

ROLE OF INTRAMEDULLARY INTERLOCKING NAIL IN FRACTURE TIBIA AMONG ADULTS – A PROSPECTIVE STUDY IN A TERTIARY CARE HOSPITAL, ANDHRA PRADESH, INDIA

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Abstract:

Background: Fractures of the tibia are one of the most common fractures encountered in orthopaedic practice since tibia and fibula along with femur form the principle load bearing bones in the lower extremity. Although they form the strongest bones of the body, they are frequently fractured due to multiple causes. Fractures of these may result in prolonged morbidity and extensive disability unless treatment is appropriate.

With recent advances in biplanar imaging and metallurgy there has been a renewed interest in closed intra-medullary interlocking nailing and have made a trauma surgeon more confident in dealing with complex fractures of tibia. Hence an attempt has been made to study the role of intramedullary interlocking nail in fracture tibia among adults.

Aims and Objectives: To study the role of intramedullary interlocking nail in fracture tibia among adults in a tertiary care hospital, Andhra Pradesh, India.

Material and Methods: Study design: Prospective study. Study Area: Tertiary care hospital, Rajahmundry. Study period: 18 months (July 2013 to Dec 2014) Study tools: A Predesigned and Pretested questionnaire, Measuring tape, Stethoscope, X-ray Chest and Leg, Routine blood investigations, Urine routine, ECG sample size:121 Statistical analysis: Analyzed using Microsoft Excel 2007 and Epi info version 3.5.3 RESULTS: The age of presentation varied from 19-64 years with a Mean age of 37.03. The incidence was significantly higher in Males (88 males and 20 females), Right side 64(59.3%) involvement was more, RTA was the main cause of trauma. 92 (85.1%), Closed type 76 (70.3%) of injuries was more common. Majority of the cases were Oblique type 44 (40.7%). Most of the fractures occurred at middle third zone 44 (40.7%). Most common complication was Anterior Knee Pain, 24 (22.22%). Union was achieved in majority 92 (85.1%) of the cases, between 12-24 weeks. Mean union time was 17.88 weeks.

Conclusion: Closed interlocking nail fixation is the procedure of choice for tibial shaft fractures.

Key Words: Intramedullary interlocking nail, Fracture Tibia, Adults

Introduction:

The most common fractures encountered in orthopaedic practice are those of Femur and Tibia since these long bones form the principle load bearing bones in the lower

extremity. Although they form the strongest bones of the body, they are frequently fractured due to multiple causes. Fractures of these may result in prolonged morbidity and extensive disability unless treatment is appropriate. These Fractures are often

the result of high-energy trauma and may be associated with multiple system injuries. The rationale for operating on fractures of moderate and major severity is to prevent disability and frequent morbidity associated with these injuries.

Gerhard Kuntscher's¹ description of closed intra-medullary nailing in 1940 revolutionized the concept of treatment of fractures of femur and tibia. With recent advances in biplanar imaging there has been a renewed interest in closed intra-medullary interlocking nailing. Recent advances in metallurgy (cold curing and variety of materials) and design of the nail such as pre-bent nail, prefabricated holes in the nail which lock the fragments with screws, have made a trauma surgeon more confident in dealing with complex fractures of the femur and tibia. Hence an attempt has been made to study the role of intramedullary interlocking nail in fracture tibia among adults.

Aims And Objectives:

To study the role of intramedullary interlocking nail in fracture tibia among adults in a tertiary care hospital, Andhra Pradesh, India.

Material and Methods:

A Prospective study of all cases with fracture tibia admitted in a tertiary care hospital, Andhra Pradesh, during a period of 18 months (July 2013 to Dec 2014) was conducted. A total of 121 cases were admitted of which 13 patients did not consent for the study and hence the number came to 108. All patients with fracture shaft of tibia above 18 years of age, all closed fractures and open fractures of type I, II, IIIA (Gustilo – Anderson) who consented for the study were included while pathological fractures, fractures within 5 cm distal to knee joint and 5 cm proximal to ankle joint, open fractures of type IIIB, IIIC (Gustilo – Anderson), ipsilateral fractures of femur and tibia and those who failed to consent were excluded from the study. A Predesigned and Pretested questionnaire containing questions about the detailed history with special reference to the mode of injury and severity of trauma was used. This was followed by physical examination including a comprehensive orthopaedic examination of the injured limb and other limbs. The involved extremity was examined for swelling, deformity, discoloration, skin integrity, neurological,

motor and vascular compromise and signs or symptoms of compartment syndrome. Medical and General surgical evaluation was sought expeditiously for all high – energy accident victims to rule out polytrauma. Radiological examination of Tibia with ipsilateral knee and ankle joints both preoperatively and postoperatively were taken for evaluation. X-ray Chest, Routine blood investigations, Urine routine, ECG were all done and also medical and anaesthetist opinion were taken to explore fitness of the patients for surgery. The purpose of the study was explained in local language and a written informed consent was taken from the patients. They were free to withdraw from the study anytime they wished.

Management of diaphyseal fractures of tibia

Our management followed the following protocol for every patient.

Pre-Operative management includes

1. Stabilization
2. Diagnosing other associated injuries

1) Stabilization of the patient

- a) Emergency care
- b) Immobilization of the affected limb
- c) Investigations

a) Emergency care

Special attention was given to cardiopulmonary status. Vital signs were monitored. The neurological status of the limb was under constant supervision in cases of the fracture proximal 1/3rd of Tibia. All the open injuries were thoroughly debrided in the operation theatre.

b) Immobilization of the affected limb:

Immobilization of the affected limb was done in Thomas splint, to prevent soft tissue damage, to decrease pain, and for easy mobilization of the patient.

c) Investigations:

The following investigations were carried out routinely.

- i) Routine blood investigations
- ii) Urine routine
- iii) Special tests: ECG, Chest X-ray PA view (> 40 years)
- iv) Radiographs: Anteroposterior and lateral views of the entire long bone including the joint proximal and distal to it.

The interval between the injury and the definitive operation ranged from 2 days to 12 days (mean 7 days).

Nail Used In The Study

It is a hollow tubular nail with a circular cross section. Proximal end has curve (Herzog curve) allowed for an eccentric anterior starting point on the tibial cortex between the tibial tubercle and the plateau avoiding insertion through articular cartilage and is expanded to give additional strength for proximal screw fixation. It has position slots to lock the jig. Its 2mm wall thickness gives the nail certain flexibility on bending. Proximal end has got threads on the inner side that provides secure fixation of the threaded conical bolt for attachment of jig/extractor.

For locking there are 2 holes on either side, at the proximal and distal ends of the nail. Circular holes for static locking measure 5 mm. Nails in diameters of 8,9 and 10mm with length from 280-360 mm with increments of 20 mm were used for tibia interlocking.

Locking screws are self tapping, 4.5mm available from 25-95mm in 5 mm increments.

Follow up

All the patients were followed up. With each follow up, clinical and radiological examinations were performed at 6 weeks, 12 weeks, 18 weeks, 24 weeks. Final assessment was done at the end of 6 months.

Clinical examination included evaluation of complaints by the patients, assessment of the range of motion, assessment of the soft tissues, evaluation of the rotational alignment, leg length discrepancy and deformities, if any. Finally the

functional implications were evaluated.

Radiological examination was performed in two planes and assessed for callus formation. Varus / Valgus and Flexion / Extension deformities if any were assessed. "Union" was defined as the appearance of bridging callus and trabeculations extending across the fracture site. "Nonunion" was defined as no evidence of fracture union progression in 6 months of follow up. "Delayed union" was defined as the appearance of the signs of fracture union, but the progress of union to consolidation is delayed than is otherwise expected.

Functional Results:

Functional results were graded based on the Johner and Wruh's Criteria for evaluation of Final Results after Tibial Shaft Fracture.² The results were designated as excellent, good, fair or poor according to the alignment of the fracture, the range of motion of ipsilateral knee, and the shortening of femur, and the degree of pain or swelling.

Johner and Wruh's Criteria for evaluation of Final Results after Tibial Shaft Fracture²

Criteria	Excellent	Good	Fair	Poor
Nonunion / Infection	None	None	None	Yes
Neurovascular injury	None	Minimal	Moderate	Severe
Deformity				
Varus/ Valgus	None	2-5"	6-10"	>10"
Pro/ Recurvatum	0-5"	6-10"	11-20"	>20"
Rotation	0-5"	6-10"	11-20"	>20"
Shortening	0-5mm	6-10mm	11-20mm	>20mm
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
Activities				
Strenuous	Possible	Limited	Severely limited	Impossible

Statistical Analysis: Analyzed using Microsoft Excel 2007 and Epi info version 3.5.2

Ethical clearance was obtained from the ethical committee of the hospital.

Results:

Age : wise distribution of patients showed that majority 60 (55.6%) of them were between 21 to 40 years, followed by 36 (33.3%) in 41 to 60 years, 8 (7.4%) below 20 years and 4 (3.7%) above 60 years. Mean age for fracture Tibia was 37.03 years

Sex distribution: Majority 88 (81.4%) of the patients in our study were males and 20 (18.6%) were females.

Side Incidence: showed right side predominance 64 (59.3%) with 44 (40.7%) on left side.

RTA was the main cause of trauma. 92 (85.1%) met with accident while 16 (14.9 %) had fall from height resulting in fracture femur

Closed type 76 (70.3%) of injuries was more common than open type 32 (29.7%)

Pattern of fracture:

Majority of the fractures were oblique type followed by transverse, spiral, comminuted and segmental types.

Pattern of fracture	No. of cases of fracture femur
Oblique	44 (40.7%)
Transverse	32 (29.6%)
Spiral	20 (18.5%)
Segmental	4 (3.7%)
Comminuted	8 (7.4%)

Anatomical location:

Majority 44 (40.8%) of fractures were at the middle third zone followed by the junction of middle third and lower third 28 (25.9%) and the junction of upper third and middle third 36 (33.3%)

Associated Injuries with fracture shaft of femur:

Out of 108 cases, 96(88.8%) cases had fracture fibula associated with fracture tibia. Only in 12(11.2%) cases fibula was intact. There were 16 (14.8%) cases with head injury, 8 (7.4%) cases with fracture clavicle, 8 (7.4%)

cases with Colles fracture and 4 (3.7%) cases with fracture both bones Forearm, associated with fracture shaft of tibia amounting to a total of 36 (33.3%).

Complications:

Most common complication was Anterior Knee Pain, 24 (22.2%) followed by Superficial Infection 8 (7.4%), Delayed Union 4 (3.7%) and Shortening 4 (3.7%). Superficial infections resolved by regular dressings and antibiotics.

There were 24 cases of anterior knee pain of which 20 cases had occasional pain, 4 cases had moderate pain as the nail was abutting the patellar tendon. There were 4 cases of delayed union and 4 cases of shortening of 1.5 cms.

There were no cases of deep infection, implant failure, malunion, nonunion and rotational deformities in our study.

Weight bearing:

Patients were allowed to walk without bearing weight on the operated leg with the help of crutches/walker on an average between postoperative day 2 - day 5. Six patients with significant comminution were advised delayed weight bearing. Weightbearing without support was advocated when clinico-radiological signs of union was observed. In 99 (91.66%) patients full weight bearing was started between 12-14 weeks.

Secondary procedure:

Four (3.7%) patients of fracture tibia who showed minimal radiological signs of union at the end of 6 weeks underwent dynamization and union occurred at 25 to 26 weeks.

Range of motion:

100 (92.6%) of the 108 patients had full range of motion at the knee at union. 8 (7.4%) patients had flexion at knee around 900-1000. All patients had full range of ankle motion at union.

Union rates:

In our study of 108 cases, union was achieved in majority 92 (85.1%) of the cases, between 12-24 weeks. Only in 12 (11.2%) cases, union was achieved in <12 weeks while in 4 (3.7%) cases there was union after 24 weeks. Mean union time was 17.88 weeks.

Assessment of Functional Results:

Result	No of cases	Percentage
Excellent	72	66.7%
Good	28	25.9%
Fair	8	7.4%
Poor	0	0%

Discussion:

The age of presentation varied from 19-64 years. Mean age was 37.03 which is well in accordance with the series of Arne Ekeland et al³ (35 yrs) and Court Brown et al⁴ (32.4 yrs). Majority 88 (81.4%) of the patients in our study were males and 20 (18.6%) were females. Our study showed right side predominance 64 (59.3%) with 44 (40.7%) on left side. Predominant mode of injury was road traffic accidents 92 (85.1%), which is comparable to the series of Lawrence B. Bone et al⁵ (90%) and Hooper et al⁶ (59%). Closed type 76 (70.3%) of injuries was more common which is well in accordance with series of Lawrence B. Bone et al.⁵ (65.8%). Court Brown et al⁴ reported 91% of closed fractures. Majority of the fractures were oblique type followed by transverse, spiral, comminuted and segmental types. Transverse and oblique fractures together were 70.3% comparable to findings of Sankarsan Patro et al⁷ (59%). Fractures most commonly (40.7%) occurred at the middle third zone which is similar to the series of Court Brown et al⁴ (44%) and Lawrence B. Bone et al⁵ (53.5%).

Associated Injuries

The percentage of associated injuries in our study was 33.3% comparable to Lawrence B. Bone et al⁵ (37.5%). Court Brown et al⁴ reported 14.4% of associated injuries.

The fibula was fractured along with the shaft of tibia in our series in 88.8% of cases, which is comparable to the series of Court Brown et al⁴ (77.7%). The associated fracture of the fibula, in most of the cases reflects the high – velocity

injury pattern in our series, as most of the injuries are due to road traffic accidents. Associated fractures were treated during the management of tibial shaft fractures.

Fractures were operated after 2 days to maximum of 12 days after injury, All the cases were operated under spinal anaesthesia.

In 94% of our patients, active Hip, Knee, ankle movements and quadriceps exercises were started on the 1st postoperative day. 94% of patients were mobilized with the walker from the 3rd postoperative day, touch-down weight bearing of the affected extremity was allowed. Suture removal was done in all patients on 10th – 12th day. Complete relief of pain was seen in 80% of patients in two weeks. 4(3.7%) cases of tibia complained of pain at ankle.

All the patients were followed up. With each follow up, clinical and radiological examinations were performed at 6 weeks, 12 weeks, 18 weeks, 24 weeks with suitable follow-up advice. Final assessment was done at the end of 6 months. In 4 (3.7%) cases of delayed union final assessment was done at the end of 7 months.

Depending upon the type of fracture and stable fixation of fracture, partial weightbearing was started. In our series, partial weight bearing was started in 94% of patients by the 6th week. Complete weight bearing was started after 12 weeks in 70%, after 14 weeks in 22% and after 16 weeks in rest 8% of the patients. The appearance of bridging callus was used to assess and allow the patient full weight bearing. The average time of full weightbearing was 13.2 weeks. Full weight bearing has been delayed in 8(7.4%) patients as there were comminuted fractures. This is comparable to Lawrence B. Bone et al⁵ where in his study weightbearing has been delayed in unstable fractures.

In our study 100 (92.6%) of the 108 patients had full range of motion at the knee at union. 8 (7.4%) patients had flexion at knee around 90^o-100^o. All patients had full range of ankle motion at union

Four (3.7%) patients of fracture tibia who showed minimal radiological signs of union at the end of 6 weeks underwent dynamization and union occurred at 25 to 26 weeks.

Time to union of a fracture was defined as time from injury to full weightbearing and healing of the fracture characterized by bridging callus seen on two radiographs

with different projections—Donald A. Wiss.⁸

In our study, time to union in fractures of tibia ranged from 12 weeks to 26 weeks with an average of 17.88 weeks. This is comparable to Arne Ekeland et al³(16 weeks), Lawrence B. Bone et al.⁵ (19 weeks), Court Brown et al⁴ (16.7 weeks) and Anglen J.O. et al⁹ (22.5 weeks).

Complications

In our cases of fracture tibia, Superficial infections were seen in 7.4%, pain (minor) in 22.2%, shortening (1.5 cm) in 3.7% and delayed union in 3.7% of the cases. There were no cases of deep infection, nonunion, malalignment and implant failure.

Lawrence B. Bone et al⁵ noted superficial infection in 1.8%, deep infection in 6.4%, shortening (1 cm) in 4.5%, valgus angulation of 5° in 1 case (0.9%), 20° of external rotation and 15° of internal rotation deformities in 1 case(0.9%) each.

Court Brown et al⁴ noted superficial infection in 0.8%, deep infection in 1.6%, shortening (0.5-2 cm) in 3.2%, external rotation deformities of 5°, 10°, 15° in 1 case(0.8%) each, nonunion in 1.6% cases and knee pain in 40.8% of the cases.

Arne Ekeland et al³ noted superficial infection in 2.1%, deep infection in 3.2%, shortening (1-3 cm) in 14.1%, nonunion in 2.1% cases and delayed union in 1% of the cases.

Final assessment was done at end of 6 months and functional results were graded using the Johner and Wruh's² criteria, taking into account the following objective and subjective symptoms of gait, pain, deformity, range of motion of knee, ankle and subtalar joints, shortening, Neurovascular disturbances, ability to do strenuous activities, radiological union and presence or absence of non-union. Functional outcome was graded into Excellent, Good, Fair and poor.

In our study of fracture tibia, 66.7% have got excellent results, 25.9% good and 7.4% fair results similar to series of Arne Ekeland et al³ (64.4% excellent, 28.8% good and 4.4% as fair).

Conclusion:

Fractures of the tibia are mainly sustained in high velocity trauma. Internal fixation is the mainstay of treatment. Conventional plating is associated with high risk of infection, malunion, non union, implant failure. Interlocking techniques lead to fewer complications of nonunion/malunion, lesser soft tissue dissection, earlier fracture healing and lesser chances of infection. Closed nailing results in less intraoperative blood loss, shorter operative time, earlier weight bearing and union and early return to work with reduced morbidity compared to the open techniques. Closed interlocking nail fixation is the procedure of choice for tibial shaft fractures.

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