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The functional outcome following the use of expert tibial nails for proximal 1/3rd and distal 1/3rd tibial metaphyseal fractures in adults

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Abstract

There is no universally accepted method of management of proximal and distal tibial fractures till date. Various modalities of treatment of fracture shaft of tibia are conservative gentle manipulation and use of short leg or long leg cast, open reduction and internal fixation with plates and screws, external fixation and intramedullary fixation with flexible nails (ender pins) and interlocking intramedullary nails with or without reaming. In total number of 25 patients admitted, there were 17 males (68%) and 8 females (32%). There were 20 closed fractures (80%) and 5 open fracture (20%) (GA type I-3, GA type II-2). Functional results were graded according to the criteria by Klemm and Borner (1986). 92% of patients achieved good or excellent results, fair results were obtained in one patient and in one patient, the functional results were poor.

Keywords: functional outcome, expert tibial nails, proximal 1/3rd and distal 1/3rd tibial metaphyseal

Introduction

Tibia is the most commonly fractured long bone and the exposed anatomical location makes it vulnerable to direct blow and high energy trauma as a result of motor vehicle accident. Tibia has precarious blood supply due to inadequate muscular envelope. Tibial fractures may be associated with compartment syndrome, vascular or neural injury. The presence of hinge joints at the knee and the ankle, allows no adjustment for rotatory deformity after fracture. Because of high incidence of complications, management often is difficult [1].

In spite of all the advances, proximal and distal fractures of tibia still pose a challenge to the orthopaedic surgeons due to the following reasons. As tibia is a subcutaneous bone, the fracture is often open. In these fractures, there is the tendency of displacement of fracture fragments after swelling subsides. Increased incidence of delayed and non-union due to poor blood supply and less soft tissue coverage at the distal third. If the rotational alignment of the fragment is imperfect, there may be cosmetic and functional disability. Being a subcutaneous bone, the rate of post operative infection is higher than in most other fractures. The conventional nails don't provide good stabilization of the short proximal and distal fracture fragments.

There is no universally accepted method of management of proximal and distal tibial fractures till date. Various modalities of treatment of fracture shaft of tibia are conservative gentle manipulation and use of short leg or long leg cast, open reduction and internal fixation with plates and screws, external fixation and intramedullary fixation with flexible nails (ender pins) and interlocking intramedullary nails with or without reaming [2].

There are many controversial issues in the management of fractures of tibia with closed intramedullary nailing. The question of reaming, its role in proximal third fractures and open fractures, is still being debated. Its role in distal third fractures is fairly established and associated fibular fracture is fixed to avoid angulation.

Expert Tibial Nail is a newer implant that overcomes the problems encountered by the conventional nails. Several technical modifications compared to standard tibial nails are incorporated in the design of Expert tibial nail.

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The numerous multiplanar locking options at the proximal and distal end allow for secure stabilization of metaphyseal fragments. Certain intraarticular tibial fractures can be addressed by intramedullary nailing in combination with other implants [3].

It enables the surgeon to further extend the spectrum of fractures eligible for intramedullary nailing. Multidirectional interlocking screws ensure that alignment can be well maintained and stability preserved in short proximal or distal tibial segments. The end cap achieves angular stability between the proximal oblique screw and the nail. These changes in implant design enhance the stability of the bone - nail construct and reduce the risk for secondary malalignment. This new system has been regarded as technically mature. It offers numerous locking options and has proven to worth in complex fracture situations. This is a prospective study to evaluate the results of Expert tibial interlocking nailing in both proximal 1/3rd and distal 1/3rd fractures of tibia and to study the complications of Expert tibial interlocking nailing in the same [4, 5].

Methodology

Twenty five patients with proximal 1/3rd and distal 1/3rd tibia fractures were selected for the study.

In total number of 25 patients admitted, there were 17 males (68%) and 8 females (32%). There were 20 closed fractures (80%) and 5 open fracture (20%) (GA type I-3, GA type II-2). The age of the patients ranged from 20 years to 70 years with a mean of 42.84 years. Most of the fracture were caused by high energy trauma by road traffic accidents accounting for 19 cases (76%), 6 cases were due to fall (24%). 6 (24%) patients had associate injuries.

There were 10 (40%) proximal third fracture, and 15 (60%) distal third fractures.

The predominant fracture patterns were oblique 12 (48%), transverse 8 (32%), spiral 5 (20%)

Preoperative preparation of patients

- Patients were kept NBM for 8-10 hours before surgery
- IV fluids as per the need were given
- Adequate amount of compatible blood if needed was arranged
- Preparation of whole extremity, private parts and back was done
- Written and informed consent was taken
- Soap water enema HS
- Tranquilizers HS
- IV antibiotics half an hour before surgery
- Shifting of the patients 30minutes before surgery to operation theatre

Preoperatively the length of the nail is calculated by subtracting 3 to 4cm from measurement taken from the knee joint line to tip of the medial malleolus clinically and medullary canal is measured at the isthmus on X-rays. Accordingly a stock of interlocking nails 2cm above and below the measured length and 1mm above and below the required diameter were always kept. We have used cannulated stainless steel Expert tibial nails in our cases.

Surgical technique

Patients were operated under spinal / general anaesthesia. Patient is placed in supine position over a radiolucent operating table. The injured leg is positioned freely, with knee flexed 90° over the edge of operating table to relax the gastro

soleus muscle and allow traction by gravity. The uninjured leg is placed in abduction, flexion and external rotation to ensure free movements of the image intensifier from AP to lateral plane. The table is adjusted to a comfortable operating height. AO pneumatic tourniquet / Esmarch rubber tourniquet was used in all patients. The affected limb is thoroughly scrubbed from mid thigh to foot with Betadine scrub and savlon. Then limb is painted with betadine solution from mid thigh to foot. Rest of the body and other limb is properly draped with sterile drapes. Sterile gloves are applied to the foot and steri-drape over the leg from knee joint to ankle.

Results

The average age of the patients was 42.84 years with majority of the patients under 35 years. There were 16 male patients and 9 female patients. Road traffic accidents were the main mode of injury accounting for 76% of cases.

Twenty cases were closed fractures and 3 cases were of the Gustilo and Anderson Type I and 2 were of Type II. In the present study, 10 fractures occurred on the right side and 15 fractures occurred on the left side and proximal 3rd was 36% and distal 3rd of the tibia was involved in 64% of cases.

Twelve fractures showed a transverse pattern, 5 were oblique, 3 were comminuted, 3 were spiral and 2 were segmented. Most (84%) of the cases were associated with ipsilateral fibula fractures. Transtendinous approach was used in all the 25 cases and reaming was performed in all the cases. The average diameter of the nails used was 9mm. 7 nails were dynamically locked. Dynamization was done in 8 cases. Skin grafting was done in 3 cases and delayed primary suturing was done in one cases. All the fracture united in the present study with a union rate of 96% closed fractures united earlier (Average time 18 weeks) compared to type I and Type II fractures with united at an average of 18.86 weeks and 20.5 weeks respectively.

Table 1: Incidence of tibial fractures according to age distribution

Age group	No. of cases	Percentage
20-30	5	20
30-40	5	20
41-50	8	32
51-60	6	24
61-70	1	4

Table 2: Incidence according to sex

Age group	No. of cases	Percentage
Male	16	64
Female	9	36

Table 3: Incidence according to side of fracture

Side of Fracture	No of Cases	Percentage
Right side	10	40
Left side	15	60

Left tibia was fractured more commonly than Right side

Table 4: Mode of injury

Mode of injury	No of Cases	Percentage
RTA	19	76
Fall	6	24

Table 5: According to level of fracture

Level of fractures	Proximal 3 rd	Distal 3 rd
No of cases	9	16
Percentage	36	64

Most of the tibial fractures were seen in distal 3rd of tibia Fifteen cases were operated under spinal anaesthesia, 9 under epidural anaesthesia and 1 case under general anaesthesia.

Table 6: Type of anaesthesia

Type of Anaesthesia	No. of Cases	Percentage
Spinal	15	60
Epidural	9	36
General	1	4

All the 25 nails were inserted through a patellar tendon splitting approach.

Majority of the nails inserted were 9mm, 4 nails were of 10mm diameter and 2 were of 8mm diameter. 18 fractures were locked in static mode and 7 fractures were locked dynamically.

Table 7: Nail size

Nail size	No. of Cases	Percentage
8mm	2	8
9mm	19	76
10mm	4	16

Table 8: Mode of locking

Mode of Locking	No. of Cases	Percentage
Static	18	72
Dynamic	7	28

All the cases were started with joint mobilization exercises on 1st post operative day. Partial weight bearing was delayed till 6 weeks irrespective of fracture configuration. The average period of commencement of full weight bearing was 12.8

weeks.

Table 9: Patient Mobilization

FWB	No. of Cases	Percentage
12 weeks	14	56
14 weeks	7	28
> 14 weeks	4	16

Table 10: Fracture Union

Type of Fracture	Average Time	Union Rate
Closed	18 weeks	100
Type I	18.86 weeks	100
Type II	20.5 weeks	90.9
Total	19.12 weeks	96

Skin grafting was done to cover the traumatic wound in 3 type II fractures whereas delayed primary closure was done in 1 cases.

Dynamization was done in 8 cases between 12 and 16 weeks depending on the progress of fracture healing.

Table 11: Secondary procedure

Procedure	No. of Cases	Percentage
Skin grafting	3	12
Delayed primary suturing	1	4
Dynamization	8	32

Functional results were graded according to the criteria by Klemm and Borner (1986). 92% of patients achieved good or excellent results, fair results were obtained in one patient and in one patient, the functional results were poor.

Table 12: Functional Results

Functional Results	No. of Cases	Percentage
Excellent		
Full knee and ankle motion No muscle atrophy Normal radiological alignment	18	72
Good		
Slight loss of knee and ankle motion (< 21°) Less than 2cm of muscle atrophy Angular deformity	5	20
Fair		
Moderate loss of knee and ankle motion (25°) Morethan 2cm of muscle atrophy Angular deformity (5° – 10°)	1	4
Poor		
Motion loss and knee and ankle motion (>25°) Marked muscle atrophy Angular deformity (> 10°)	1	4

Discussion

The mean age of the patients in the present study was 42.84 years, majority of the patients were males accounting for 17 (68%) cases. The average age of the patients was 42 years in a study of epidemiology of proximal metaphyseal by Nork *et al* [6]. The average age in a study of 52 distal metaphyseal fractures conducted by Mosheiff *et al.* [7] was 37 years. The world wide incidence of tibial fractures in males in 41 per 100,000 per year. The increased incidence of open tibial fractures in young males corresponds with their activity level whereas the incidence again increases in elderly individuals due to osteoporosis [8].

The leading cause of the injuries was road traffic accident in the present study accounting for 76% of cases. The commonest cause of proximal metaphyseal fractures was road traffic accidents (34.61%) in Mosheiff *et al.* study, whereas Vidyadhar *et al.* [9] reported that 95.5% of their cases were due to road traffic accidents. This indicates that the incidence of fractures can be brought down by road safety measures.

The average duration of time interval between injury and intramedullary nailing 3.47 days in present study. Numerous

studies have stressed on early debridement and stabilization of open fractures of tibia. Some recent reports have questioned this belief. Shanker *et al.* [10] that their experience indicates the incidence of complications correlates more with the severity of the injury then with time from injury to treatment. Delay of 6 to 18 hours did not reflect a proportional increase in incidence of complications. Henley *et al.* [11] opined that the risk of developing an adverse outcome was not increased by aggressive debridement/lavage and definitive fixation upto thirteen hours from the time of injury when early prophylactic antibiotic administration and open fracture first aid were instituted. In the present study, all the cases with open fractures were administered antibiotics on admission and irrigation and thorough debridement were carried out within 12 hours of admission.

Anterior knee pain is the most common complication after intramedullary nailing of the tibia. Dissection of the patellar tendon and its sheath during nailing is thought to be a contributing cause of anterior knee pain. Toivanen *et al.* [12] concluded that a paratendinous approach for nail insertion does not reduce the prevalence of chronic anterior knee pain

or functional impairment. We used a patellar tendon splitting approach in all the 25 patients, knee pain was found in 7 patients (28%) with kneeling activities.

The cause of anterior knee pain may be a prominent nail, heterotrophic ossification of patellar tendon, injury to menisci or ligaments or due to degenerative changes in the joint. If the knee pain is severe, nail removal will lead to improvement of the symptoms.

Average diameter of the nails used in the present study was 9mm. majority of the nails were of 9mm diameter (76%). Reaming allows insertion of larger diameter, stronger nails with larger bolts which produce tight bone implant contact that provide load sharing and resistance to bending or angulation at the fracture site. Unreamed small diameter nails, despite interlocking may not provide adequate stability, especially in proximal and distal third fractures and after dynamization.

The reamed nails can be dynamically locked in stable fracture configurations such as transverse fractures without comminution, allowing early weight bearing without the fear of screw breakage, 8 (32%) nails were dynamically locked in the present study.

Patients were encouraged to move knee and ankle joints on the 1st post operative day after the patient has recovered from anesthesia. Partial weight bearing was delayed till 6 weeks irrespective of the fracture configuration. Full weight bearing was allowed based on clinical and radiological assessment of fracture healing. The average period of commencement of full weight bearing was 12 weeks in the present study.

Fourteen patients (56%) in the present study were allowed to full weight bearing by 12 weeks, 7 patients (28%) were allowed to full weight bearing by 14 weeks and in 4 patients (16%) the full weight bearing was allowed after 14 weeks.

Larsen *et al.*^[13] allowed partial weight bearing of 15kgs for 6 weeks in early post operative period. There were no cases of compartment syndrome, fat embolism or peroneal nerve palsy in the present study.

McQueen *et al.*^[14] reported that there is no evidence of an increased incidence of compartment syndrome with reamed intramedullary nailing. He opined that the increase in compartment pressure associated with nailing is produced by reduction of the fracture and stretching of the adjacent muscles.

Crutch walking without weight bearing was started at the 3rd post operative day when the patient was free of pain and had obtained adequate control of the limb. But the gradual partial weight bearing was started only once the degree of radiological union was strong enough to withstand the weight of the body without causing loss of fracture reduction or undue pressure on the nail. Weight bearing was gradually increased as per the progress of radiological healing process and clinical assessment. Full weight bearing either coincided with the complete radiological union or preceded the radiological union by few weeks.

In the study by Mosheiff R *et al.* full weight bearing was started at 6 weeks for the extra articular fractures with no comminution and in case of fractures which involved articular surface; it was extended by 6 more weeks. In the study by Dogra AS *et al.*, full weight bearing was started at a mean of 5.5 months (1-14) months.

The mean interval of the radiological union in the present study was 19.12 weeks. Closed fractures united earlier (average time 18weeks) compared to type I and open fractures (average of 18.86 weeks and 20.5 weeks respectively). The one case was associated a superficial infection at the distal

screw site and took 26 weeks to show union. One case of type I open fracture involving proximal third of tibia went for implant failure and eventually implant was removed.

traumatic wound in 3 type II fractures where as delayed primary closure was done in 1 cases. All the procedures requiring soft tissue coverage were done after nailing.

Dynamization allows the fracture site to be compressed during early weight bearing and enhance fracture healing.

Dynamization was done in 8 cases by removing either the proximal or distal bolts between 12 and 16 weeks depending on the progress of fracture healing.

Conclusion

- Intramedullary nailing is a safe and effective technique for the treatment of tibial metaphyseal fractures.
- It avoids the additional soft-tissue dissection associated with traditional open procedures as well as the complications associated with external fixators.
- Newer nail designs like that of Expert tibial nail allow proximal and distal segment to be controlled through placement of multiple distal interlocking screws within a small distance.
- The proximal and distal segment of these fractures is more difficult to control with intramedullary implants because of the metaphyseal flare.

References

1. Henley MB, Meier M, Tencer AF. Influences of some design parameters on the biomechanics of the unreamed tibial intramedullary nail. *J Orthop. Trauma.* 1993; 7:311-19.
2. Lang GJ, Cohen BE, Bosse MJ *et al.* Proximal third tibial shaft fractures. Should they be nailed? *Clin. Orthop. Relat. Res.* 1995; 315:64-74.
3. Robinson CM, McLauchlan GJ, McLean IP *et al.* Distal metaphyseal fractures of the tibia with minimal involvement of the ankle. Classification and treatment by locked intramedullary nailing. *J Bone Jt Surg.* 1995; 77-B:781-87.
4. Tornetta P, Collins E. Semiextended position of intramedullary nailing of the proximal tibia, *Clin. Orthop. Relat. Res.* 1996; 328:185-89.
5. Konrath G, Moed BR, Watson JT *et al.* Intramedullary nailing of unstable diaphyseal fractures of the tibia with distal intraarticular involvement. *J Orthop. Trauma.* 1997; 11:200-05.
6. Blachut PA, Keating JF, Ricard S, O'Brien PJ, Meek RN, Broekhuysen HM. Reamed versus unreamed locked intramedullary nailing of open tibial shaft fractures: A prospective randomized study. *J Bone Joint Surg.* 2000; 82B:149.
7. Ilizarov GA. Clinical application of the tension stress-stress effect for limb lengthening. *Clin Orthop.* 1990; 250:8-26.
8. Singh VK, Singh Y, Singh PK *et al.* Unreamed intramedullary nailing with oblique proximal and biplanar distal interlocking screws for proximal third tibial fractures, *Journal of Orthopaedic Surgery.* 2009; 17(1):23-7.
9. Schemitsch EH, Kowalski M, Swinkowski MF, Harrington RM. Comparison of the effect of reamed and unreamed locked intramedullary nailing on blood flow in the callus and strength of union following fracture of the sheep tibia. *J Orthop Res.* 1995; 13:382-89.
10. Keating JF, O'Brien PI, Blachut PA, Meek RN,

- Broekhuysen HM. Reamed interlocking intramedullary nailing of open fractures of tibia. *Clin Orthop*. 1997; 338:182-91.
11. Holbrook JL, Swiontkowski MF, Sanders R. Treatment of open fractures of the tibial shaft: Ender nailing versus external fixation: A randomized, prospective comparison. *J Bone Joint Surg*. 1989; 71A:1231-8.
 12. Nork SE, Schwartz AK, Agel J *et al*. Intramedullary nailing of distal metaphyseal tibial fractures. *J Bone Jt Surg*. 2005; 87-A:1213-21.
 13. Brown PW, Urban JG. Early weight bearing treatment of open fractures of the tibia: An end result of 65 cases. *J Bone and Joint Surg (Am)*. 1969; 51:59-75.
 14. Thakur AJ. Intramedullary nailing. In: *The elements of fracture fixations*. 1st Edn. New York: Churchill Livingstone, 1997, 81.
 15. Charles M, Brown C. Fractures of the tibia and fibula. In: *Rockwood and Green's Fractures in Adults*. Bucholz R, Heckman W, (Eds). 5th edition. Philadelphia: Lippincott-Raven Publishers. 1996; 1:1941-92.