International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(2): 550-554

www.orthopaper.com
Received: 18-02-2020
Accepted: 20-03-2020

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Outcome of expert tibia nail in proximal and segmental tibia fractures-a prospective study

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DOI: https://doi.org/10.22271/ortho.2020.v6.i2i.2096

Abstract
Intramedullary nailing in proximal tibia fractures is a challenging surgical technique with malalignment reported as high as 84%. The pull from the extensor mechanism, the hamstrings, wide medullary spacemakes nailing difficult in these fractures.
Our prospective study includes 20 cases of proximal and segmental tibia fractures treated by expert tibia nailing and followed for a period of one year. The analysis was done using klemm and borner criteria and oxford knee scoring system. Excellent resul; Its were obtained in twelve patients good in four and fair n three patients. One patient lost follow up. Intramedullary nailing leads to excellent outcomes when performed for appropriate indications and with adjuvant techniques in proximal and segmental tibial fractures.

Keywords: Proximal tibia, inramedullary nailing, segmental tibial fractues

Introduction
Tibial fractures are the most common long bone fractures. The benefits of intramedullary nailing include load sharing, sparing of extra-osseous blood supply and avoidance of soft tissue dissection thereby minimizing postoperative complications. Proximal tibia fractures constitute a heterogenous group of bony injuries accounting for 5-11%ofalltibial shaftfractures and often results from high velocity trauma. Management mainly depends upon the fracture pattern and the condition of soft tissues. Though conservative management attempted in simple un displaced fractures operative treatment is the rule to avoid knee stiffness, to allow early mobilization and weight bearing.
Surgical options varies from external hybrid fixation, MIPO with new locking plates to intramedullary nailing. Expert tibia nail enables the surgeon to further extend the spectrum of fractures eligible for intramedullary nailing. Though intramedullary nailing is associated with unsuccessful reduction and malalignment certain modifications in surgical technique is proposed such as use of blocking screws, femoral distracters, buttress plate, different patient positioning and extended parapatellar and retro patellar approaches.

Materials and methods
Our prospective study includes 20 cases of proximal and segmental tibia fractures treated by expert tibia nailing and we have analysed the functional outcome of the patients based on range of movements, pain, and bony union.
The study includes 20 patients with tibial fractures admitted and examined according to protocol in Tirunelveli medical college from June 2016 to September 2018. Associated injuries are noted clinical and radiological investigations carried out to get fitness for surgery. Patients underwent expert tibia nailing fixation for the fracture sustained. The patients were followed up to fracture union until one year thereafter

Inclusion criteria
1. Age above 18 years
2. Proximal and segmental tibia fractures (involving the proximal 3rd of tibia)
3. Closed fractures and compound fractures Gustilo Anderson type 1 and type 2

Exclusion criteria

1. Age less than 18 years
2. Patients with co-morbid medical condition
3. Gustilo & Anderson type 3 Compound Tibial fractures
4. Intraarticular exytension of fractures
5. Cases of more than 30 days duration

Preoperative planning

Proper preoperative planning should be performed, including standard history taking, examination of the patient to find out other associated injuries including neurovascular assessments, complete radiological examination with antero posterior and lateral views of one joint above and one joint below.

Investigations

Radiographic evaluation includes
Anterior-Posterior view & Lateral view
CT knee- CT not taken in all cases. CT taken in cases with doubtful intraarticular extension of fractures.

Surgical technique

The patient is positioned supine on a radiolucent table. The ability to flex the knee by atleast 90degree is required. A closed reduction is performed under image intensifier guidance which can be temporarily fixed with reduction clamps. The required nail length is determined using the radiographic ruler. The possibility of axial shortening due to primary compression or secondary dynamisation must be considered when determining the nail length.

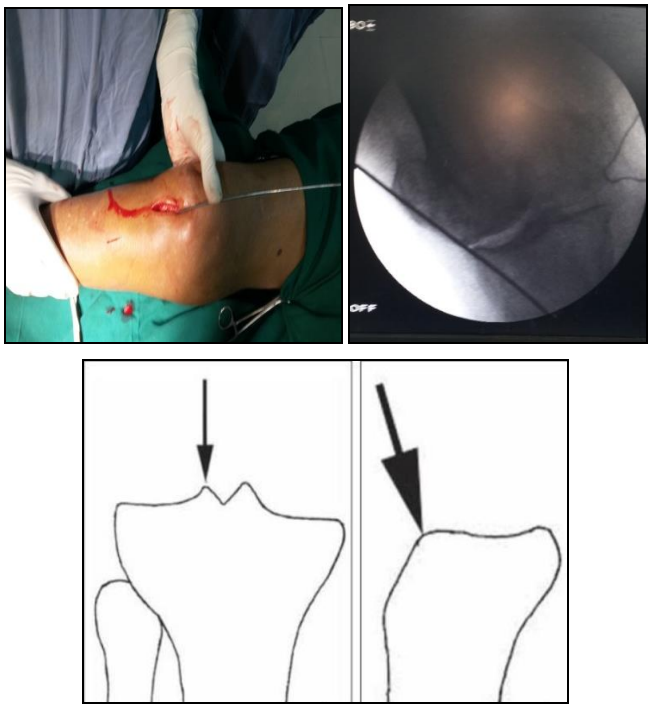

Fig 1: Entry point should be at the medial aspect of laeral tibial spine in AP view and at the ventral edge of tibial plateau in lateral view

Depending on the anatomy of the patient and surgical preference, the incision can be trans patellar, medial patellar or even lateral parapatellar and extends from the inferior third of patella to the tibial tuberosity. In our study we use only midline patellar tendon splitting approach. Entry point is crucial in AP view the entry point is in line with the axis of the medullary canal and with the medial aspect of the lateral tubercle of the intercondylar eminence. In the lateral view the entry point is at the ventral edge of the tibial plateau.

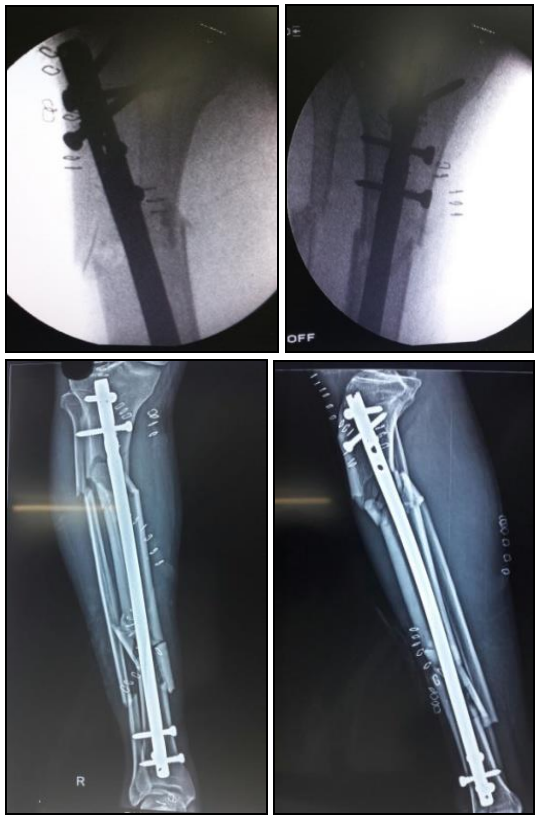

Fig 2: Fluoroscopy images and post-op images

Insert the guide wire for approximately 8-10cm. it should be in line with the centre of the medullary canal. The expert tibia nail is introduced with the knee in at least 90 degree flexion using insertion handle and slight rotational movements. The passage of the nail through the fracture site should be closely monitored and the final position confirmed using the image intensifier. Confirm proximal and distal nail position in Anteroposterior and lateral views. Consideration must be given for primary compression or secondary dynamisation. Distal locking with 2 mediolateral screws are sufficient. In segmental fracture with very distal lower segment three or four screws distally are recommended. For proximal locking it is recommended to semi-extend the leg in order to relax the muscles acting as a dislocating factor on the proximal segment. Ideally four screws are required. First screw to be applied is the anteroposterior oblique screw which decreases the incidence of apex anterior angulation. The medio-lateral screws can be applied if there is space which is usually not present in proximal third fractures. The other two oblique locking is done following this using jig. Drilling and introduction of the screw in the oblique holes are preferably monocortical to avoid injury to popliteal vessels, the tibial and common peroneal nerves and injuries to the proximal tibiofibular joint.

We used one or more of the following techniques to reduce the malalignment following nailing of proximal tibial fractures.

1. An ideal entry point in the ventral edge of tibial plateau and in line with the lateral tubercle of the intercondylar eminence.
2. Using femoral distracters/clamps /inter fragmentary screws for reducing the fracture also helps in counteracting the deforming forces.
3. Use of poller screws adjacent to the nail reduces the chance of nail translation and decreases varus valgus instability.

4. Position: semi-extended
5. Implant Design: herzog bend and multiplane locking
6. Augmentation with plate- temporary or permanent

Fig 3: Augmentation with plate to prevent valgus in intraarticular segmented fractures

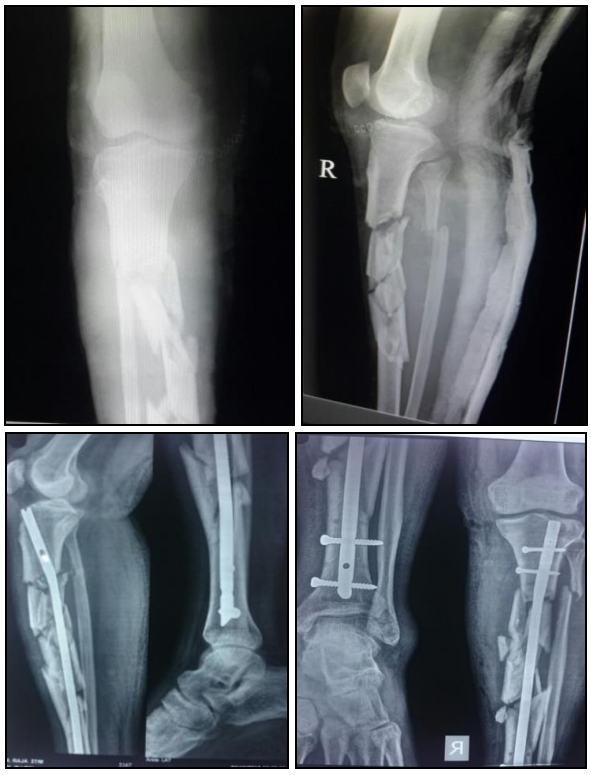

Fig 4: Proper entry point appropriate implant and augmentation techniques can maintain alignment, rotation and length evenin severely comminuted proximal tibial fractures but required grafting for union.

Post-operative protocol

After surgery the limb was kept in elevated position. The timing of knee rehabilitation was based on Fracture pattern Bone quality Stability of fixation and Patient compliance.

Isometric quadriceps exercises are started at the second post-operative day. Ankle pump exercises to avoid DVT and to promote limb circulation. Knee bending started and gradually increased in range as the patient tolerates pain. Both active and passive knee bending and straight leg raising exercises are done. For 48 hrs. – ankle pump exercises and static quadriceps strengthening exercises. Dressing opened and wound condition checked. Drain were not kept as most cases were done as closed technique. Non weight bearing walking starts once the pain is tolerated. Suture removal done on 12th post op day and patients were discharged. At the time of discharge full range of movements were achieved.

Follow UP

Regular checkup was done to assess infection, clinical and radiological union and rehabilitation purposes. First visit at 6 weeks after surgery. Partial weight bearing was started at 6 weeks for all cases & full weightbearing was started at an average of 10-12 weeks after radiological signs of union appear. All the patients were followed up carefully watching for any complication every fortnightly till fracture healing. After that every monthly up to 6 months. After that every 3 months. The analysis was done using klemm and borner criteria and oxford knee scoring system

Results

The Age group varied from 20 to 70 years with mean age of 45 years. Incidence of fracture was observed maximum between 40 to 60 years of age. Usually the time interval between injury and surgery was 2 to 5 days. Our study involves 17 Males and 3 females. Males are more affected in our study compare to females.

17 patients had proximal tibial fractures and 3 had segmental fractures. Eighteen patients had h/o RTA and 2 had self-fall. Average time for partial weight bearing is six to eight weeks and full weight bearing is twelve to fourteen weeks depending upon radiological union. Average time taken for radiological union is fourteen weeks.

Two patients had delayed union for which dynamization and grafting done. One among three of the segmented fractures with delayed union lost follow-up and was removed from our study. The analysis was done using klemm and borner criteria and oxford knee scoring system. And the results were graded as

Table 1:

Grading	No of cases	percentage
Excellent	12	60%
Good	4	20%
Fair	3	20%
Poor	0	0%

In our study the average operation time was 60 min and perioperative blood loss was 150 ml. 3 patients had associated injuries like humerus, both bone forearm, and distal radius fractures which was stabilized simultaneously. All cases achieved union at the end of study with good functional outcome. Even though certain complications like stiffness, infection were present they were managed and good results were achieved**.**

Complications

Wound infection: In our study patient had wound infection. The infection was treated according to pus culture sensitivity

report with intravenous antibiotics for 3 weeks followed by 3 weeks of oral antibiotics. Since metaphysical region is richly vascular the infection subsided with daily dressing and appropriate antibiotics.

Shortening

In our study 1 patient had 1cm shortening due to impaction of the fragments and severe comminution. They were treated with foot wear modification and they did well with it.

Knee stiffness

In our study 1 patients had stiffness of knee joint because of poor co-operation with knee mobilization exercise and infection and was treated with mobilization under anesthesia and got good functional range of movement. These patients were given good physiotherapy follow up.

Malunion: Two cases went for malunion. Proximal tibia fractures are notorious for malunion when treated with intramedullary nailing which was reduced in our study. This was managed conservatively as the patient had good functional range of movements and had no clinical manifestations and complaints. Malunions were prevented by additional use of plates and poller screws.

Fig 5: Valgus malalignment

Discussion

Among tibial fractures proximal tibia fractures derive particular attention even though they are extraarticular. There are different modalities of treatment available. Open reduction and plate and screw fixation need a long incision to expose the whole fracture region along with removal of periosteum and soft tissue which may result in increase chance of fracture nonunion, infection, skin flap necrosis, plate breakage etc. external fixators are ideal for open tibial fractures with severe soft tissue injury.

Challenges of nailing in proximal and distal tibia includes wide medullary space, small unstable fragment, and intra-articular extension is common. Malalignment typically appears as apex anterior and valgus angulation accompanied by posterior displacement of the distal fragment. As the expert tibia nail can achieve angulation to stabilize the interlocking system, it can increase the transverse and axial stability of broken ends of fracture, thus being a good choice for proximal and segmental tibial fractures.

The expert tibia nail has a Herzog bend which is more distal compared to conventional tibia nail and the angle is 6 degree in the nail used in our study which is less compared to 11 degree in conventional tibia nails that we use. These changes prevent excessive anterior angulation of the proximal fragment which is usually seen in intramedullary nailing of proximal tibial fractures. The 3 oblique proximal locking options which are not seen in conventional tibia interlocking nails helps to achieve more stability in the proximal fragment which are placed above the medial lateral screw holes.

Malalignment in our study was 15%is also comparable with late studies of Lindvall *et al.* (2009) J Orthop Trauma, Heisterman *et al.* (2011) J AAOS, Attal *et al.* (2012) Arch Orthop Trauma which varies between15.5% to 40.9%. But this does not affect the functional outcome of the patients.

Table 2: Results in our study are comparable with other similar studies

Study	No of cases	Excellent	Good	Fair
Ding-shuan, lei lu, Feng gao	33	62%	21%	17%
S. kuhn, M Hansen, P.M Rommens	26	58%	19%	23%
Our study	20	60%	20%	20%

Conclusion

- Proximal tibial fractures are more prone for malalignment – anterior angulation and valgus deformity
- Proper preoperative planning and specific implant selection needed for reduction
- Intramedullar nailing is safe and effective technique for treatment of proximal tibia and segmental fractures.
- Reduction of metaphyseal fracture involves various techniques like puller screws, distracters. Buttress plate, interfragmentary screws.
- Malalignment which are particular for proximal tibial fractures could not be avoided completely in all cases but they were not clinically significant and did not affect the functional outcome of the patients.
- Expert tibia nailing is a very effective method in closed treatment of proximal and segmental tibial fractures.

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