridement and fixation after coming to the hospital is 9.2 hrs. K Padha et al[8] noted Ten fractures reported within 6-10 h of injury, while 8,7 and 5 reported after 10-14h, 14-18h and 18-24h respectively. The patients were taken for surgical debridement and fixation, on an average within 4.7h (range 2-11h) after reaching the hospital. Since the study was conducted in a single institute, care should be taken while inferring the result to the general population.

CONCLUSION

This study states that, primary nailing is very useful in the management of open tibia fractures which is treated beyond golden hours (6 to 48hours) with a very minimal complication rate and an acceptable clinic -radiological outcome. The results were found to be satisfactory in terms of the time required for healing and the range of motion achieved.

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