

Original Research

Functional And Radiological Outcomes In Tibia Fractures Treated By Closed Reduction With Interlocking Nail Using Suprapatellar Approach: A Prospective Study

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ABSTRACT

Aim & Objectives: To evaluate functional and radiological outcomes in tibia fractures treated by closed reduction with interlocking nail using suprapatellar approach

Design: Prospective clinical study

Methods: 32 patients with tibia fractures were treated with Suprapatellar nailing from February 2021 to March 2022 and subsequently evaluated at 1, 3, 4.5, 6, 9 and 12 months post operatively for fracture union, knee ROM, tibial alignment, functional outcome (Lysholm score) and complications (pain and infection).

Results: Mean age of patients was 44.62 years. Just one patient reported anterior knee pain at 12 months follow-up out of 32 patients. Mean knee ROM at 12 months was 127.03 degrees in comparison to 128.1 degrees on the opposite side. Lysholm knee mean score at 1 year follow-up was 90.40. Mean time for fracture healing based on RUST score was 5.15 months. Only two cases of complications were noted, one of delayed union and superficial infection, each. There was no case of mal-alignment.

Conclusion: Suprapatellar nailing as a treatment modality of tibia fractures treated with closed reduction resulted provided brilliant functional and radiological outcomes.

Keywords: tibia fractures, interlocking nail, suprapatellar closed reduction

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INTRODUCTION

Among long bones, Tibia is one of the most frequently fractured bones in the human body. The tibial shaft fractures account for 2% of all fractures, constituting the most among all the diaphyseal fractures [1]. Associated with a diverse range of injury mechanisms, tibial fractures were deemed serious, debilitating and potentially fatal throughout history. Currently, the incidence of all kinds of tibia fractures is 51.7 per 100,000, roughly one thirds of which is accounted by the diaphyseal tibial fractures with the incidence of 15.7 per 100,000 person-years. In women, all kinds of tibial fractures demonstrate a progressing trend with age; while men show a uniform distribution across age groups, with the exception of young males who had slightly higher incidence for tibial shaft fractures [2]. Management of tibial fractures is dictated primarily by the character & location of fractures and their associated soft tissue

injuries. Multiple treatment modalities are available including intramedullary nailing, open reduction and internal fixation and external fixation. First reported in medical journals in mid-1800s, Intra-medullary nailing for diaphyseal fractures was developed and popularized by Gerhard Küntscher in the 1930s and 40s, earning him a Nobel Prize nomination [3]. Currently, interlocking intramedullary nailing constitutes the ideal management modality for unstable tibial shaft fractures. Conventional tibia nailing is done by Infra-patellar approach which requires extreme flexion at the knee joint as the point of entry for nailing is beneath the patellar tendon in the region across the space separating the articular surface of tibia and the tibial tubercle. Over the past few decades, Intramedullary nailing techniques and nail designs have witnessed a tremendous evolution, which brought proximal as well as more distal tibia fractures under the ambit of indications for nailing.

Despite having benefits, Intramedullary nailing for proximal tibia fractures are technically daunting because the muscular forces on fracture fragments tend to keep the fractured tibia in procurvatum deformity and the conical shape of tibia metaphysis also render it difficult for nailing as slightly angulated entry can lead to valgus or varus deformity. [4]. To prevent this specific complication of proximal tibial fracture mal-alignment with nailing, a semiextended technique was developed by Tornetta et al. (1996) [5]. A partial medial parapatellar arthrotomy was employed and patella was displaced laterally to insert interlocking nail with the knee in semi-extended position with approximately 15 degrees flexion. This technique reported good results. The suprapatellar nailing, introduced by Dean Cole MD in US, is a variation of the semi-extended approach of Tornetta. This Suprapatellar approach requires an incision proximal to the proximal pole of patella, and through the PF joint, the nail is inserted using a protected sleeve. This study aims to evaluate functional and radiological variables in tibial fractures treated by closed reduction with interlocking nail using suprapatellar approach.

PATIENTS & METHODS

Patients: From February 2021 to March 2022, all the patients (n=32) who were above the age of 18 years with tibial fractures AO type 42 (closed and open Gustilo-Anderson type I, II & IIIA) and presented to our institute were included in the study. Patients who sustained Gustilo-Anderson type IIIB & IIIC fractures were excluded. All patients went through closed reduction with intramedullary nailing using Suprapatellar approach.

Technique: After positioning the patient supine on the OT table, a pad is placed under the ipsilateral hip to prevent external rotation of limb at hip joint during surgery and a bolster is placed under the leg maintaining 15-20 degrees of knee flexion. The opposite lower limb is placed either on the table or be flexed and kept hanging on the side of the table. The fluoroscopy is positioned on the side opposite to the affected limb. A 5 cm vertical midline incision is taken from a point 2.5 cm cephalad to the upper patellar pole extending proximally. In line with the incision, the quadriceps tendon is incised vertically. The patella-femoral joint is accessed from beneath the upper pole of patella with a finger. Any intra-articular adhesion is broken manually and a blunt trocar with a protector sleeve is slid down through the incision in the PF joint ultimately coming in contact with the entry point. The ideal entry point for Suprapatellar nailing is a point which is located slightly medial to the lateral intercondylar eminence in the antero-posterior view and slightly anterior to the articular margin of tibia in the lateral view (Figure 1,2). Under C-arm guidance, an entry is established by introducing a guide pin through the protector sleeve.

The direction of the guide pin must be in line with the shaft of the bone. The pin acts as a point of purchase and is drilled inside only for 2-5cm. After accepting the position of guide pin, an entry reamer is pushed from inside the protector sleeve to widen the canal. Both the guide pin and the reamer are then pulled out. The fracture is reduced with the guidance of C-arm and the reduction is held by an assistant. A ball-tipped guide wire is advanced through the entry point and pushed across the fracture site. With the reduction secured, the canal is reamed with progressively increasing sizes of reamers over a guide wire. After intramedullary reaming is done, an appropriate sized nail is selected and inserted through the entry canal over a guide wire and across the fracture (Figure 3). As the knee is positioned in slight flexion of 15-20 degrees, antero-posterior and lateral views are conveniently obtained to check for fracture alignment and proximal and distal ends positioning. Free hand technique is employed for distal interlocking and then proximal locking is done with the guidance of the nailing system. Check fluoroscopy views are taken. Knee and other surgical wounds are washed with saline. Patellar tracking is checked by subjecting knee to full range of movements. Compression dressing is done after meticulous closure in layers.

Post-operative Protocol & Outcome Measures:

Active and active-assisted ROM exercises of knee and ankle joint, and quadriceps strengthening exercises were commenced on first post-op day followed by dressing of the surgical site on 3rd day. Sutures were removed in the 3rd week post-operatively. Weight bearing was decided on the basis of fracture pattern and the final fixation. Patients were followed-up of patients at periods of 1, 3, 4.5, 6, 9 and 12 months after surgery. At each visit, patients had to report a VAS (Visual analogue scale) score for anterior knee pain. Knee ROM was documented with the help of Goniometer on every visit. Patients were also asked to fill a Lys holm knee questionnaire, based on which a Lysholm score was obtained on each follow-up. Lysholm knee score is a validated patient-recorded tool to measure lower extremity functional status in patients with a spectrum of lower limb conditions [6]. Antero-posterior and lateral x-ray films are obtained to evaluate position of implant and fracture union and a RUST score was assigned at each follow up. Developed by Whelan et al., Radiographic union score for tibial fractures (RUST) is a valid outcome metric for assessment of tibial fracture healing. A score of 10 or above signifies radiological union [7].

RESULTS

Patients & Fractures: In our study, 32 patients were included and followed up for at least a period of 12 months. The average age of patients was 44.62 with the range varying from 20 to 76 years. The age group of 20-30 years of age was affected the most. Out of 32 patients, there were 18 males and 14 females. 17

patients had right sided fractures and 15 had left sided fractures. 20 fractures were closed and 12 were open. Open fractures were further classified on the basis of Gustilo-Anderson classification and included 9 GA type I, 2 GA type II and 1 GA type IIIA. Fractures

were also classified according to AO/OTA classification and included 11 AO 42A (A.1 = 2, A.2 = 6, and A.3 = 3), 12 42B (B.1 = 4, B.2 = 5, and B.3 = 3), and 9 42C (C.1 = 3, C.2 = 4, and C.3 = 2).



Figure 1: Guide pin entry in AP view



Figure 2: Guide pin entry in Lateral view



Figure 3: Nail insertion on a Suprapatellar zig



Figure 4: 21 yr old male with history of road traffic accident. (a) shows AP and lateral views preoperatively. (b) shows AP and lateral views 1 year post-operatively. (c) and (d) shows Knee RoM at 1 year

Knee ROM: The average knee range of movements at 1 year follow-up was 127.03 degrees. The mean knee ROM on the contra-lateral side was 128.1 degrees. All knees had full extension. Twenty nine knees had flexion > 120 degrees. None had flexion less than 90 degrees.

Lysholm Knee Score: The lysholm knee score was used to evaluate knee functional status. The mean score at 1 year was 90.40. The breakdown of the score included 14 excellent (95-100), 14 good (84-94), 3 fair (65-83) and 1 poor (<65).

Time to Radiological Union: The mean time taken for fracture union was 5.15 months. This was based on RUST score and a score of 10 or more was considered as union. Only one patient had union after 6 months and needed dynamization at 6 months, following which union was achieved as 9 months.

Knee Pain: In our study, 31 out of 32 patients reported no pain (VAS=0) at 12 months follow-up. Only one patient complained of mild pain anteriorly (VAS = 2).

Mal-alignment: Out of 32 patients, no patient had more than >5 degrees of mal-alignment in any plane. Mean coronal mal-alignment was 1.93 degrees and mean sagittal mal-alignment was 2.03 degrees.

DISCUSSION

The tibial fractures constitute one of the most common fractures encountered by an orthopaedic surgeon. Since the resurgence of interest in Intramedullary Nailing for diaphyseal fractures in 1970s, it has been touted as the gold standard. The conventional method is to make an infrapatellar entry either through patellar tendon or sparing it. Although this has provided satisfactory results, but there have been reports of anterior knee pain in the literature. Also, the procedure mandates the knee to be kept in hyper-flexion during surgery which renders the reduction vulnerable to sagittal plane (procurvatum and antecurvatum deformity) and coronal plane (varus and valgus) deformities. A relatively newer approach of performing Intramedullary Nailing through suprapatellar entry point has gained traction in the last few years. Our study was conducted at Mahatma Gandhi Hospital, Jaipur from February 2021 to March 2022 and included 32 patients of tibial fractures treated by closed reduction with interlocking nail using suprapatellar approach. We reviewed some prospective studies assessing functional and radiological outcomes of tibial fractures treated by suprapatellar approach. In our study of 32 patients, only one patient had a complaint of knee pain at 12 months. Sanders et al.[4] reported only one out of 36 patients with knee pain. Cazzato et al.[8] also reported just 1 patient out of 25 patients for knee pain.

However, Fu et al.[9] reported no incidence of knee pain. At 1 year the average ROM of affected limb was 127.03 degrees. This was in contrast to 128.1 degrees in the contra-lateral limb. Sander's et al. reported similar range of movements in both limbs at 1 year. Fu et al. reported knee ROM of 117 degrees. The average Lysholm knee score reported at 12 months was 90.40. Others reported similar score. The mean Lysholm score reported by Sander's et al. was 82.14 while Cazzato et al. reported Lysholm score of 97.7 at 24 months follow-up. In our study the main LEFS score at final follow up was 69.13. The average time taken for radiological union was 5.1 months. Fu et al. reported average healing time of 20.2 weeks. In our study, there was no incidence of mal-alignment. Fu et al. also reported no cases of mal-alignment. Also, there was no incidence of knee infection for the whole period. However, there was one case out of 32 cases of superficial infection associated with open wound. This was in consonance with both Sanders et al and Cazzato et al who reported no cases of infections, knee or elsewhere. No case of nonunion was encountered, albeit one case had delayed union, which required dynamization. Fu et al reported no delayed union.

CONCLUSION

In recent times, the Suprapatellar approach has come to be considered as a useful tool in a surgeon's armamentarium. We believe that Supra-patellar nailing, when performed in accordance with present surgical guidelines and techniques, is an excellent modality to treat tibial fractures requiring nailing. This is supported by low incidence of complications and relatively early return to baseline functional status.

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Conflict Of Interest

None

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Informed Consent

Informed consent was obtained for the purpose of clinical images.

Institutional Ethical Committee Approval

Institutional ethical committee clearance for this study was obtained (MGMCH/IEC/JPR/2021/385)

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