



Orthopaedics

CLINICAL, RADIOLOGICAL AND FUNCTIONAL ASSESSMENT OF INTRAMEDULLARY NAILING OF TIBIAL FRACTURES THROUGH SUPRAPATELLAR APPROACH

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ABSTRACT Intramedullary Nailing is the standard protocol for the management of tibia fractures all over the world. We present our experience in intramedullary nailing using suprapatellar approach in the management of proximal tibia fractures at Maharaja Agrasen Medical College, Agroha. **Methods:** The study was conducted from October 2022 to December 2023 and included 30 patients above 18 years of age presenting with proximal tibia fractures managed by suprapatellar tibia nailing. Clinical and radiological evaluation was done at 4, 12 and 24 weeks. Functional outcome was assessed according to Lysholm Knee Scoring Scale. **Results:** The average age of patients in our study was 38.13 years with male preponderance. Road Traffic Accident was the mode of injury in 70% cases. The average duration of surgery was 85.3 minutes. The average time of union was 19 weeks in present study. 86 % patients achieved full knee flexion by 24 weeks. In two cases there was delayed union and one had non union. None of the patients had any deep infection. The average Lysholm Knee Score was 91.4.

KEYWORDS :

INTRODUCTION

Tibial shaft fracture is common and comprises about 2% of workload in all fractures in adults. The goal of tibial fractures treatment is to obtain early union of fracture in the most acceptable anatomical position with early and maximum functional return of activity. Presently intramedullary nailing (IMN) is the gold standard for the treatment of tibial shaft fractures. Nailing ensures good fracture fixation and stability, prevents fracture malalignments and allows early mobilization. IMN allows for minimal soft tissue disruption, conservation of the periosteal blood supply, early mobilization & weight-bearing and higher union rates.¹ An infrapatellar (IP) with patellar tendon splitting or parapatellar approach to the tibia with the knee joint flexed 90 degrees is the commonly followed entry for intramedullary tibial nailing. In proximal tibial shaft fractures, there is anterior malalignment of the proximal fragment due to the pull of the patellar tendon and this pull increases further when the knee is in a hyper-flexed position. There is also a risk of poor patient repositioning, suboptimal reaming, poor reduction and nail placement. The nail is inserted either through a trans or parapatellar technique which causes post-operative anterior knee pain, with an incidence between 10 and 80%.² To overcome these issues, the semi extended suprapatellar (SP) approach was developed, which has the patient positioned in approximately 15-20 degrees of flexion, putting less tension on the structures & soft tissues about the knee and enables the surgeon to insert the nail in an optimal position with relative ease.

The Knee is maintained in semi-extended position, the disadvantage of proximal fragment migration is addressed, there is proper fracture reduction of proximal fractures and simplified intra-operative imaging with shorter fluoroscopy time. The suprapatellar approach aims to avoid post-operative knee pain, which is due to patellar tendon splitting, proximal nail protrusion, intra-articular structural damage and involvement of the infrapatellar nerve commonly seen with infrapatellar nailing.³ Suprapatellar approach offers decreased risk of malalignment and improved range of motion of the knee joint.

MATERIAL AND METHODS

This study was conducted on 30 adult patients with age 18 and above after informed consent, presenting with proximal tibial fractures in the Department of Orthopaedics in Maharaja Agrasen Medical College, Agroha, Hisar from October 2022 to December 2023. Patients who were ambulatory before surgery and trauma duration was upto 2 weeks were included. Patients with distal tibia fractures, open grade 2 & grade 3 fractures and pathological fractures were excluded from the

study. In every patient a detailed history regarding the mode, duration and nature of injury was taken. Radiological investigation was done and the fracture was classified according to AO classification. Pre-operative planning was done to decide the size and length of implant to be used.

Operative Technique

Standard operative technique was used. In 50% (15) cases, even after placing the protection sleeve at correct point there was a difficulty in making correct entry point because protection sleeve tended to skid from its placement.

Two types of jig system were used as provided by the vendors. One was rotating jig for proximal interlocking bolt insertion while another one had semi-circular fixed jig with different holes for proximal fixation. There was problem in both jigs in insertion of most proximal interlocking bolt due to long conical bolt which obstructed drilling and bolt insertion.

Post-operative patients received broad spectrum intravenous antibiotics for a minimum of 3 days, and then were shifted to oral antibiotics till suture removal. Knee mobilization exercises were started on the next day of surgery. Weight bearing on the affected limb was allowed gradually starting from partial to full weight bearing according to findings on x-rays (fracture pattern & stability, quality of fracture reduction and implant position). In stable fracture weight bearing was allowed as early as possible, as per tolerability & co-operation of the patient. In case of comminuted fracture/ unstable fracture weight bearing was delayed & was started in graded manner as per fracture anatomy and patient profile.

Clinical and Radiological evaluation of patients was done at 4, 12 and 24 weeks. Functional outcome was assessed according to Lysholm Knee Scoring Scale.

RESULTS

The average age of patients in our study was 38.13 years with male preponderance (83.33%). There was equal occurrence of right sided fractures and left sided fractures. Road Traffic Accident was the mode of injury in 70% cases, trivial fall in 16.67% of cases and physical assault in 13.37% of cases. Majority of the fractures were closed occupying 73.33%, the rest were open fractures. 30% patients were having associated injuries and 47 % patients were having associated medical illnesses. Almost all patients had some swelling which took

some time to subside, however blisters were observed in 7%. In 23% patients the interval between the injury and surgery was less than 72 hours, in 34% between 72 hours to 1 week and in 43% surgery was delayed even beyond 1 week. The average duration of surgery was 85.3 minutes. The average time of union was 19 weeks in present study. 86 % patients achieved full knee flexion by 24 weeks and some extension lag (5° to 10°) was observed in 28% patients. In two cases there was delayed union and one had non union. None of the patients had any deep infection. The average Lysholm Knee Score was 91.4 in this study.



Fig 1 Suprapatellar Nail With Zig

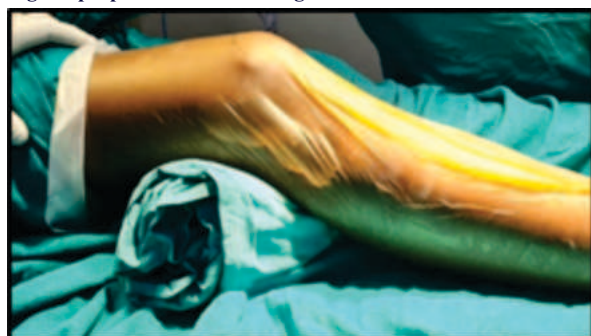


Fig 2 Limb Position – 15-20 Degrees Of Knee Flexion

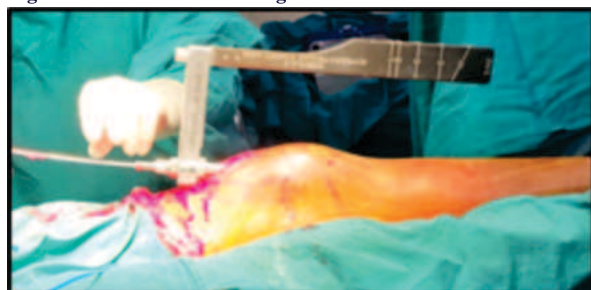


Fig 3 Suprapatellar Nail Zig Being Used To Carry Out The Procedure

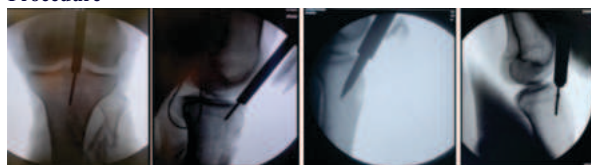


Fig 4 Steps Of Making An Entry- Placement Of Sleeve In Ap And Lateral, Insertion Of Trocar, Insertion Of Beaded Guide Wire

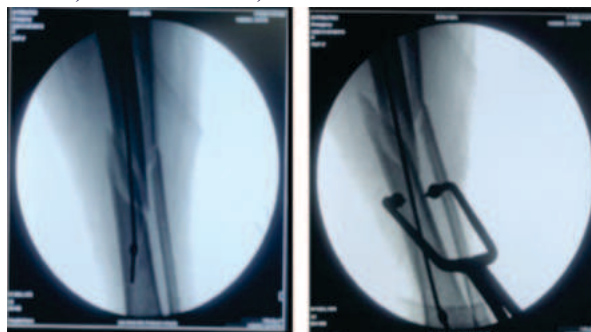


Fig 5 Negotiation Across Fracture Site & Fracture Held With Pointed Clamp

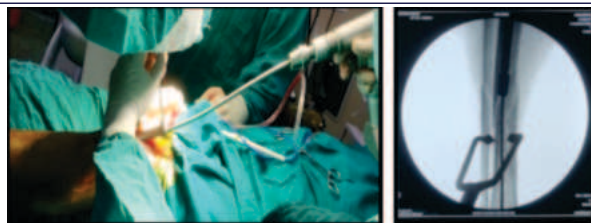


Fig 6 Reaming With Flexible Reamers

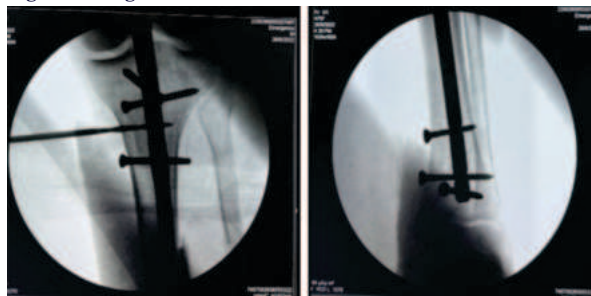


Fig 7 Proximal Locking (with Zig) And Distal Locking (without Zig)



Fig 8 Pre-operative Radiographs , Post-operative Radiographs And Follow-up Radiographs Showing Fracture Union

DISCUSSION

Proximal third tibial fractures constitute about 8-10% of all tibial fractures. Due to the peri-articular nature of the injury, restoration of anatomical alignment is vital to regain the function. Use of nail to fix these fractures seems safe, following the successful results of tibial shaft fractures after nailing.⁴

But use of the standard nail with regular infrapatellar approach had unacceptable high malunion, non-union, loss of reduction and other complications as noted by Freedman and Lang.^{5,6}

Requirement of the hyper flexion of the knee in infrapatellar technique leads to inappropriate entry which is more medial in coronal plane and directed posteriorly in sagittal plane.⁷ Narrow medial condyle of the tibia and broad lateral condyle along with the pull from extensor mechanism, gastrocnemius causes clinically observable valgus, anterior angulation of the proximal fragment with posterior translation of the distal fragment.^{6,8} All these factors makes it difficult to achieve the reduction, hold the reduction and fix the fracture.^{5,9} Also infrapatellar approach has higher anterior knee pain.¹⁰ Tornetta et al suggested the nailing in the semi extended position using para patellar approach. After subluxating patella and using trochlear groove, he could successfully negotiate the adverse factors and could get good results.⁸ Persistent anterior knee pain, traumatic arthrotomy and injury to the intraarticular structures, altered patellar tracking due to the release of the retinaculum were few of the concerns raised for this approach.^{11,12,13}

Increased chance of injury to the intra articular structures by supra articular approach had been refuted by Gains et al.¹² Sanders et al demonstrated the excellent outcome with suprapatellar approach in the heterogeneous tibial fracture case series. Arthroscopic evaluation following nail insertion and MRI follow up at one year follow up revealed no significant cartilage damage to trochlear groove or to the patella.¹⁴ Chan et al in their RCT of suprapatellar and infrapatellar approach for the nailing of the tibial shaft fracture management found no significant difference in the outcome.¹⁵ Similar findings or superiority of suprapatellar approach over infrapatellar approach were noted by other authors as well.^{16,17,18}

In our series, we have 30 homogenous fracture patterns included the extra articular fractures of meta-diaphyseal region of the proximal tibia which were treated with intramedullary nailing through suprapatellar approach. The average operative time of various studies ranges from 72 minutes to 147 minutes. In the present study, the average operative time was 85.3 minutes which is comparable to 86.5 minutes, the

average operative time of study by Lu et al.²¹ Tibia nailing through suprapatellar technique reduces the time for surgery and hence the soft tissue complications.

Table 1: Comparison Of Duration Of Surgery With Other Studies

Series	Year	Total no. of patients	Duration (mins)
Courtney et al18	2015	21	147
Fu et al19	2016	23	78.2
Křivohlávek et al20	2018	55	72.7
Lu et al21	2020	27	86.5
Garg et al22	2021	10	81
Present study	2023	30	85.3

In the present study, the average time for union was 19±3 weeks. The maximum number of fractures united between 12-18 weeks. There were 2 cases (case no. 18 & 21) of delayed union which united at 26 weeks and 28 weeks respectively. Both these patients were chronic smokers. Fu et al, Garg et al and Gadegone et al reported union times which were comparable to the present study and were 20.2 weeks, 15.15 weeks and 20.4 weeks respectively as shown in table 2.

Table 2: Comparison Of Time For Union With Other Studies

Series	Year	Total no. of patients	Union(weeks)
Fu et al19	2016	23	20.2
Çiçekli et al23	2019	58	28
Kulkarni et al24	2020	43	28
Garg et al22	2021	10	15.15
Gadegone et al25	2022	62	20.4
Present study	2023	30	19

The mean Lysholm Knee Score of the study is 91±8.4 of which 18 (62.06%) of the patients had excellent results, 7 (24.13%) patients had good results, 3 (10.34%) patient had fair results and 1 (3.45%) patient performed poorly. Similar outcomes were reported by other studies as shown in table 3.

Table 3: Comparison Of Lysholm Knee Score With Other Studies

Series	Year	Total no. of patients	Lysholm Knee Score
Sanders et al14	2014	37	82.14
Křivohlávek et al20	2018	55	93.4
Çiçekli et al23	2019	58	87.71
Garg et al22	2021	10	87.19
Lindo et al26	2021	35	98
Present study	2023	30	91

Two cases had superficial surgical site infection in early post op period which subsided with 7 days of intravenous antibiotics. There were no cases of deep infection. There were two cases of delayed union. The fracture healed spontaneously at 26 weeks and 28 weeks respectively. There was one case of non-union who was diabetic and chronic smoker. One case had loosening of proximal antero-posterior interlocking bolt presented at 22 weeks with union at fracture site. The bolt was removed under local anaesthesia.

Intra-operative Observations

The intra-operative problems that we faced, have not been mentioned or observed by other authors. In 15 cases we had found difficulty due to skidding of protection sleeve, we overcome this issue in rest of cases by fixing the guide pin at entry point with slight hammering, then the protection sleeve along with inner sleeve combination was slid over the guide pin. The problem of long conical bolt which obstruct drilling, was solved with alteration of length of threaded part of conical bolt by manufacturer. There is a scope of further refinement of instrumentation (particularly insertion tools and jigs) which will make procedure more smooth and less time consuming. It also calls for uniform standardization of instrumentation for this particular procedure.

Limitations

We were not able to confirm the iatrogenic damage to intraarticular structures during nail insertion through suprapatellar pouch, as pre & post procedure arthroscopy and MRI need to be done which is time bound and increases the financial burden on the patients.

There is the lack of preoperative knee outcomes; however, this is currently a limitation of all studies on this subject as pre-injury outcomes cannot be obtained secondary to the nature of trauma.

CONCLUSION

Intramedullary interlocking nail remains the standard treatment for

displaced proximal tibia fractures. Suprapatellar approach of intramedullary tibia nailing in semi-extended position of knee offers an alternative to traditional infrapatellar approach and adds to armamentarium of intramedullary nailing in indicative and selective patients. It is a viable option for proximal third tibia fractures due to its inherent advantages of positioning, fracture reduction, perfect nail entry & placement a good post-operative range of motion. There is scope of improvement and innovation of insertion tools and jigs need to be uniform for this particular procedure.

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