



Original Article

Radiological and Functional Outcome of Intramedullary Nailing Vs External Fixation in Gustilo Anderson Type 3B Tibia Fracture

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ABSTRACT

Background: Open/Compound fractures of tibia are the most common type of fracture to occur following road traffic accidents; however, sports injury, fall from height can also frequently produce these fractures. Open fractures of tibia (Gustilo Anderson Type 3B) are quite challenging to treat, with respect to associated soft tissue injury and the decision for type of implant to be used by an orthopaedic surgeon. The decision making is based on the wound condition, the amount of muscle and soft tissue damage, type of fractures, and availability of equipments. This study was undertaken to evaluate the most optimal method for the management of compound fractures of tibia vis a vis comparing reamed tibia interlocking nail and external fixator in the management of GA Type 3B compound fractures of tibia.

Controversy exists over whether the use of external fixation or tibial intramedullary nailing is optimal for the treatment of open tibial fractures. The aim of this study was to compare radiological and clinical outcomes in terms of postoperative infection, malunion, delayed union, nonunion and hardware failure between these two treatment methods.

Materials and Methods: The study was undertaken in the Department of Orthopedics Pacific Institute of Medical Science, Udaipur, India. The study involved both male and female patients with open fractures of tibia, (Gustillo and Anderson, Type 3B). This was a prospective study conducted from month of April onwards. Hundred patients who had open/compound fracture of tibia (Type 3B) were evaluated. The patients were followed-up for duration of 6 to 10 months (Average 8 months).

Detailed analysis of function of the patient was done on the basis of following criteria by Johner and Wruh.

Conclusion: The study conducted on 100 patients, who suffered from open/compound fracture tibia (Type 3B), it was reported that patients who were operated with with external fixator had better outcome and decreased morbidity, as compared to patients treated with reamed tibia interlocking nail.

2. Need for the Study

Epidemiological studies propose that road traffic accidents are commonly responsible for tibial shaft fractures, next to sports injuries.

Severity of soft tissue injury is directly related to the amount of high energy trauma. Diverse techniques are now accessible for treatment of diaphyseal fractures of tibia. Modern orthopedic surgeons must be attentive to the advantages, disadvantages and limitation of every technique available, to select the ideal line of treatment for each patient.

There is a tremendous amount of uncertainty amongst orthopaedic surgeon, in deciding the type of implant to be used for compound fractures tibia (Type 3B).

The common fear among surgeons includes:

1. Chances of intramedullary osteomyelitis following tibia interlocking nail in a Type 3B tibia fracture.

2. The tibia interlocking nail, being an intramedullary implant, has a higher chance of developing acute followed by chronic osteomyelitis.
3. The use of external fixator which causes increased morbidity and delay in patients return to activities of daily living.
Hence, there is a need to determine the ideal line of treatment in Type 3B compound fractures tibia that is, whether tibia interlocking nail has an advantage compared to external fixator; the external fixator being the preferred modality for treatment of compound fractures.

Keywords: Type 2 Diabetes Mellitus; SGLT2 Inhibitors; GLP-1 Receptor Agonists; Cardiovascular and Renal Protection.

INTRODUCTION

The study was undertaken in the Department of Orthopedics, Pacific Institute Of Medical Science, Udaipur. The study involved both male and female patients with open fractures of tibia, (Gustillo and Anderson, Type 3B).

This was a prospective study conducted from April onwards. Patients who had compound fracture of tibia (Gustilo Anderson Type 3B) were evaluated. The patients were followed-up for duration of 6 to 10 months (Average 8 months).

3.1. Inclusion criteria

- 1) Age between 18yrs and above
- 2) Open fractures type IIIB according to Gustillo Anderson classification.

3.2. Exclusion criteria

- 3) Less than 18 years
- 4) Associated intra-articular fractures of proximal /distal tibia.
- 5) Gustillo type I to IIIa, IIIc fractures.
- 6) Polytrauma patients with head injury, blunt abdominal trauma and blunt chest trauma.

3.3. Management

3.3.1. Rapid primary survey

In the casualty, a rapid survey was conducted and emergency measures were undertaken to combat pain, hemorrhage, and shock with proper sedation, analgesic, intravenous infusion or transfusion of blood when required.

3.3.2. Detailed secondary survey

- 1) History and thorough clinical examination.
- 2) Assessment of soft tissue injury.

Protocols were followed according to Ganga Hospital protocols. At casualty level, general state of the patient was assessed. Primary survey, with recording of vitals was done, with emphasis on hypovolemia, associated orthopedic or other systemic injuries. Resuscitative measures were taken. All the patients received analgesics via I.V injections, Injection tetglob 500 I.U and triple antibiotic therapy was started with I.V antibiotics, covering both gram + and gram -ve bacteria.

All patients within the criteria were shifted for saline irrigation and debridement. Wound swabs were collected for culture and sensitivity. Wounds were subjected to thorough saline wash. Subsequent wound care and antibiotic treatment was determined by severity of the open fractures.

Routine investigations were carried out for all patients. Fractures were evaluated clinically and radiographically. Radiographs were taken in two planes, A-P and Lateral view. I.V antibiotics, cephalosporins, aminoglycosides and Nitroimidazole were started for all the patients.

Patients were separated into 2 groups. Group A patients consisted of patients treated with intramedullary nailing whilst group B consisted of patients treated with external fixator.

Selection of patients into respective groups was done arbitrarily, keeping in my mind the extent and type of contamination of the wound.

3.3.3. Wound debridement

A scrupulous, layer by layer debridement of the open wound was initiated, beginning from the skin and subcutaneous tissue. A thin layer of healthy skin was excised surrounding the wound.

Debridement of the wound was carried out, respecting the soft tissue such as blood vessels, nerves, and tendons. All foreign materials were debrided, either by washing or by excision of the tissue.

Antibiotics were started intravenously before surgery, and continued for 2 weeks of postoperative period routinely and further extended depending upon the status of the wound and culture sensitivity report.

Post debridement, the open wounds were enclosed using sterile dressing pads soaked with normal saline. The fractures were immobilized by using an above knee pop slab.

3.3.4. Intervention

Except for the selection of the fixation device, open fracture care was similar in the two treatment groups. All patients underwent emergency irrigation and debridement along with swab for culture sensitivity with concomitant skeletal stabilization. Patients were randomly allocated into one of the two treatment groups.

- 1) In Group A patients: Reamed tibia interlocking nail was used as primary fixation device.
- 2) In Group B patients: External fixator was used as stabilization device. Depending on the level of fracture and fracture geometry three types of frames were constructed using 4, 5 and 5.5 mm Schanz pins, universal rods and clamps:
 - (a) Unilateral uniplanar frame
 - (b) The delta frame
 - (c) Joint frame

3.4. Postoperative care

Non-adherent, antibiotic covered dressings were used to cover open wounds. Local wound irrigation with normal saline was carried out. Occurrence of wound infection evaluated using parameters like, temperature, as well as white blood cell count and wound inspection.

Regular wound debridement and dressings were carried out, to obtain a healthy granulation bed. Antibiotics were altered according to the sensitivity report.

Check X-rays were done and consequently alteration in the frame was done if necessary in external fixation. Physiotherapy was encouraged with active and passive range of movements of the ankle and knee joint and quadriceps strengthening exercise initiated without more ado following the surgery. As early as patient could tolerate, he/she was encouraged to start partial weight bearing.

3.5. Fracture healing

“Fracture healing in fractures stabilized by external fixator or intramedullary nail occurred by callous formation. Callous was stimulated by progressive force transmission across the fracture site. After soft tissues granulation, patients were encouraged to initiate partial and then full weight bearing.

3.6. Follow-up

The patients under study were evaluated at every 2 weeks interval.

They were evaluated both clinically and radiologically and serial X-rays were ordered at 2 weeks interval. Secondary procedures such as dynamization and/or bone grafting were undertaken at the end of 20 weeks, when fracture union was not satisfactory.

3.7. Rehabilitation

Physiotherapy was initiated immediately after 1st postoperative day.

Patients were assisted to do quadriceps exercises, active straight leg raise and knee bending exercises. After achieving good healing of the soft tissues and check X-ray showed satisfactory callus, the patient was started on full weight bearing and removal of fixator.

Patients having knee or ankle stiffness were treated with dedicated physiotherapy which also included; local ultrasonic therapy and wax bath was advised for 10-14 days to avoid muscle spasm.

External fixator was removed after 3-6 months, subsequently PTB cast was utilised for 4-8 weeks. Weight bearing was gradually increased according to patient's tolerance level.

The study group were frequently examined both clinically and radiologically, till complete union was achieved. Standard considered for the time of union were as follows:

- 1) Regular union - union occurring before 30 weeks
- 2) Delayed union - union occurring after 30 weeks
- 3) Non-union - no signs of union even after 9 months.

The fracture was accepted as united when:

- 1) Fractured tibia was clinically stable on physical examination.
- 2) Sufficient callus seen on the roentgenogram showed.
- 3) No discomfort/pain or need of support while weight bearing.

RESULTS

The study includes 100 Gustillo Anderson Type 3B fractures of the tibial shaft from April onwards. The patients were followed up for duration of 6-10 months.

Minimum age of the patient was 18 years. Average age of the patient was 30.7 years.

Road traffic accidents were the bulk mode of injury causing tibial shaft fractures, accounting for 71% of all tibial fractures. The commonest site of fracture was located at the middle-third of the tibia. This constituted 62% of tibial fractures. The diaphysis is a more rigid bone, so fractures are common in middle third of tibia

4.1. Complications

Hence, comparing the 2 groups, it was evident that, group

A patients (Tibia interlocking nail) had an infection rate of 26%. Complications like non-union, delayed union and Malunion were 21, 10 and 10 percent, respectively.

In group B patients (External fixator) had an infection rate of 12%. Non-union, delayed union and Malunion were, 10, 14 and 4 percent respectively.

5. Functional Results Functional outcome of the patient was done on the basis of Johner and Wruh criteria.

Table 1: Age distribution according to sex

Age	Male	Female
18-30	28	8
30-45	17	6
45-60	10	2
60-75	8	3
>75	12	6
Total	75	25

Table 2: Mode of injury

Mode of injury	Number of patients	Percentage
RTA	71	71
Fall	17	17
Crush injury	12	12

Table 3: Anatomical location of fracture

Anatomical location of fracture	Number of patients	Percentage
Upper and middle third junction	13	13
Middle third	62	62
Middle and lower third junction	22	22
Lower third	3	3
Total	100	100.00

Table 4: Type of fracture

Type of fracture	Number of patients	Percentage
Transverse 18 18 Oblique 17 17		
Wedge(butterfly)	10	10
Spiral	17	17
Communitied	35	35
Segmental	3	3
Total	100	100.00

Table 5: Type of implant used

Type of implant	Cases	Percentage
Tibia Interlocking nail	50	50
External Fixator	50	50
Total	100	100

Table 6: Radiological fracture union

Fracture union (weeks)	Number of patients	
	Tibia Interlocking (50)	External fixator (50)
6-8	2	0
8-12	7	0
12-16	11	3
16-20	17	19
24-28	10	17
>36	3	5
Total	50	44 (6 pts lost to F.U)

Table 7: Weight bearing

Weeks	Partial wt. bearing No of patients		Full wt. bearing No of patients	
	Group A (50)	Group B (44)	Group A (50)	Group B (44)
4 – 8	4	0	0	0
8-12	18	6	4	2
12-16	21	11	13	9
16-20	5	16	26	10
20-24	2	9	7	13
>24	0	2	0	10

Table 8: Complications: Comparing complications of Group A against Group B

Complications	Number of patients		Percentage	
	Group A	Group B	Group A	Group B
Wound infection	6	13	12	26
Screw breakage/Pin Site infection	3	15	6	30
<u>Nonunion</u>	5	21	10	42
Delayed union	7	10	14	20
Anterior knee pain	1	–	2	–
<u>Malunion</u>	2	5	4	10
Joint stiffness	9	14	18	28
Shortening	0	2	0	4

Table 9: Functional outcome
Functional outcome

	Group A	Group B
Excellent	29	17
Good	13	9
Fair	5	7
Poor	3	11
Total	50	44

Table 10: Johner and Wruh's criteria for evaluation of final results

S, No.	Criteria	Excellent (Left=Right)	Good	Fair	Poor
1.	Non-unions, <u>ostetitis</u> , amputation	None	None	None	Yes
2.	Neurovascular disturbances	None	Minimal	Moderate	Severe
3.	Deformity				
	Varus/Vargas	None	2-5°	6-10°	>10°
	<u>Anteversion/ Recurvation</u>	0-5°	6-10°	11-20°	>20°
	Rotation	0-5°	6-10°	11-20°	>20°
4.	Shortening	0-5mm	6-10mm	11-20mm	>20 mm
5.	Mobility				
	Knee	Normal	>80%	>75%	<75%
	Ankle	Normal	>75%	>50%	<50%
	Subtalar	>75%	>50%	<50%	—
6.	Pain	None	Occasional	Moderate	Severe
7.	Gait	Normal	Normal	Insignificant limp	Significant limp
8.	Strenuous activities	Possible	Limited	Severely limited	Impossible
9.	Radiological union	Consolidated	Consolidated	Union	Not consolidated

DISCUSSION

Hundred patients, who suffered from Type 3B open fractures of the tibia, were managed with interlocking intramedullary nailing and external fixator during time period from April at Pacific Institute Of Medical Sciences, Udaipur. Cases included in the study, were fresh injuries and traumatic fractures.

For a period of 8-10 months, cases were followed-up at opd level.

Goal was to operate the tibia fractures either by closed interlocking intramedullary nailing or by external fixator, followed by early mobilization and to compare and determine the best modality of treatment for Type 3B open fractures of tibia. 50% of patients were operated by tibia interlocking (reamed) and rest 50% by external fixator.

Thorough wound irrigation and debridement was performed.

46 fractures which were operated with tibia interlocking united within 8-10 months of injury, while 16 patients operated with external fixator united within 10-12 months of injury. 10 patients with communitied fracture failed to unite (non-union) 10 months after the injury.

Despite the advantage that the use of external fixator involved a shorter duration of operating time and being more suitable in polytrauma patients, it was not well tolerated by the patients. Also the incidence of complications such as non-union, delayed union, pin site infection and re-fracture were higher, compared to group a patients.

The use of intramedullary interlocking nail involved a shorter duration of fracture healing, early weightbearing and early ambulation to pre injury state. However complications such as acute osteomyelitis, chronic osteomyelitis, infection management, implant removal due to uncontrolled infection were higher compared to external fixators

CONCLUSION

1. In this comparative study, role of external fixation and intramedullary interlocking nail was compared, to determine the ideal line of treatment of compound fractures of tibia (Gustillo IIIB). The results obtained were then compared, in terms of union of fractures, complications and functional outcome.
2. The results of closed interlocking intramedullary nailing and external fixator in the treatment of open fractures of the Tibial shaft. (Gustillo type IIIB) were compared
The outcomes of open fractures tibia were compared in terms of (a) Time required for the union of fracture.
(b) Range of motion of ankle and knee joint. (c) Rate of Malunion and mal rotation (d) Rate of infection.
(e) Failure of the implant.
3. Three goals were attempted, for successful treatment of open fractures of tibia. The prevention of infection, the achievement of bony union and the restoration of function.
4. These goals are interdependent and usually are achieved in the chronologic order given. For example failure to prevent infection promotes delayed union or non-union and delays functional recovery of the limb.
5. The 100 odd patients were arbitrarily divided into 2 groups. 50 patients were operated with tibia interlocking nail (group a) and remaining 50 with external fixator, (Group b)
6. Hence this study, it was reported that cases of Type3b open fractures tibia, which were operated by tibia interlocking nail had the following advantages
(a) Early mobilization and decreased morbidity
(b) Better patient compliance
(c) Less rate of deformities (d) Faster return to pre-injury status

While patients operated with external fixators had following advantages

- (a) Lesser incidence of infection

7. Hence, it was concluded that in Gustilo Anderson Type 3b tibial shaft fracture operating by tibia interlocking nail had more advantages and better patient compliances than operating with external fixation.

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