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Original Article

Extra-articular distal tibial fractures, is interlocking nailing an option? A prospective study of 147 cases

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ABSTRACT

Purpose: Distal tibia fractures comprise about 7%–10% of lower extremity trauma. Because of the peculiarity of the soft tissue and subcutaneous location of the bone there are many controversies in the ideal treatment of distal tibia fractures especially extra articular pilon fractures. Plating is fraught with complications of wound dehiscence and infection. There are limited studies which document outcomes in such cases using intramedullary interlocking nail. We intend to study the outcome and complications of extra articular distal tibial fractures treated with interlocking nailing.

Methods: This is a prospective study conducted in a tertiary care orthopaedic hospital in southern India. There are 147 patients of distal tibia extra-articular fractures managed by IM nailing with follow up of more than one year were included in this study. Only cases with fresh injury (less than 1 week), fracture below the isthmus, closed and open Gustilo Anderson type 1 and 2 fractures were included in the study. Patients were reviewed at 3, 6, 12 and 24 weeks after surgery and thereafter at one year and were assessed for clinical and radiological signs of healing, any complications, time to union and functional outcome.

Results: There were 102 males and 45 females (male/female ratio is 2.3:1) with a mean age of 38.96 (range 23–65) years. According to AO classification, there were 78 cases (53.06%) of 43-A1, 39 cases (26.53%) of 43-A2 and 30 cases of 43-A3 constituting 20.40%. The fracture united in all the patients at an average of 18 weeks (range 16–22 weeks), none of the patient in our series had a delayed or non-union. Two patients (1.47%) had the fracture united in mild valgus but it was well within the acceptable limits (<5°). The functional outcome was assessed in all the patients at final follow up using Olerud and Molander score all the patients fared an excellent to good score, there were no cases with poor score.

Conclusion: Intramedullary nailing is a viable option to treat distal tibial fractures with excellent outcome. Wound complications related to plating can be avoided but meticulous surgical technique is key to avoid malunion.

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Introduction

Fractures of distal tibia comprises of 7%–10% of lower extremity fractures. The tibia is the most common long bone to fracture owing to its subcutaneous nature and precarious soft tissue coverage especially in the distal one third.[1–4] Fractures of lower third of tibia are associated with an accompanying fibular fracture in about 85% of cases.[3,4] These fractures are considered to be inherently unstable and frequently associated with complications like delayed union, malunion, soft tissue complications and infection.[5–8] The optimum management of such extra-articular pilon fractures is conjectural with no clear guidelines depicting treatment. Historically the closed fractures of lower tibia have been treated by closed reduction and casting other modalities include plating (open and minimal invasive), interlocking nail, external fixators including Ilizarov circular ring fixators. Even within the specific modality of treatment there exists many variations in the technique. The recent trend drifted towards plating of extra-articular pilon fractures and plating for associated fibular fracture as well. However, due to anatomic

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peculiarities of distal tibia and swelling, blistering in acute trauma setting, plating is frequently associated with soft tissue complications like superficial infection, wound dehiscence, delayed healing and exposed implants which requires flap coverage.[9] Intramedullary nailing is a minimally invasive and more biological option of fixation and is considered as gold standard for tibia shaft fractures. It has gained recent popularity for the management of extra articular pilon fractures and indications are widened to include distal tibial fracture with partial articular extension as well. However, angular malalignment in the frontal plane is a frequently reported complication with IM nailing in distal tibia fractures due to wide medullary cavity besides delayed union, malunion and implant failure.[10,11] The purpose of this study was to evaluate the clinical and radiographic outcome of extra-articular pilon fractures treated with interlocking intramedullary nailing.

Methods

This prospective study was done in a tertiary care centre of southern India between December 2011 to December 2016, 147 patients of distal tibia extra-articular fractures managed by IM nailing with follow up of more than one year were included in this study. Inclusion criteria was skeletally mature individuals with fresh injury (less than 1 week), fracture below the isthmus, closed and open Gustilo Anderson type 1 and 2 fractures.[12] Fractures with articular extension, within 3 cm of ankle joint, open type 3 fractures, associated with other comorbidities affecting rehabilitation, neurovascular deficit, bilateral injuries, ipsilateral femur or pelvis fracture, spine fractures and fractures in skeletally immature patients were excluded from study. Mode of trauma, any comorbid conditions, smoking and alcohol intake history was recorded for all patients. In examination, swelling over the ankle, open wounds, and neurovascular status was assessed. Standard anteroposterior and lateral radiographs of the leg and ankle were taken. The fractures of distal tibia (extra-articular) were classified as per AO/OTA classification system into 43-A1, 43-A2 and 43-A3 depending upon the fracture geometry. The patients' general conditions like obesity or history of smoking or alcohol intake and comorbidities like diabetes or neuropathy status were also noted and informed written consent was obtained from all the patients. The management plan, cost of surgery/implant, hospital stay, and possible complications of the surgery was explained to the patients in detail. Complications include superficial wound infection, implant failure, delayed or non-union, ankle instability, and varus/valgus mal-angulation. Patients were reviewed at 3,6,12 and 24 weeks after surgery and thereafter at one year and were assessed for clinical and radiological signs of healing, any complications, time to union and functional outcome. Union was defined radiologically as the presence of mature bridging callus in three or more cortices seen in bi-planar radiography without fracture site pain on unsupported weight bearing. Malunion was described as fractures healed in >5° angulation in the frontal plane (varus/valgus), >10° angulation in the sagittal plane (procurvatum/recurvatum), torsional deformity >10°, or a shortening > 1 cm. The functional outcome was assessed by using Olerud and Molander score.

Surgical technique

All the patients were operated under spinal anaesthesia. Patient was positioned supine on the operating table and prophylactic antibiotic (Ceftriaxone 1 g) was given. Draping and painting was done in a standard manner. The fibular fracture was dealt first, we used a stainless steel rush nail in all the fibular fractures that required fixation. A small stab incision was made over the tip of lateral malleolus, using a 2.5/3.0 mm K wire, a portal was made into the medullary cavity of the distal fragment of the fibula. A rush nail of appropriate size was put initially into the distal fragment only to control the distal segment and it was reduced to proximal fragment under image intensifier and advanced proximally. The size of the rush nail varied upon the medullary cavity and location of the fracture. The distal 2–2.5 cm of the nail has been bent by about 15° keeping the hook of the nail laterally to prevent varus deformity of the ankle. In the next step, the distal tibial fracture was reduced under image intensification and intramedullary nailing was done through a Para median incision over patellar tendon, the patellar tendon was retracted laterally and entry portal was made. We engaged the guide wire in the lateral half and slightly anteriorly from the midline in anteroposterior and lateral view respectively to prevent valgus and recurvatum of distal fragment. After proper placement of guide wire and ensuring adequate reduction under C-arm, reaming of medullary canal was done and IM nailing with biplane distal screws and static locking was done. The limb was placed on two pillows for initial two days post operatively and intermittent isometric and isotonic exercises were started on the first post-operative day. Patients were assessed clinically for wound infection, wound dehiscence, and ankle instability. They were also assessed radiographically for fracture union, delayed or non-union and implant failure. Radiographs were taken immediately on post-operative day and then at 6, 12 and 24 weeks. Partial weight bearing was allowed at 6–8 weeks and full weight bearing at 12–14 weeks depending upon the status of clinical and radiological bone healing.

Results

There were 102 males and 45 females (male/female ratio is 2.3:1) with a mean age of 38.96 (range 23–65) years. Eighty-seven (59.18%) patients were treated for a right-sided fracture and 60 (40.81%) for a left tibial fracture. Motor vehicle accident was the most common mode of trauma in our series followed by fall from height and sports injuries. The fractures of distal tibia (extra-articular) were classified as per AO/OTA classification system into 43-A1, 43-A2 and 43-A3 depending upon the fracture geometry. There were 78 cases (53.06%) of 43-A1, 39 cases (26.53%) of 43-A2 and 30 cases of 43-A3 constituting 20.40%. There were 41 (27.89%) open fractures in our series with Gustilo type 1 constituting the majority ($n = 27$) and the remaining were type 2 ($n = 14$). The fibula was fractured in 107 (72.78%) patients, mid-shaft followed by distal third was the commonest site of fracture. Intramedullary nailing was done in supine position with medial para-patellar incision in all the patients with leg either flexed over a sterile bolster or hanging from the side of table. We fixed fibular fracture with intramedullary nail (Rush Nail) in all the patients that required fibular fixation. All the patients were available for final follow up at one year. The fracture united in all the patients at an average of 18 weeks (range 16–22 weeks), none of the patient in our series had a delayed or non-union (Figs. 1 and 2). The fibular fracture healed earlier than tibial fracture at an average of 14 weeks. There was no case of deep seated infection, three patients had superficial skin infection which completely healed with antiseptic dressing only. All the 3 superficial infection were seen in patients with open fractures. None of the patient in our series had any sign of ankle stiffness, instability, chronic infection, wound dehiscence or gross malunion. Two patients (1.47%) had the fracture united in mild valgus but it was well within the acceptable limits (<5°) (Fig. 3). There was no case of mal-angulation in the sagittal plane. All the patients where the fibula fracture was above 5–7 cm and not needed fixation were started on ankle and knee isometric and isotonic exercises on day two after the initial operative pain subsided. For the patients where the fibula was fixed, initial below knee posterior slab applied and kept for 2–3 days. Partial weight

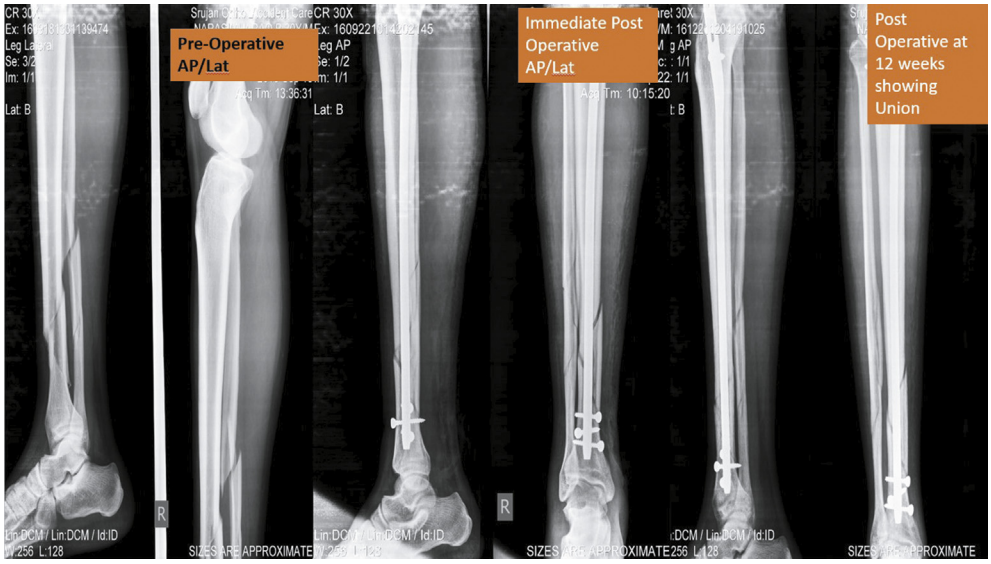

Fig. 1. Fracture of lower third tibia managed by interlocked nailing showing anatomic alignment and progressive union at 12 weeks post-surgery.

bearing was allowed at 6 weeks after assessing clinically and radiologically progressing to full weight bearing at 12 weeks post-operatively. The functional outcome was assessed in all the patients at final follow up using Olerud and Molander score all the patients fared an excellent score, there were no cases with poor score.

Discussion

Extra-articular fractures of distal tibia comprise of about 7–10% of all lower extremity fractures.[1–4] The management of extra-articular pilon fractures is variable and no clear guidelines exist. The un-displaced or minimally displaced closed fractures can be adequately managed by casting, however, it carries a significant risk of ankle and knee stiffness. Intramedullary nailing is considered as a gold standard in the treatment of tibial shaft fractures with many authors extending the indications to include distal tibial fractures even partial articular as well.[1,13–15] Nailing in distal tibial fractures is advantageous as its more biological fixation, minimally invasive, early rehabilitation and soft tissue complications are fewer compared to plates. Bedi et al.[16] in his study on surgical treatment of non-articular distal tibial fractures reported that IM nailing is a less invasive method that does not cause soft tissue compromise, spares vascularity and is performed without opening the fracture area. Guo et al.[17] in a study of 85 patients comparing intramedullary nailing with plate fixation in distal tibial metaphyseal fractures found no significant differences in terms of time to union. Moreover, function and alignment were better in the intramedullary nailing group, although it was not statistically significant. Freedman et al.[18] in a study on tibial fracture malalignment following intramedullary nailing observed the malunion rate was 7% in tibial diaphyseal fractures and 8% in distal third fractures. Heimlich et al.[19] studied the effect of interlocking screw hole tolerances in tibia fractures treated with intramedullary nailing and concluded that the reduction obtained intraoperatively deteriorated to some degree during the period until union and it was due to the larger diameter of the screw hole in the nail than the diameter of the screw. The malunion rate in our series was 1.47% which is very low compared to other published results and even malalignment in our series was within the acceptable limits (<5°). We attribute this low malalignment to the meticulous surgical technique and biplanar locking of nail in distal

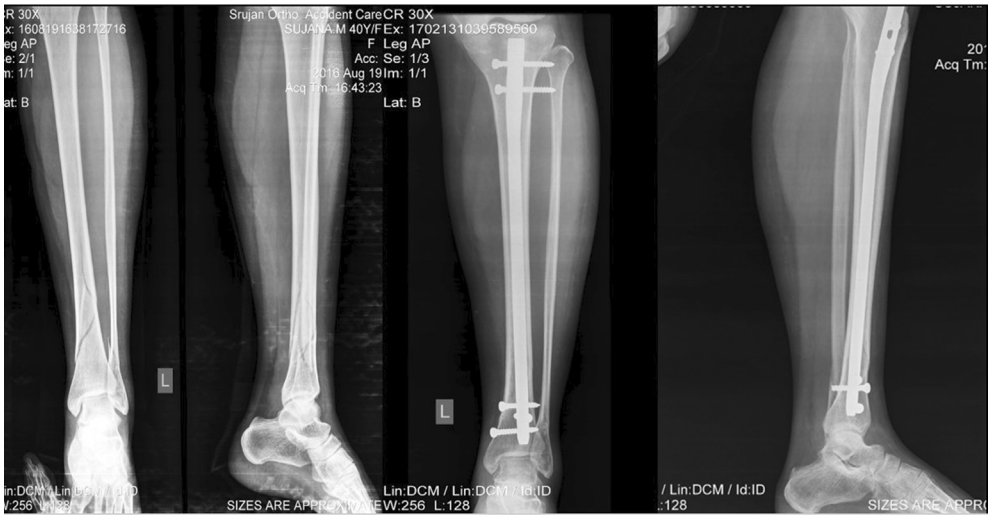

Fig. 2. Case 2 fracture being managed by locked nailing showing adequate reduction and fracture union.

Fig. 3. Radiograph of a patient at 12 weeks post-surgery showing ankle valgus (LDTA 81° against normal of 86°–92°).

segment, we consider that malalignment in coronal or sagittal plane can be tackled well intraoperatively by anatomic reduction under image intensification, use of poller K wires where required and were removed immediately after locking and fibular fixation prior to tibial fixation. The average time to union of tibial fracture was found to be 18 weeks in our study with a range of 16–22 weeks whereas fibular fracture united at an average of 14 weeks irrespective of fixation. Superficial wound infection was seen in three (2.04%) patients and none of the patient in our series had either delayed union or non-union. Janssen et al.[20] in their study on distal tibial fractures found the mean time to radiographic union as 21 weeks (range 13–28 weeks) for the IM nailing group, delayed union occurred in 3 patients (25%) who had IM nailing. Management of distal tibial fractures with open reduction and plating is frequently associated with soft tissue complications like wound infections, dehiscence and wound necrosis, which, in some cases, required flap transfer for limb salvage.[9] Anderson et al.[21] in a study on ankle fractures in the elderly quoted complication rate of 40% for open reduction and internal fixation of fibula fractures. Teeny et al.[22] in their study on variables contributing to poor results and complications in tibial plafond fractures treated with open reduction and plate fixation observed poor results in 50% of the cases with 37% developing deep infection. It is also considerably higher in patients with systemic diseases, particularly diabetes and neuropathy and in those with compromised local soft tissues and those who smoke. In contrast to open reduction with internal fixation (ORIF), intramedullary nailing can be performed in the setting of acute trauma on day one itself. Robinson in his study on extra articular pilon fractures treated by intramedullary nailing reported a 100% union rate similar results were obtained by Nork in another study on distal tibial fractures.[23,24] El Ibrahimi et al.[25] confirmed that good results with no major complications were obtained with reamed nailing. Fan et al.[26] reconfirmed that there were no signs of non-union or malunion with intramedullary nailing in distal tibial fractures. In our study the union rate for both fibula and tibia was 100%, there was no case of delayed union or non-union and no deep infection in any patient. None of the patient had any complication pertaining to fibula fracture, this might be because we did not open any fibular fracture and closed intramedullary nailing for fibula was done in almost all the cases which required fixation.

We conclude that intramedullary nailing is a better modality of treatment for distal tibial extra-articular fractures. It is more biological way of fixation and is done without disturbing the fracture hematoma, associated with minimal complications compared to ORIF. We recommend that intraoperative reduction as anatomic as possible be maintained while passing guide wire, reaming and

inserting nail to prevent any mal-angulation. The most widely reported complication with IM Nailing is angulation in frontal plane, however, we consider that it can be managed very well intraoperatively by anatomically reducing the fragments under image intensification and with the use of poller K wires where required.

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Ethical statement

This study has been approved by the responsible committee and informed consent has been obtained from all patients or relatives.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The author(s) received no financial support for the research, authorship, and/or publication of this article.

Appendix A. Supplementary data

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