

## International Journal of Orthopaedics Sciences

ISSN: 2395-1958  
IJOS 2019; 5(1): 48-52  
© 2019 IJOS  
www.orthopaper.com  
Received: 26-11-2018  
Accepted: 30-12-2018

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## Functional outcome of metaphyseal and diaphyseal fractures of tibia treated with expert tibial interlocking nail: A prospective study

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i1a.10>

### Abstract

**Introduction:** Tibia is the most commonly fractured bone due to road traffic accidents and other high-energy trauma and surgical management is required for most of these fractures, with either internal or external fixation. Locked intramedullary nailing has been widely accepted as a satisfactory treatment of tibial fracture. The indications of their use have been extended to fractures closer to proximal / distal fragments with introduction of expert tibial nail. It is a new kind of low, multidirectional locking tibial intramedullary nail developed to attain increased angular stability and to enhance the axial and lateral stability of fracture fragments.

**Aim:** To study the functional outcome and duration of union of metaphyseal and diaphyseal fractures of tibia treated with expert tibial interlocking nail.

**Methodology:** Study was done in 30 patients with fresh tibial metaphyseal/diaphyseal fractures treated surgically with expert tibial nail between October 2016- March 2018. Patients were followed up at 6 weeks, 3 months, and 6 months. The intra-operative blood loss, duration of surgery, intra operative complications, post-operative complication, and duration of hospital stay were studied. Functional outcome was assessed based on Johner and Wruh's Criteria.

**Results:** Among the 30 patients treated with expert tibia nail for metaphyseal/diaphyseal tibial fractures, 25 were male and 5 were females. Most of patients were in the age group ranging from 20-30 years with a mean age group of 40.1 years. The mode of injury for 24 patients was road traffic accidents which accounted for about 80 %, 5 were due to fall which accounted for 16.67 % and 1 was due to assault which accounted for 3.33 %. 16 cases sustained right side tibia fracture and 14 cases sustained left side tibia fracture. The average period of commencement partial weight bearing was 7 weeks and full weight bearing was 13.43 weeks. Excellent results were seen in 43.33% cases, Good results were seen in 33.33%, Fair results in 16.67 %, poor results in 6.67% according to Johner and Wruh's Criteria.

**Conclusion:** Our results with expert tibial interlocking nailing are encouraging and demonstrate the benefits of new nailing system. Changes in the design of the nail for improved proximal and distal locking enables it to use in metaphyseal/diaphyseal fractures of tibia. A better stabilization of small fragments has been achieved by the availability of locking option in three planes, thus providing a higher stability of the bone implant construct. Complications were comparable to other studies.

**Keywords:** functional outcome, metaphyseal, diaphyseal fractures, interlocking nail

### Introduction

Tibia is frequently fractured long bone in the body with an annual incidence of tibial shaft fractures is 26 per 1, 00,000 individuals <sup>[1]</sup>. Because of its location, the tibia is exposed to widespread injury; it is the most frequently fractured long bone. Because one third of the tibial surface is subcutaneous all through its length, open fractures are more frequent in the tibia than in any other major long bones <sup>[2]</sup>. They are roughly three times more common in males than in females and average age of patients is about 37 years. In adolescent age group, tibia is frequently fractured bone among males and are usually documented to high energy trauma such as motor vehicle accidents. Their incidence increase again later in life with the development of osteopenia and osteoporosis <sup>[1]</sup>. High-energy trauma are usually caused by motor vehicle accidents, fall from height, direct blows and gunshots. Low-energy trauma are typically caused by sporting injuries, fall from standing height and twisting injuries. They may also be related with

pathological conditions of bone [3]. Closed reduction and cast immobilization is the standard treatment for low-energy tibial shaft fractures [4-6].

In recent decades, usage of intramedullary locking nails has become very popular, and many studies have shown that patient having tibial shaft fracture treated with IMLN had better functional outcome than those treated with cast immobilization.

The conventional method of closed reduction and cast application of tibial fractures results in delayed union, malunion and restricted range of motion at the ankle and knee joint. These were the common complications when tibial fractures were treated with a cast [7].

Interlocking nailing has been demonstrated to be the method of choice for fixation of these fractures. The intramedullary nailing under image intensifier satisfies the objective of stable fixation with minimal tissue damage resulting in better and faster fracture unions.

Introduction of modern implants like the Proximal Tibial Nail and Expert Tibial Nail has led to major advancement in intramedullary nailing of proximal tibial fractures. Introduction of interlocking bolts below the tibia plateau in these new implants, helped the surgeon to treat very proximal tibial fractures with intramedullary nailing [8].

Intramedullary nailing offers an attractive treatment option, however there are some problems in treatment of fracture tibia with conventional intramedullary interlocking nailing, like difficulty in manipulating fractures of proximal and distal 1/3rd tibia

Comminuted metaphyseal fractures. These shortcomings of conventional intramedullary interlocking nail in managing proximal and distal third fractures have been overcome by the introduction of Expert Tibial Interlocking Nail due to modifications in operative techniques, its design and advancement in locking screws [8].

Intramedullary nailing system-Expert Tibial Nail System (ETNS) is used for fractures in the tibial shaft as well as for metaphyseal and certain intra-articular fractures of the tibial head and the pilon tibiae. In addition to the standard static and dynamic locking options, the ETNS provides multi directional locking options in the proximal and distal part of the nail. End cap block the most proximal screw creating an angular stable construct. ETNS has an option for compression at the fracture site (up to 7 mm) by inserting one distal locking screw and one proximal dynamic locking screw with a compression screw. The present study is being taken to review the results of

metaphyseal and diaphyseal fractures of tibia treated with Expert Tibial Interlocking Nail.

## Material and Methods

**Study design:** Prospective observational study.

**Ethics approval:** The study was approved by IEC.

**Study location:** Department of Orthopedics, Shri B M Patil Medical College, Vijayapura, Karnataka, India.

**Study period:** October 2016- March 2018.

**Sampling size:** Consecutive sampling method was used. The study involved 30 confirmed cases of metaphyseal and diaphyseal fractures of tibia.

**Study population:** In the study confirmed cases of metaphyseal and diaphyseal fractures of tibia of either sex were treated with intramedullary fixation "Expert Tibial Interlocking Nail".

## Following inclusion and exclusion criteria were used.

**Inclusion criteria:** Patient who has been diagnosed as having metaphyseal and diaphyseal fractures of tibia and treated with Expert Tibial Interlocking Nail. Patient aged 18 years and above, Closed & Compound fractures Type 1 and Type 2 according to Gustilo Anderson classification, Diaphyseal fractures of tibia, Extra-articular metaphyseal fractures of proximal and distal tibia (simple, wedge, or complex), Segmental and comminuted diaphyseal fractures of tibia.

**Exclusion criteria:** Patients below the age of 18 years, Compound fractures of Tibia type 3 according to Gustilo Anderson classification, Comminuted intra-articular fractures, Polytrauma, Associated with neurovascular injuries, Contralateral tibia fractures, Patient medically unfit for surgery, Pathological fractures, Patients treated conservatively.

## Methodology

Patients admitted with metaphyseal and diaphyseal fractures of tibia were examined and investigated with X-ray leg AP and Lateral view. All fractures were treated using Expert Tibial Interlocking Nail. Follow up was done at 6 weeks, 3 months and 6 months. Functional outcome was assessed based on Johner and Wruh's criteria.

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

## Results

The study involved 30 confirmed cases of metaphyseal and diaphyseal fractures of tibia of either sex. There were 25 males and 5 females in the study. All cases were treated with

intramedullary fixation with "Expert Tibial Interlocking Nail". Most of patients were in the age group ranging from 20-30 years with a mean age group of 40.1 years.

The mode of injury for 24 patients were road traffic accidents

which accounted for about 80 %, 5 were due to fall which accounted for 16.67 %, 1 was due to assault which accounted for 3.33.

In our study 10 patients had oblique fractures, 9 had spiral fractures, 6 had transverse fractures and 5 sustained communitated fractures.

**Table 1:** Incidence of closed and open fractures

	Closed	Open	
		Type I	Type II
No. of Cases	18	8	4
Percentage	60%	26.67%	13.33%

**Patient Mobilization:** Joint mobilization exercises were started for all the patients on 1 post-operative day. Irrespective of fracture configuration partial weight bearing was delayed for

6 weeks. The average period of commencement partial weight bearing was 7 weeks and full weight bearing was 13.43 weeks.

**Table 2:** Commencement of partial weight bearing

Partial weight bearing (PWB)	Number of patients	Percentage
6 weeks	19	63.33%
8weeks	9	30%
>10 weeks	2	6.67%
Total	30	100.00%

**Table 3:** Commencement of full weight bearing

Full weight bearing (FWB)	Number of patients	Percentage
10-12 weeks	17	56.67%
13-16weeks	10	33.33%
17-24 weeks	3	10%
Total	30	100%

**Union:** 20.33 weeks was the average time taken for union, closed fracture and Type I open united earlier at (18.66 weeks and 21.75 weeks respectively) when compared to Type II

fracture took 25 weeks 100% of the fractures united with 3 fractures showing a delayed union.

**Table 4:** Complications

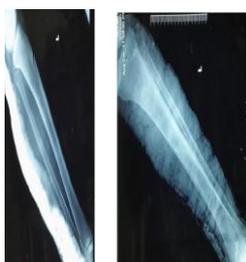
Complications	Number Of Cases	Percentage
Malunion	1	3.33%
Superficial Infection	4	13.33%
Deep infection	0	0%
Knee pain	10	30%
Implant Failure	0	0%
Shortening	2	6.67%
Delayed Union	3	10%
Ankle pain	2	6.67%

**Functional Results:** Functional results were graded according to the criteria by Johner and Wruh’s Criteria <sup>[9]</sup>. 43.33 % of patients achieved excellent results, 33.33 % of patients

achieved good results, 16.67 % fair results were seen and in two patients, the functional results were poor (6.67%).

**Table 5**

Functional Outcome	No. of Patients	Percentage
Excellent	13	43.33%
Good	10	33.33%
Fair	5	16.67%
Poor	2	6.67%
Loss Of Follow Up	0	0%
Total	30	100%



Pre-Operative



Month Postoperative Radiographs



6 month radiograph showing radiological union

### Delayed union



Pre-operative



20 weeks follow up

### Malunion



### Discussion

Fractures of tibia continue to pose vexing problems to the Orthopaedic surgeons; chief among them is selecting the optimal method of treatment. Intramedullary nailing offers an attractive treatment option, however there are some problems in treatment of fracture tibia with conventional intramedullary interlocking nailing like difficulty in manipulating fractures of proximal and distal 1/3rd tibia communitated metaphyseal fractures.

Expert tibial nail design allows better control in metaphyseal tibial segments through multiple interlocking holes in close proximity to either end of the nail. Multidirectional interlocking screws ensure that alignment is well maintained and stability preserved despite a short proximal or distal fragments.

In this study a total of 30 patients with tibial metaphyseal/diaphyseal fractures were treated with Expert tibial intramedullary interlocking nailing in BLDE (Deemed to be University)'S Shri B.M. Patil's Medical College, Hospital and Research Centre, Vijayapura from October 2016- March 2018. At least for a period of 6 months, patients were followed up. All the patients were obtainable for follow up.

The mean age of the patients in the present study was 40.1 years, majority of the patients were males accounting for 25 (83.33%) cases comparable with series by Lakshpat *et al.* [10] was 42.8 years while in series of Duwelius *et al.* [11] mean age was 40.5 years.

In the present study the leading cause of the injuries were road traffic accident accounting for 80% of cases correlates with the study conducted by Barbieri *et al.* [12] in which they observed 75% due to high energy trauma.

Irrespective of the fracture configuration partial weight bearing was delayed till 6 weeks. Full weight bearing was allowed based on clinical and radiological assessment of fracture healing. The average period of commencement of full weight

bearing was 13.33 weeks in the present study.

The mean interval of the radiological union in the present study was 21.8 weeks. Closed fractures and type 1 fractures united earlier (average time 18.66 weeks and 21.75 weeks respectively) compared to type 2 open fractures (average of 25 weeks). Average time taken for clinical union was 13.4 weeks while average duration of radiological union was 16.8 weeks in a study conducted by Lakshpat *et al.* [10] on 20 patients.

Complications resulting from expert tibial nailing in our study were malunion in one patient (3.33%), superficial wound infection in four cases (13.33%), anterior knee pain in ten patients (30%), shortening in two patients (6.67%), delayed union in 3 patients (10%) and two patients had ankle pain (6.67%). None of the patients had deep infection, wound dehiscence deep vein thrombosis, compartment syndrome or non-union. Comparable with a study conducted by Mohammed and Ramaswamy Saravanan [13], Akshay Phadke *et al.* [14] Lakshpat Yadav *et al.* [10].

Functional results were graded according to the criteria by Johner and Wruh's Criteria<sup>9</sup>. 43.33 % of patients achieved excellent results, 33.33 % of patients achieved good results, 16.67 % fair results were achieved and in two patient, the functional results were poor (6.67%) comparable with study done by Nandakumar Bhairi *et al.* [15].

### Conclusion

Our results with expert tibial interlocking nailing are encouraging and demonstrate the benefits of new nailing system. Changes in the design of the nail for improved proximal and distal locking enables it to use in metaphyseal/diaphyseal fractures of tibia. A better stabilization of small fragments has been achieved by the availability of locking option in three planes, thus providing a higher stability of the bone implant construct. Complications were comparable to other studies. Good functional results and union rates were achieved.

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