

## Case Series

# The study of outcome in fractures of proximal third of tibia in adults treated by expert tibia nail

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## ABSTRACT

This study aims to evaluate the clinical, functional outcome and complications of fracture proximal third of tibia treated with expert tibia nail in terms of radiological union, functional outcomes by short form -36 (SF-36) score, Johner and Wruhs criteria, visual analogue score and patient satisfaction score. Twenty-five patients with fracture proximal third of tibia treated with expert tibia nail in SNMC and HSK hospital and research centre, Bagalkot were enrolled in this study. The radiological union was assessed by plain radiograph and functional outcome by SF-36 score, Johner and Wruhs criteria, visual analogue score and patient satisfaction score. The radiological union was achieved in all the patients between 14 to 26 weeks duration (mean of  $19.6 \pm 2.82$  weeks). The mean SF-36 score was  $84.9 \pm 4.06$  and the mean visual analogue score was  $2 \pm 1.78$  at the 22<sup>nd</sup> week of follow-up. Results based on Johner and Wruhs criteria, 17 patients had excellent, 6 had good, 1 had fair and 1 had poor results. The average patient satisfaction score was 8.88 out of 10. There were 8 cases of post-operative knee pain, 5 cases of infection, 2 cases of malunion, 1 case of shortening and 1 case of the delayed union in our study. Intramedullary fixation with expert tibia nail for fracture proximal third tibia is a safe and less invasive technique. The radiological union was achieved in all the cases. This technique ensures excellent functional outcomes and a low incidence of complications.

**Keywords:** Expert tibia nail, Proximal third tibia fracture, SF-36 score, Johner and Wruhs criteria, Visual analogue score

## INTRODUCTION

Due to the increasing number of road traffic accidents, long bone fractures are more common nowadays. Tibia is frequently fractured long bone in the body with an annual incidence of about 17 per 1,00,000 individuals due to its subcutaneous location.<sup>1</sup>

Extra-articular proximal tibia fractures are common with incidence ranging from 5-11% of all tibia shaft fractures.<sup>2-4</sup> Its subcutaneous location makes it vulnerable to direct blow and high velocity injuries due to RTA. Tibia has a

precarious blood supply due to its poor muscular envelope. Tibial fractures may be associated with complications like compartment syndrome, neurovascular injuries, infections. Because of these complications, treatment of tibial fractures is of paramount importance.

Among the treatment of tibial fractures, the treatment of metaphyseal fractures of the tibia remains challenging, establishment of length and prevention of the coronal, sagittal, rotational malalignment is at most important during fixation which is mainly due to the mismatch between medullary canal diameter between the two

fragments of the metaphyseal tibial fractures and anatomy of the metaphyseal region.

The treatment options for the metaphyseal tibial fractures are conservative management, open reduction with plate osteosynthesis, external fixators and recently the intramedullary interlocking nailing. Each treatment has its own advantages and disadvantages.

Conservatively treated patients have an unsatisfactory result on account of shortening, angular deformity, delayed union, malunion and rarely non-union.<sup>5</sup> As the knee and ankle joints have predominantly single plane functional movements, the effects of the malunion and delayed union is high with secondary osteoarthritis of the joints.

Proximal third tibia fractures are usually treated with a large and strong plates to overcome the bending and torsional forces on the proximal tibia. Typical problems of plate fixation include extensive soft tissue dissection, plate prominence, implant loosening and delayed mobilization.

External fixators are usually reserved for open fractures with pitfalls of pin tract infection, malunion, nonunion and high incidence of joint stiffness.

Intramedullary nailing is an alternative to plating for proximal third tibia fractures the dynamic forces of the patellar tendon pull the proximal fragment into an apex anterior angulation, whereas the attachment of the pes anserinus causes valgus stress on the same fragment but, in addition to the deforming forces, the capacious medullary canal at the metaphyseal level creates the potential for improper reduction and sub optimal nail placement during nailing with the knee hyper-flexed.<sup>6</sup> To overcome all these problems various techniques have been used with intramedullary nails like proximal and lateral entry point, use of the semi-extended position, suprapatellar approach, retropatellar approach, poller blocking screws, oblique interlocking screws.<sup>7-12</sup>

So, nowadays most authors consider intramedullary interlocking nailing is the most effective treatment of choice. The expert tibial nail is a newer design of intramedullary nail devised in 2005, it has multiplanar locking options at its proximal end which results in stable fixation and good purchase in the fracture fragments, and has shown good results.<sup>13-15</sup>

Thus, propose to conduct study to evaluate effectiveness of expert tibia nail in terms of alignment, a radiological union of fracture and functional outcome in metaphyseal and diaphyseal fractures of proximal third of tibia.

## CASE SERIES

This is a case series study carried out between November 2019 and June 2022 at the SNMC and HSK hospital and research centre, Bagalkot in the department of

orthopaedics. Twenty-five patients admitted with proximal third tibia fracture during this period were treated with expert tibia nail and were studied for the functional outcome, fracture union, and complications.

Inclusion criteria was-proximal third tibia fractures AO type 41 A2/A3\*, 42 A/B/C (a). (a)-is proximal third of diaphysis, age above 18 years, segmental fractures with any one of the fracture lines follow the above AO type, fresh fractures less than 3 weeks of trauma.<sup>16</sup>

\*-When intramedullary nailing is being done, the AO types 41A2 and 41A3 fractures behaves similar to proximal third diaphyseal fractures of tibia, hence these AO fractures types are also included in our study.

Exclusion criteria was patient refuse to give consent, fracture line extending into intraarticular surface, open fractures deemed unfit for nailing, wound or infection over the nail insertion site, general contraindications for the surgery.

## Surgical procedure

All patients were operated under spinal/ epidural anaesthesia/ general anaesthesia. Patient is operated with knee flexed to 40-90 degrees on a bolster. The injured leg is scrubbed, painted with betadine, spirit and draped. Longitudinal incision over the patellar tendon in between lower pole of patella and tibial tuberosity 5 to 6 cm long is used, splitting the tendon longitudinally. The Entry portal is made with curved awl to open the medullary canal 2 cm proximal in the midline just in front of joint line (lateral view) just medial to lateral tibial tubercle (AP view) (Figure 1). A 3.2 mm guide wire with ball tip is pushed into the canal, past the fracture site into the malleolar region (0.5 to 1 cm proximal to ankle joint) assisted by reduction manually (Figure 2). Reduction was achieved with the help of k-wires as blocking screws, reduction clamps (Figure 3) temporarily in necessary direction to prevent the deformity and if need arises, a small incision is made over fracture site to align the bones before reaming the canal. Reaming is done sequentially and determination of the length of nail is done with C-arm assistance. Ball tip guide wire is replaced with plain guide wire with the use of Teflon tube. The expert nail with its proximal semicircular insertion handle and jig is passed over the guide wire and nail are centralized as far as possible and the guide wire is removed (Figure 4). Fracture reduction is confirmed with c-arm and proximal fragment is locked with the multidirectional proximal screws through the expert nail jig and number of screws in proximal fragment were dependant on the stability of the fracture (Figure 5). If there is any distraction at the fracture site in stable fractures, distal locking is done first followed by back hammering to maintain the continuity of the cortex at the fracture site. For distal locking by free hand technique and the c-arm is used to confirm the locking, nail position and fracture alignment. The wound is closed and dressing is done, compression crepe bandage is applied. Post

operatively, slab is discontinued to encourage the mobilization of the knee but if fracture is found to be unstable slab is continued till the suture removal.

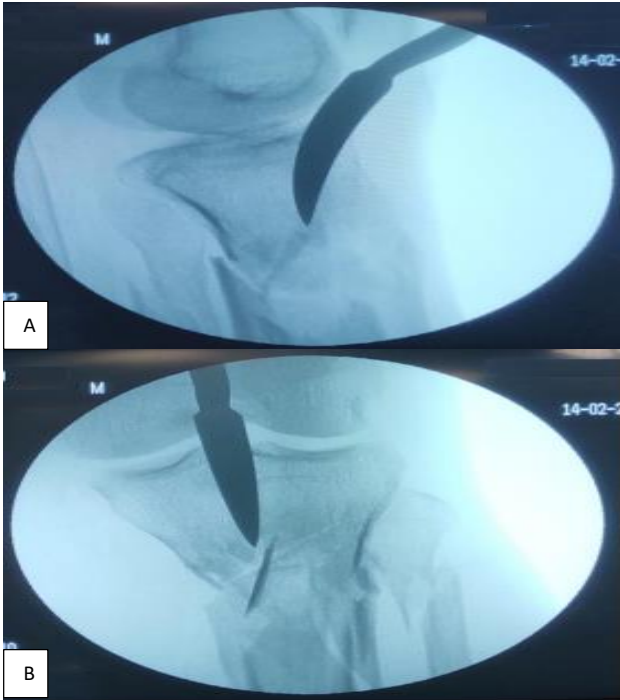


Figure 1 (A and B): C-arm image of awl entry in anteroposterior and lateral view.

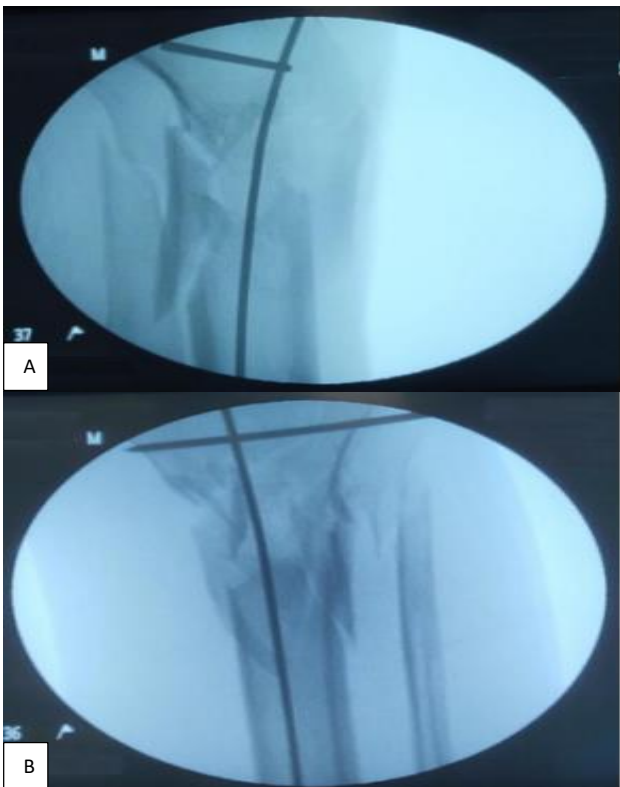


Figure 2 (A and B): Insertion of guide wire with reduction technique with the use of k-wire as poller blocking screw.

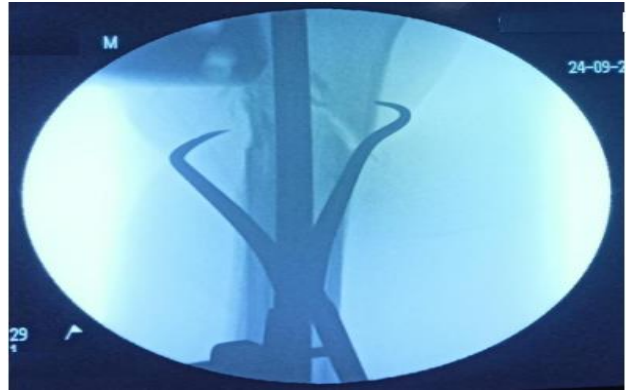


Figure 3: Reduction technique using reduction clamp.



Figure 4: Final insertion of expert nail with the jig.

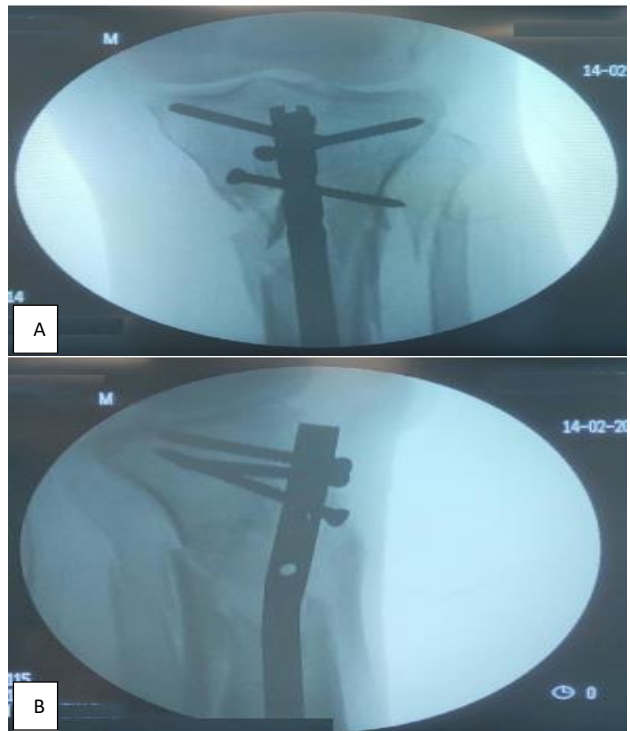


Figure 5 (A and B): AP and lateral view of proximal locking of expert nail.

### Post-operative period

Antibiotics and analgesics were administered according to patient compliance. Standard procedures for dressings and suture removal were followed. Active quadriceps exercises are started on 1<sup>st</sup> postop day with active ankle and toe movement with knee mobilization, as far as patient is comfortable and free of pain. Patient is made to ambulate within week of postoperative day without bearing weight on operated leg with walker. Regular post-operative follow-up will be done at 6 weeks and at the interval of 1 month till union of fracture and subsequently as required to note clinical examination findings, radiological union of fracture and alignment by X ray and to note functional outcome by SF-36 score, Johner and Wruhs criteria, visual analogue score and patient satisfaction score. In this study fracture union was considered when patient was weight bearing without pain, fracture site was not tender on palpation, radiograph showed callus in at least 3 cortices in anteroposterior and lateral views.<sup>17,18</sup>

### DISCUSSION

Management of tibial metaphyseal fractures has always held particular interest for orthopaedic surgeons, as not only they are relatively common but also difficult to treat.

Most of the closed tibial fractures are unstable because of variable degrees of comminution and displacement. Valgus malalignment is due to the medial nail entry point and the laterally directed nail insertion angle in the proximal fragment, mainly because of the medial parapatellar approach commonly used for nailing. Valgus malalignment may also be due to inadequate reduction before nailing in addition. The following solutions have been resorted to by different surgeons to address each of the problems associated with nailing these fractures. The semi extended position of 15 to 20 degrees of flexion of the knee is recommended.<sup>8</sup> Before reaming and nailing, the temporary anatomical reduction is achieved in closed fractures by manipulation under image intensifier guidance, in open fractures bone reduction clamps can be used after open reduction, painless fixator clamps (devised by AO) which penetrate only the outer cortex are an alternative. Some surgeons recommend anterior plating with reconstruction plates before nailing. In proximal tibial fractures, it is important to insert the nail slightly lateral to the usual starting point, to avoid valgus angulation. The entry point should be placed on the tibial plateau more posteriorly than usual so that it encroaches on the joint surfaces. To reduce the apex angulation, a posterior poller screw is inserted in the mediolateral direction and placed in the distal portion of the proximal fragment slightly posterior to the longitudinal axis. To prevent valgus angulation, lateral poller screw is inserted in anteroposterior direction and placed in the distal portion of proximal fragment slightly lateral to the longitudinal axis.

Proximal bend of nail plays important role in management of these fractures. Ideally, proximal bend should be in

proximal fragment. We evaluated results and compared them with other studies. Our analysis is as follows-The current study consists of 25 cases of proximal third tibia fracture in adults treated with expert tibia nail and all the patients were available for the follow up. In our study, the maximum number of patients were in the age group of 40-49 years and the average age incidence was 38.12 years whereas 40.8 years in Lang et al study, 27 years in Hooper et al study, 41 years in Sanders et al, 38 years in Mohamed et al which are comparable.<sup>5,9,11,19</sup> Among them there were 17 males and 8 females, there is a male preponderance in this series which is also observed in other studies done by Lang et al, Hooper et al and Sanders et al.<sup>5,9,11</sup> We have noticed that road traffic accidents were the most common cause of injury being responsible for 80% of cases followed by self-fall (20%) which are comparable with studies done by Lang et al, Mohammed and Kadam et al.<sup>15,19</sup> Right tibia fractures were more in this series. All the fractures were classified according to AO classification.

In our study, 40 % of fractures are closed and 60% are open type of fractures while the study done by Lang et al had 68.75% open fractures and 31.25% had closed fractures, Nork et al had 62.85% had closed fractures and rest was open fractures.<sup>19,20</sup> Sanders had 59.45% had closed and 40.55% had open fractures.<sup>9</sup>

The mean surgical time for the procedure was 72 minutes, ranging from 38 to 120 minutes, and the correlation between duration and the fracture type was insignificant.

In our series, all fractures united with the mean time of  $19.6 \pm 2.82$  weeks (range 14-26 weeks), but one patient had delayed union, 15.7 weeks in study by Hooper et al, 16.7 weeks in Court brown et al study and 19 weeks in a study done by Lawrence et al.<sup>5,21,22</sup>

In our study, intra operative complication were none and post operatively 2 patients had a deep infection, 3 superficial infections of which 4 were open fractures and 1 patient with deep infection got implant removal and rest of them got relieved with regular dressing and antibiotics, delayed union in 1 patient, 8 patients had knee pain and 1 patient had a shortening of <2 cm and 1 patient with knee restriction. 2 malunion with 1 case of >5° valgus and another case of anterior recurvatum >10° of malalignment though clinically patient had no complaints. Larsen et al<sup>23</sup> reported a malunion in 2 cases out of 22 treated with reamed nailing of which one case of malunion found with an anteroposterior angulation of 10° was seen in the proximal third of the tibia. Freedman and Johnson<sup>4</sup> in their study found that 58% of proximal third fractures were malaligned when compared to 7% of middle third and 8% of distal third fractures. In a study by Hansen et al using the expert tibia nail, they found that the risk for varus, valgus, or antecurvatum malalignment of more than 5 degrees in any plane on radiologic long leg views was 4.3% for shaft fractures, 1.5% for distal fractures, and 13.6% for proximal fractures.<sup>24</sup> In the study done by Mohamed 3 patients (10%) had malalignment, two

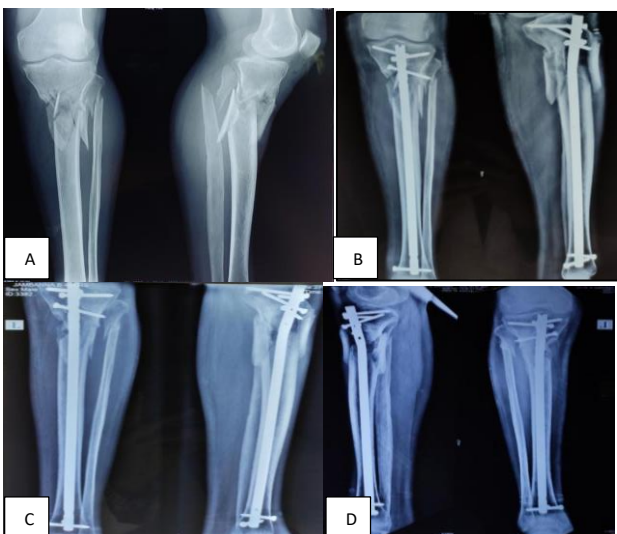
patients got superficial wound infection (6.7%) both responded well to antibiotics, 8 (26.7%) patients had at least moderate knee pain after vigorous activity.<sup>11</sup> Attal et al in their study with the expert nail for tibia fractures showed 6.9 % of patients had nonunion, 9% of patients had malalignment in the reduction of the fracture.<sup>25</sup>

In our series, mean short form-36 score and visual analogue score was 65.48±4.14, 72.4±4.22, 78.44±5.00, 84.2±5.10, 84.9±4.06 and 4.64±1.49, 3.84±1.51, 2.96±1.74, 1.91±1.85, 2±1.78 at the end of 6 weeks, 10 weeks, 14 weeks, 18 weeks and 22 weeks respectively. The average patient satisfaction score was 8.88±1.27 (range 6-10). Mean SF-36 score and visual analogue score between fracture types were insignificant, while scores from the study done by Sanders et al was 89.7 and 1.<sup>9</sup>

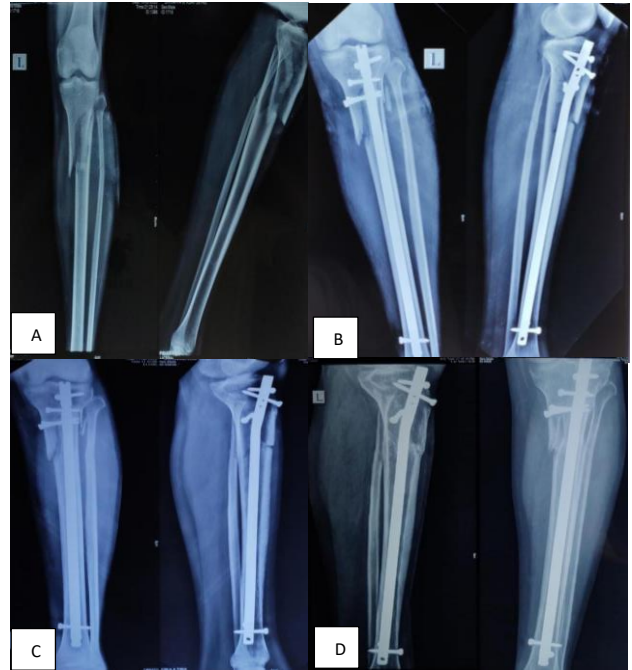
Final assessment in our series was done using Johner and Wruhs criteria which involves parameters of objective and subjective symptoms of gait, pain, deformity, range of motion of the knee, ankle, and subtalar joints, shortening, neurovascular disturbances, ability to do strenuous activities, radiological union and presence or absence of non-union, functional outcome was graded into excellent, good, fair and poor, final results in this study excellent in 17 patients, good in 6, fair in 1 patient, poor in 1 patient at end of last follow-up. Comparatively with other studies (Table 1). X-ray case illustrations of 2 patients of this study have been demonstrated in Figure 6 and 7.

**Table 1: Comparative results based on Johner and Wruhs criteria.**

| Study                        | Excellent | Good | Fair | Poor |
|------------------------------|-----------|------|------|------|
| Bhalotia et al <sup>14</sup> | 68.3      | 16.6 | 6.6  | 8.3  |
| Kadam et al <sup>15</sup>    | 20        | 8    | 2    | -    |
| Klemm et al <sup>26</sup>    | 62.5      | 31.8 | 4.5  | 1.2  |
| Present study                | 68        | 24   | 4    | 4    |



**Figure 6 (A-D): X rays of pre op, post op, 14 and 22 weeks of proximal tibia fracture (case 1).**



**Figure 7 (A-D): X rays of pre op, post op, 14 weeks and 22 weeks of proximal tibia fracture (case 2).**

Our study had certain limitations like small sample size, single centered study and lack of comparison group.

**CONCLUSION**

Intramedullary fixation with expert tibia nail for fracture proximal third tibia is a safe and effective technique. The radiological union was achieved in all the cases with the average time to union was 19.6±2.82 weeks and one case had delayed union. Reduction tools were required in almost all the cases and it has a vital role in maintaining the reduction until the nail is inserted. Expert nail helps in better hold in the proximal fragment and minimize the malalignment problems along with the advantages of intramedullary nail. The technique gives excellent functional outcomes and has very few complications.

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