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ISSN : 2348 - 5612 | Volume : 04 , Issue : 07 | October - December 2017

CLINICAL OUTCOME OF TIBIA INTRAMEDULLARY NAILING USING SUPRAPATELLAR PORTAL

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ABSTRACT

ISSN : 2348-5612 © URR
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INTRODUCTION : Reamed locked intramedullary nailing has become the standard treatment protocol for displaced tibia shaft fractures. Suprapatellar tibia nailing in the semi extended position has emerged as a safe and effective surgical technique that allows overcoming certain challenges faced with other sub patellar and parapatellar approaches. Suprapatellar nailing helps in achieving and maintaining fracture reduction, not only in proximal third tibia fractures but also distal one third fractures which is in contrast to infrapatellar approach that requires the affected extremity to be placed in more than 90 degree flexion at the knee. Preliminary investigations have suggested that this technique is associated with a low rate of complications, including a reduced incidence of postoperative anterior knee pain.

MATERIALS AND METHODS : 21 patients were enrolled in this study from the period August 2015 to May 2017 , who underwent tibia fixation with intramedullary interlock nailing via the suprapatellar approach. Out of 21 patients,(17 male and 4 female patients) 8 had mid shaft fracture, 4 had proximal one third shaft fractures and 9 had distal one third shaft fractures. The patients were followed up for a period of 6 months postoperatively. The post-operative data consisting of hospital stays, fracture healing time, angular deformities and associated complications were all recorded.

RESULTS: 21 patients were followed up in this study. The average hospital stay of the patient was 9 ±3.4 days. Callus started appearing in the patients at average 8 weeks postoperatively. The mean range of motion at knee and ankle joints improved significantly during the progressive

follow up. The average score according to Modified Functional Evaluation System by Karlstrom-Olerud was 29±4.1 points. 11 patients (52.38%) did not have any angular deformity measured postoperatively at 6 weeks and 6 months. 8 patients (38.10%) had an angular deformity < 5o .Remaining 2 patients (9.52%) fell in the category of >5o and <10o.

CONCLUSION: Intramedullary tibia nailing using suprapatellar approach is a safe and effective technique for proximal third tibia shaft fractures with its indication extending to diaphyseal fractures too.

INTRODUCTION

Tibia shaft fractures representing a relatively common injury, are typically encountered in young patients and they usually result from high-energy trauma.[1] Intramedullary nailing has become a standard protocol for all types of tibial diaphysis fractures with the advantage of early weight bearing along with fracture healing. Intramedullary nail fixation benefits from minimal surgical dissection with preservation of the extra osseous blood supply to the fracture .However controversies still exist around the exact entry point for tibia intramedullary nailing.

Various routes have been developed for intramedullary nailing of tibia, most common of which is the infrapatellar route. A major side effect of tibial nailing is postoperative anterior knee pain, with a mean incidence of 47% after 2 yr.[2]Infrapatellar approach requires the injured extremity to be positioned at a minimum of 90° flexion in the knee joint to achieve optimal exposure of the correct entry point causing continuous monitoring with C-arm difficult. Further, proximal third tibial shaft fractures in particular seem to be at risk for valgus and apex anterior deformities and posterior displacement of the distal fragment.[3]

In this study, suprapatellar approach for tibia intramedullary nailing was utilized. This technique is generally done for proximal one third tibial shaft fractures that are more prone to anterior apex deformity ,extending its indication to diaphyseal fractures and distal tibia shaft fractures, wherever applicable . The semi extended position may eliminate the extension force of the quadriceps and may greatly facilitate the reduction of the apex anterior angulation. In this technique, the injured extremity remains in the same physiological semi extended position

during the entire procedure. Additional manipulations during distal interlocking are unnecessary as the injured leg is positioned stretched on the table and the fluoroscopic C arm control also becomes much easier during the whole procedure.

The main benefit of intramedullary nailing in semi extended position is that it improves postoperative fracture alignment.[4] Perfect fracture reduction can be achieved in nearly every case by positioning the extremity in semi extension.

Suprapatellar approach has been associated with a low incidence of post-operative anterior knee pain , which becomes a limiting factor in other conventional approaches for tibia intramedullary nailing. This is due to the fact that the patellar tendon is preserved and infrapatellar nerve is protected during this approach. A further indication for suprapatellar nailing of the tibia is a fracture with a skin lesion or severe soft tissue damage in the infrapatellar region. The distance between the suprapatellar skin incision and the site of soft tissue trauma helps to prevent a secondary trauma due to the surgical access, which favors fracture healing. From experience in this method of nailing, the soft tissue is exposed to far less intraoperative trauma compared with traditional positioning. Further advantages of the method are reduced need for an assistant and a shorter operating time. Additionally, soft tissue scar formation will not be located on the anterior knee, but rather superior to the patella, which may reduce flexion-related pain and pain with kneeling. Further, the usage of protection sleeve during the reaming reduces the retropatellar contact pressure thus, reducing any incidence of damage to the patellofemoral joint. It is recommended that the correct position of the sleeve is checked radiographically several times during the process to avoid intraarticular damage.

MATERIAL AND METHOD

HOSPITAL SETTING: Department of Orthopedics, Sri Guru Ram Das Institute of Medical Science and Research, Amritsar.

21 patients, who underwent tibia intramedullary nailing using suprapatellar approach, were enrolled in this study which was conducted from august 2015 to May 2017. Patients were followed up for a period of 6 months.

INCLUSION CRITERIA:

1. Tibial shaft fractures suitable for intramedullary nailing.

2. Skeletal maturity present(age >=18 years).

EXCLUSION CRITERIA:

1. Tibia shaft fractures that require articular reconstruction with plates.

2. Tibial plateau fractures.

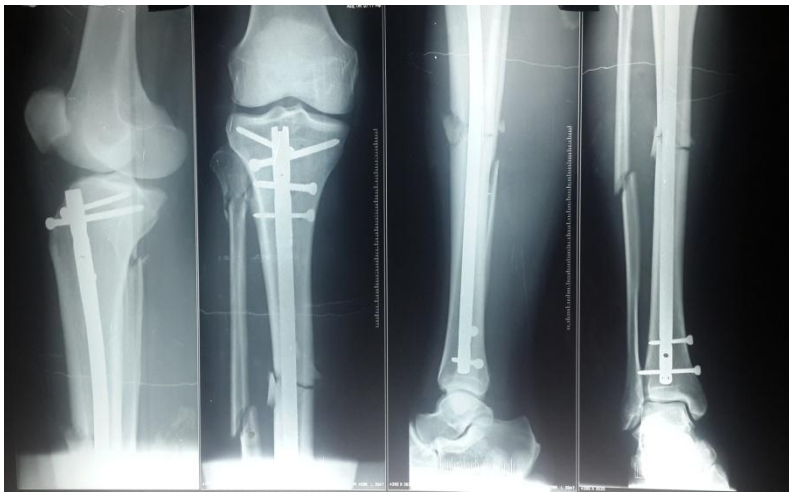
3. Pilon fractures

OPERATIVE TECHNIQUE: The patient is positioned supine on a radiolucent table , and the injured leg is positioned with a roll under the knee joint so that it is flexed 20-30 degrees. A 1.5-cm to 2-cm longitudinal skin incision is made 1cm above the base of the patella. The quadriceps tendon is exposed by blunt dissection and a longitudinal midline split is performed in the tendon. For optimal entry, it should be possible to run a finger easily under the patella and into the knee joint. The patella can be subluxated to one side, or can be elevated enough for instrumentation. Depending on the type of nail and manufacturer, the protecting entry tube may be inserted now, but it is much easier to start with the guide wire and place it "free-hand'' on top of tibia.

The entry point is easy in most of the cases with suprapatellar approach. The guide wire is directed through the intercondylar notch , posterior to the patella and in majority of the cases the guide wire hits the accurate entry point. On the lateral view, the entry point is anterior to the anterior articular margin. In the tibial medullary canal, the guide wire must be directed towards the central position in both planes. When the correct position of the guide wire is verified by radiographic imaging in both anteroposterior and lateral views, the protection sleeve is inserted . With a blunt trocar, the sleeve can be carefully rolled over the guide wire and in under the patella to the top of the tibia. It is important to ensure under fluoroscopy that the sleeve ''sits''on top of the tibia to prevent iatrogenic damage to the knee joint. It is important that sleeve's location is regularly checked during the reaming process. The remaining surgical procedure, including the reaming process and insertion of the nail, is performed through the cannula system, allowing for appropriate protection of the surrounding soft tissues and intra-articular structures . The reaming process , nail insertion followed by distal and proximal locking is similar to the conventional intramedullary nailing. At the conclusion of the surgical procedure, a thorough irrigation of the

surgical site is advised to avoid retained debris within the knee joint. The postoperative treatment protocol is identical to established protocols of tibial nailing, and early range of motion exercises of the knee and ankle are encouraged.

A



B

A. Preop Xray of 30 year old male with fracture proximal one third fracture

B. Postop x ray of the same patient.

A **B**

A. Prep x-ray of 70 year old patient with fracture proximal one third shaft tibia.

B. Post op x-ray of the same patient.

Postoperative treatment and rehabilitation exercises

Passive flexion and extension exercises of knee and ankle joints from postoperative day 1 and active flexion and extension exercises of knee and ankle joints and strength training of lower limb from postoperative day 3 were taken. After 1 week, patients were encouraged to get out of bed and get walking exercise with no weight-bearing on the affected limb.

Post op weight bearing protocol is as per the fracture personality and the comminution. After 6–8 weeks, they were allowed partial weight-bearing with crutches in case of simple fractures.

However, in cases of communized fractures, weight bearing was restricted until early signs of callus formation was seen on X rays.

RESULTS: 21 patients , that were enrolled in this study, were followed up for a period of 6 months . The average hospital stay of the patient was 9 ±3.4 days postoperatively .Sequential full length X rays of the operated leg were obtained after 1 month, 2months, 3months and 6 months postoperatively. X rays showed that callus appeared at the fracture site in nearly all the patients at an average of 8 weeks postoperatively. No complications were observed. No patient experienced loosening, or breakage of the implant and no patient complained of knee joint pain. No reduction loss and aggravating displacement occurred after the surgery.

Besides this functional outcome involving knee pain, active ROM at knee joint and ankle joints were recorded using Modified Functional Evaluation System by Karlstrom-Olerud(graded as Excellent = 33 Points ,Good = 32-30 Points , Satisfactory = 29-27 Points , Moderate = 26-24 Points , Poor = 23-21 Points)

GRADING	NUMBER OF PATIENTS
Excellent = 33 Points	4
Good = 32-30 Points	9
Satisfactory = 29-27 Points	8
Moderate = 26-24 Points	0
Poor = 23-21 Points	0

ANGULAR DEFORMITIES: Varus and valgus angulation were also measured on X-ray films taken post-operatively at 6 weeks and 6 months. The angulation more than 10° is considered to be malunion.

11 of 21 patients (52.38%) did not have any angular deformity measured postoperatively at 6 weeks and 6 months. 8 patients (38.10%) were found to have angular deformity < 5^{o} .Remaining

2 patients (9.52%) fell in the category of >5° and <10°. None of the patients had coronal plane deformities >10°.

Angular deformity (°)	**Number of cases**	**Percentage**
None	11	52.38
2-5	08	38.10
6-10	02	09.52
>10	00	00.00
Total	21	100

Rosemeyer and Pförringer suggested that surgery is indicated for valgus deformity of more than 12°, varus deformity of >6°.[5] These coronal deformities said to affect the functional outcome of the patients when it is more than 10°.[6] Particularly, the varus malunion said to affects the knee ankle joint kinematics and had long-term effect on functional outcome. Although varus malalignment of the lower limb occurs occasionally, still it may cause osteoarthritis in the medial compartment of the knee[7]. Though the incidence of coronal plane deformities is low, we should try to reduce it intra-operatively with the use of fluoroscopy so that further alteration in biomechanics of knee and ankle joint and related osteoarthritis can be prevented.

DISCUSSION: Intramedullary nailing of tibia fractures by suprapatellar approach has an advantage of simple positioning of the knee of injured leg in semi extension throughout the duration of operation. This helps in easy reduction and also retaining of fracture reduction during nailing. This approach is especially efficient for proximal third tibia shaft fractures while its indication can be extended to mid shaft and distal third fractures.

In this study, all the patients obtained satisfactory reduction and good recovery outcomes, with no loss of reduction and no aggravating displacement during the follow up. These acceptable results could be attributed to the nearly extend position during suprapatellar technique, since it

would reduce the stretch force on patellar ligament during the reduction of proximal tibial fractures when compared with hyperflexion in infrapatellar nailing. From experience in this method of nailing, the soft tissue is exposed to far less intraoperative trauma compared with traditional positioning.

Besides this, easy manipulation of C-arm fluoroscopic machine ,also facilitate fracture reduction and fixation during surgery.[8] Patients who were treated with suprapatellar approach felt mild or no postoperative anterior knee pain as compared to conventional infrapatellar or parapatellar technique possibly due to sparing of the patellar ligament injury and infrapatellar nerve injury.

Concerns over the use of SPN include entry through a healthy knee joint and the risk of inflicting damage to the knee joint . Gelbke *et al.*(2010) found that the mean contact force on the patellar articular surface was 3.83 MPa via a suprapatellar approach, lower than 4.5 MPa (a critical pressure to cause chondrocyte injury) and hence, they considered suprapatellar nailing had a limited damage to cartilage.[9] Gaines *et al.* also proved that the suprapatellar approach was associated with a lower overall incidence of damage to intraarticular structures.[10]

In this study, there was also no patient suffering from the postoperative knee pain at present, which could be explained by the placement of the sleeve adjoining tightly to tibial spine which protects patella cartilage from the damage of surgical instruments. Sanders *et al.* (2014) have initially reported the clinical and radiographic results of tibial fractures after supra patellar intramedullary nailing and found excellent tibial alignment, union and knee joint ROM.[11]

In our study that patients showed excellent clinical outcomes in bone union, knee joint ROM and the functional recovery, with no complications such as knee pain, infection, osteomyelitis and nonunion.

CONCLUSION : Intramedullary tibia nailing via suprapatellar approach is an efficient and convenient treatment for selected tibial fractures, with less postoperative knee joint pain, fewer postoperative complications and early functional recovery.

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