Distal third tibia fractures treated with interlocking intramedullary nail

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ABSTRACT

The management of extraarticular fracture of the distal tibia remains controversial. Surgeons are not very keen on using intramedullary interlocking nail for these fractures because of difficult nail fixation, wider medullary canal in the distal tibia and late angulation .The advent of newer nails with locking holes in the distal parts has made nailing possible even in cases of distal tibia fractures. Between January 2012 to June 2014, 17 skeletally mature patients with mean age of 35.8 years with distal third tibia fractures within 11 cm from the tibial plafond were treated with intramedullary interlocking nail. The radiological and functional outcome was evaluated with a follow up of at least one year. All fractures united within the study period with a mean time of union 21.76 weeks. On the final follow up, 4 patients had a mean angulation of 2.75 degrees in coronal plane, 6 patients had an angulation of 3.5 degrees (2-8 degrees) on the saggittal plane and no rotational malalignment. None of the patients developed angulation outside the acceptable range. The average Olerud and Molander score at final follow up was 91.76 ranging from 85 to 100 with 12 (70.6%) of the patients having good outcome and 5(29.4%) of them having an excellent outcome. Intramedullary interlocking nailing with two distal locking bolts in case of distal third tibia fracture leads to good to excellent functional outcome and good rate of union.

Keywords: Distal tibia; intramedullary interlocking nail

INTRODUCTION

Fractures of the distal third of tibial shaft occurs commonly as a consequence of road traffic accident, fall from height, sports and direct injury.[1] The management of extraarticular fracture of the distal tibia and intraarticular with minimal involvement of the ankle joint remains controversial.[2,3]Various modalities of treatment have been reported till date with advantages and disadvantages of each modality. Conservative management, closed reduction and interlocking nailing, open reduction and plating, minimally invasive percutaneous plate osteosyntheis and external fixation are the some of the modalities available for the treatment of these fractures.

Non operative treatment is suitable for minimally displaced fractures while more displaced fractures are managed with operative techniques.[4-6] Conservative management of these fractures are associated with increased stiffness and decreased quality of life due to prolonged immobilization, loss of reduction and high rate of secondary procedures.[7-9]

External fixators are associated with complications like need of secondary operation, prolonged healing time and pin tract infection.[10, 11]Patients managed with both plate and nail can be mobilized early. Advocates of plating suggest better alignment with this technique. However, plating is associated with wide soft tissue dissection and disruption of the fracture hematoma which can lead to interference with the normal physiology of bone healing, wound dehiscence, infection, hardware prominence and delayed healing.[12-18]

In contrast, intramedullary interlocking can be done with closed technique alleviating the drawbacks of plating technique. Intramedullary interlocking nail has been seen to be an acceptable and effective method of treatment of tibial shaft fractures.[13, 19-24] With the newer design nails with locking holes nearer the distal end of the nail, the indication of nailing can be extended even to the distal third tibia fractures and fractures with intrarticular extension into the ankle.[19, 21]

Minimally invasive percutaneous plate osteosynthesis is a newer technique which is associated with minimal soft tissue dissection leading to less disruption of fracture hematoma and preservation of periosteal blood supply with promising results and less wound complications.[14, 25] However, despite using locking plate, one study revealed that 48% of the patients required implant removal either for irritation by hardware and skin impingement or infection.[26]

Intramedullary interlocking nailing is not considered a good option by some surgeons in the management of distal third tibia fractures because of difficult nail fixation, wider medullary canal in the distal tibia and late angulation.[3, 12, 27-31] The advent of newer nails with locking holes in the more distal part of the nail have

made nailing possible even in distal tibial fractures. There are few studies that show good results of nailing in terms of late angulation and rate of union.[13, 19, 20, 21, 28, 32] The aim of this study is to evaluate the radiological and functional outcome of distal third tibial fractures treated with closed intramedullary interlocking nail in skeletally mature patients.

MATERIALS AND METHODS

This study was conducted in the Department of Orthopaedic surgery in Kathmandu Medical College Teaching Hospital. Between January 2012 to June 2014, 17 skeletally mature patients with distal third tibia fractures were treated with intramedullary interlocking nail. Informed consent was taken from all the patients. Patients with polytrauma, comminuted tibial pilon fracture, fractures too distal in which two distal interlocking bolts could not be fixed, pathological fractures, compound fractures of Gustilo grade II and above and the patients who could not be followed up for at least a year were excluded from the study. There were 9(52.9%) male and 8(47.1%) female patients from 18 to 56 years with a mean age of 35.8 years. Nine (52.9%) patients had fracture of the right tibia while 8 (47.1%) had fractures of the left tibia. Twelve (70.6%) patients has sustained injury in road traffic accident and 5 (29.4%) had injury by fall from height. One (5.88%) patient had compound fracture (Gustilo I) and the rest of the fractures were closed. Eight (47.1%) fractures were oblique, 4 (23.5%) were transverse, 3 (17.6%) were spiral and 2 (11.8%) were comminuted. None of the fractures were intraarticular.

One (5.9%) patient had diabetes mellitus type 2 and 3(17.6%) had hypertension which were under control. No patient had peripheral vascular disease. Seven (41.2%) patients were smoker and 6 (35.3%) were consuming alcohol on regular basis which could impede the quality of bone.

All patients were treated with closed reduction and internal fixation with intramedullary interlocking nail. Nailing was done by transpatellar approach. All nails were inserted after reaming. Two proximal locking and 2 distal locking bolts were inserted in all patients. All but one patient had fibula fracture. The fibula fractures were at least 5 cm above the syndesmosis. Patients were evaluated for syndesmotic injury preoperatively and none had syndesmotic injury. In patients who had no fibula fracture, oblique osteotomy of fibula was done during the surgery so that the fracture impaction could be possible. Postoperatively third generation cephalosporin was given intravenously for 48 hours which was converted to oral form and continued for a total of 7 days. Partial weight bearing was started as soon as the patient was comfortable (1-14 post operative days). Full weight bearing was advised after radiological evidence of union. Radiographic assessment was done by standard anteroposterior and lateral views of x ray taken at 3 weeks, 6 weeks, 12 weeks, 3 months, 6 months and 1 year after surgery. The alignments immediately after the surgery and at the last follow up were compared for the malalignment. Malunion was defined as angulation of more than 5 degrees in coronal plane, 10 degrees on saggittal plane and 10 degrees of rotation.[33] Non union was defined as no radiological sign of healing at 6 month. Union was defined as presence of solid callus on three out of four cortices judged on the anteroposterior and lateral radiograph or obliteration of fracture line and possible painless weight bearing. Patients were followed up for an average of 1.46 years (1-2 years). Functional assessment was done by the Olerud and Molander Ankle Score at last follow up (Table 1).[34]

Table 1. The Olerud and Molander ankle score

Pain	Score
None	25
Walking on uneven surface	20
Walking on even surface	10
Walking indoors	5
Constant and severe	0
Stiffness	
None	10
Stiffness	0
Swelling	
None	10
Evenings	5
Constant	0
Stair climbing	
No problems	10
Impaired	5
Impossible	0
Running	
Possible	5
Impossible	0
Jumping	
Possible	5
Impossible	0
Squatting	
No problems	5
Impossible	0
Supports	
None	10
Tape, wrapping	5
Stick or crutch	0
Work, activities of daily living	
Same as preinjury	20
Reduced	15
Change of job	10
Severely impaired	0
Total	100

RESULTS

The average distance of the fracture from tibial plafond was 8.08 cm ranging from 6.2 to 11 cm.

Average duration of delay in surgery was 9.8 days (2-35 days). Eleven patients (64.7 %) had delay in surgery because of poor soft tissue condition like massive swelling, fracture blisters and abrasions. One patient had to wait for 35 days before surgery since she was managed conservatively but later decided to operate because of an unacceptable angulation. Eleven (64.70%) patients had one distal locking bolt in anteroposterior and one in mediolateral direction and the rest 6 (35.29%) had both distal locking bolts in mediolateral direction.

In immediate post operative period, 3 patients had angulation in coronal plane (all varus), 1 patient had angulation in saggittal plane (recurvatum) and none had rotational malalignment. At the last follow up, 4 patients had angulation in coronal plane (all varus) with an average of 0.65 degrees (maximum 4 degrees) and 6 patients had angulation in saggittal (all recurvatum) of an average of of 1.23 degrees (maximum 8 degrees). None of the patients had rotational malalignment or angulation more than 5 degrees in coronal plane and more than 10 degrees in saggittal plane. A weak negative correlation(ρ = -0.293, p= 0.253) was found between the distance of fracture from the mortise and angulation at last follow up suggesting tendency towards high chance of angulation or higher chance of unstable fixation in the fractures near the ankle joint than in fractures farther from the joint (fig 1).

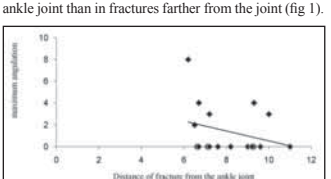

Fig. 1 : Correlation of the angulation at last follow up with distance of fracture from the ankle joint

Among patients having at least some angulation on the last follow up, the mean angulation was 1.16

degrees when both the distal locking screws were in mediolateral direction and 1.5 degrees in cases

where distal locking were in mediolateral and anteroposterior direction.. However the difference in mean was not significant Mean distance of fracture from the ankle mortise was 9.7 cm among patients having both distal locking bolts in mediolateral direction and 7.2 cm in patients having one distal locking bolt in anteroposterior and one in mediolateral direction (p = 0.00). All patient developed union within study period of two and half years.

Fig. 2. Preoperative and Post operative radiographs showing varus angulation

The average time of union was 21.76 weeks ranging from 12 to 36 weeks. Six (35.3%) patients required at least one form of secondary procedure for union. Out of 6 patients, 5 required dynamization of proximal bolts to aid union. One of the patients developed infective non union at 6 month and the infection was not controlled by repeated debridement and intravenous antibiotics. Exchange nailing was done at 25 weeks and the fracture ultimately united at 36 weeks.

The average Olerud and Molander score at final follow up was 91.76 ranging from 85 to 100. Five (29.4%) of the patients had excellent outcome while 12 (70.6%) of the patients had good outcome. The mean angulation at last follow up in patients having excellent outcome was 1.2 degrees and in patients having good outcome was 1.5 degree without statistically significant difference (p= 0.815) suggesting that angulation within acceptable limit does not have significant effect on the functional outcome (fig 4).

Fig. 3 Pre and post operative radiograph showing locking in two planes

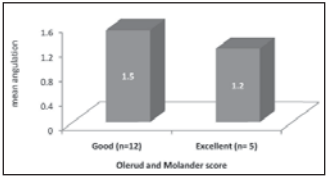

Fig. 4. Mean angulation in different functional outcome groups

One patient had numbness around the scar on the knee. Four patients had implant removal after 1 and half years as a routine procedure. At the last follow up, the average range of motion of knee and ankle were 94.3% and 93.4% on the contralateral side, respectively. At the last follow up 7(41.2%) of the patients had mild swelling at the knee, leg or ankle which was not found to be associated with any limitation of the activities or deep vein thrombosis.

DISCUSSION

Distal third tibia fractures are common injuries and comprise of around 10-13 % of all tibial fractures.[19, 35] Nailing can be done by closed technique and this avoids all complications related to open reduction and placement of prominent hardware. We evaluated the outcome of these fractures managed with closed interlocking nailing.

In our series we found that intramedullary interlocking (IMIL) nailing in case of distal third tibia fracture leads to good to excellent functional outcome and good rate of union with acceptable angulation.

Ehlinger M *et al* analyzed 51 patients with distal tibia fibula fractures treated with anterograde intramedullary interlocking nailing.[24] Mean Olerud and Molander score was 83.2. Similarly mean Olerud and Molander score in the series of Ibrahimi A E *et al* was 87.9.[13] In our series, the mean score was 91.76 which was consistent with the other studies.

A high union rate of 96 to 100 percent has been reported in multiple series.[13, 19-21, 24, 32] In our series as well all patient united within the study period. Nork *et al* in their series of 36 patients reported the average union time to be 23 weeks.[20] Other studies by Fan *et al*, Megas *et al*, Ehlinger *et al* and El Ibrahami *et al*, however, noted much shorter union time 17, 16, 15.7, 17.5 respectively.[13, 19, 21, 24] Mean union time in our series (21.7 weeks) was slightly longer than noticed in many literatures. As we had a relatively smaller sample size we believe that a few outliers may have influenced the results.

The results of angulation are varied in literature. Fan et al and Mosheiff R *et al* found no unacceptable angulation whereas proportion of angulation as high as 22% of malunion has been reported by Megas et al.[19, 21, 32] Elingher found an angulation of more than 10 degrees in 1.9% of the patients.[24] Ibrahimi A E *et al* evaluated 33 patients managed with intramedullary nailing of distal tibia fractures and found 12.1% patients with malunion.[13]

In our series, 8 patients had at least some angulation in one plane, however, none had unacceptable angulation. We found that the mean angulation at last follow up was slightly more in patients where the distal locking bolts were applied one on the coronal plane and other on the saggittal plane than in patients where both the locking bolts were applied on coronal plane. However, the result was not statistically significant. The mean distance was significantly shorter in patients where distal locking was done in two planes. This suggests the tendency of surgeons towards fixing the distal locking bolts in two planes in fractures nearer to the ankle joint. Also, there were more patients who had distal locking bolts in two planes. The definite conclusion about the effect of patterns of locking could be deduced, had the pattern of locking been randomized.

Elingher reported two cases (3.92%) of deep infection.[24] Ibrahimi A E noted one patient with anterior knee pain and discomfort on kneeling.[13] We also found one case (5.88%) of infective non union. However the complications described in literatures like pseudoarthrosis, anterior knee pain, implant failure and iatrogenic fractures were not found in our study.[20, 24, 32] Malalignment or loss of reduction has been reported to occur after IMIL due to improper reduction, poor nail fixation, loose fixation and nail propagation into the ankle joint.[19, 36] However our study failed to demonstrate any of these complications.

Elingher reported 11.76% of patients requiring at least a form of secondary procedure for union out of which dynamization was the most commonly deployed. In our series 35.29 percent of the patient required at least a form of secondary procedure for union most of which were dynamization (29.4%). This might be because in our study all patients whose progress of union was considered inadequate by 12 weeks postoperatively were taken in for dynamizaiton.

The limitation of our study was the small sample size as a result of which the data could have been highly affected even by a single outlier and the effect of the pattern of distal locking on the outcome could have been better delineated had the locking pattern been randomized.

In our small series of 17 patients, we found that IMIL nail is in fact a good option in cases of displaced fractures of distal third tibia, once thought to be contraindicated for nailing. The interlocking holes on different planes in

interlocking nails continue to widen the scope of nailing in distal tibia fractures. A large sized study needs to be conducted to confirm these early benefits that are being observed with intramedullary interlocking nails in distal third tibial shaft fractures.

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