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Research Article

Functional Outcome of Extra-Articular Distal Tibia Fracture Treated with Tibia Interlocking Nail: A Case Series

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Abstract

Background: Intramedullary interlocking nailing has emerged as one of the suitable management options for distal tibia fractures as it allows mechanical compression on weight-bearing, which stimulates bone healing. We studied 40 cases of extra-articular distal tibia fracture treated by intramedullary nailing.
Methods: We retrospectively studied 40 patients of both sexes above the age of 18 years with closed fractures and grade 1, 2, and 3A compound fractures treated at SVP Hospital, Ahmedabad, India. Clinically, the fracture was considered to be united when the patient was completely pain-free. Patients were followed up at monthly intervals till union. At each follow-up, patients were assessed both clinically and radiographically, and details were recorded based on proforma.
Results: The evaluation of the result was done using American Orthopedic Foot and Ankle Society (AOFAS) criteria. Thirty-three patients had excellent functional results, five had good functional results, and Two had fair functional results. In this study, 38 (95%) patients had radiological union within 24 weeks. Two patients had union after 28 weeks.
Conclusion: Intramedullary nailing is a minimally invasive procedure that preserves the soft tissue and the fracture hematoma. It maintains the length, alignment, and rotation and allows micromotion at the fracture site on weight-bearing, which stimulates callus formation. It has a good functional outcome with gratifying results when used in extra-articular distal tibia fractures.

Keywords: Bone Nails; Tibial Fractures; Tibia

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Background

Modern lifestyle and increase in high-speed road traffic accidents, especially two-wheelers, have led to an increased incidence of complex fractures of the distal tibia. This has made their treatment all the more difficult. On the basis of location, distal tibia fractures are second in incidence next to tibial diaphyseal fractures (1).

The ultimate goal of treatment of distal tibia fractures is restoring mechanical alignment, achieving fracture union, and regaining functional and pain-free weight-bearing and motion while avoiding complications (1, 2). Intramedullary interlocking nails have emerged as one of the most suitable management options for the treatment of lower third shaft tibia fractures as they allow mechanical compression on weight-bearing, which stimulates bone healing. Interlocking nails have widened the range of indications for medullary osteosynthesis of tibia shaft fractures to include almost every type of fracture (2). The osteosynthesis of tibia fractures with a locked intramedullary nail is recommended by various authors due to the high union rates, low infection and deformity rates, and good functional results (3).

Intramedullary nails currently represent an effective approach to the treatment of complex tibial fractures such as distal tibial meta-diaphyseal fractures. The low multidirectional locked nailing may represent a superior surgical option since it offers advantages in terms of mean operating time, hospital stay, full weight-bearing time, and union time (4). Therefore, in our series, we have studied 40 cases of extra-articular distal tibia fracture treated by intramedullary nailing.

Methods

This is a retrospective study of 40 patients with distal tibia fractures treated by intramedullary nails at SVP Hospital, Ahmedabad, India, from 2020 to 2022. Patients with distal tibia shaft fracture above 18 years with closed and grade 1, 2, and 3A open fractures were included in the study. Patients with age below 18 years, medical contraindication for surgery, grade 3B, 3C compound fractures, pathological fractures due to tumors, and ipsilateral lower limb neurovascular deficit were excluded from the study.

Radiographs of one joint proximal and one joint distal, i.e., anteroposterior (AP)/lateral views of ankle and knee joints, were done, and patients were admitted to the trauma center and for open wounds, if any, normal saline wash was given under aseptic precautions and a sterile dressing was kept. The above knee slab was given, and the limb was elevated on the Bohler-Braun splint. Intravenous antibiotics were given to patients with open wounds.

General anesthesia/spinal anesthesia/epidural anesthesia was given as per the anesthetist's choice. Depending on the fracture pattern, the patient was taken on a fracture table or a simple table with the knee flexed to 70 degrees on a bolster. A pad was used to support the distal femur at a sufficient distance from the popliteal artery and vein. A straight incision was made from the lower pole of the patella to tibial tuberosity approximately 5 cm in length, centered over the patellar tendon.

The patella tendon was split in the midline. The entry site should be centered over the tibial medullary canal.

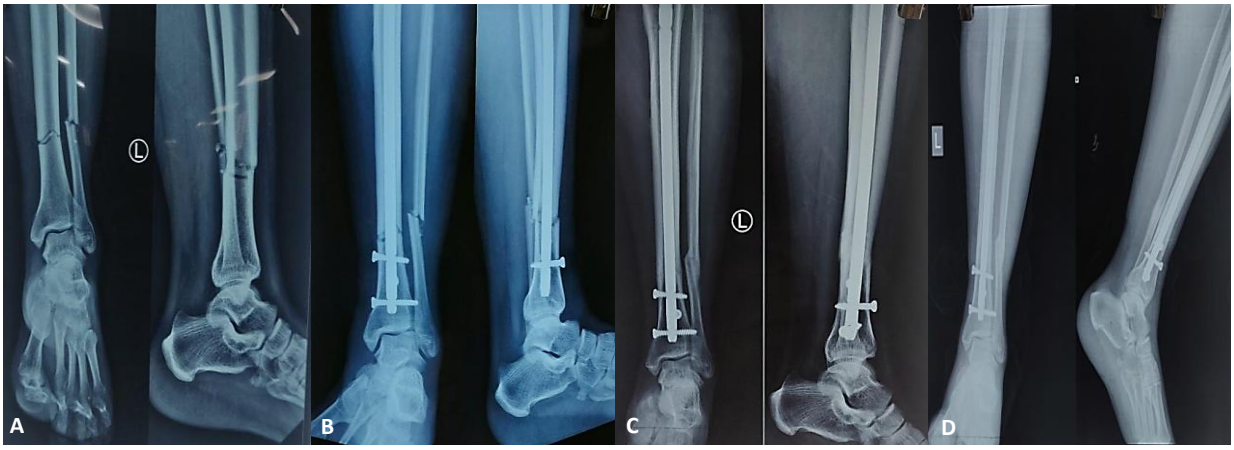

Figure 1. A) Pre-op X-ray; B) Post-op X-ray; C) 3-month follow-up X-ray; D) Final follow-up X-ray

A curved awl was used to open the medullary canal and is pushed as far as possible into the medullary canal, while the handle should be in line with the axis of the shaft. 3.2 mm guide wire was pushed into the canal, past the fracture site, and into the supra malleolar region (0.5 to 1 cm proximal to ankle joint), assisted by manual reduction. Reaming was done with the help of flexible reamers. The medullary canal was reamed 1 mm or 1.5 mm more than the diameter as measured at the isthmus.

The selected nail attached with a jig was passed over the guide wire and was inserted into the bone as far as possible (that is 1 cm proximal to the distal articular surface of the tibia). Measured hammering was done to drive the tip of the nail to the distal metaphysis, and the proximal end of the nail should be flushed with the cortex at the entry point. The guide wire was removed. Distal locking was done using the free-hand technique under the C-arm. Proximal locking was done through the holes provided in the jig. The nail and screw position with fracture alignment and rotation was checked under the C-arm. Closure was done in layers, and sterile dressing was applied.

Fibula fixation was done in distal fibula fractures, which were at or below the level of the syndesmotic joint. In a few cases, slightly proximal fractures of the fibula were also nailed to improve stability as found necessary by the operating surgeon.

Postoperatively, the below knee slab and Bohler-Braun splint elevation were given to control the swelling. A postoperative X-ray was done to see fracture alignment, rotation, and implant placement (Figure 1). From postoperative day one, knee bending and toe movements were started according to the pain tolerance of patients. Below knee slab was continued for 4-6 weeks. Regular sterile dressing of the suture line was done. Patients were discharged between the third and fifth post-op days. Stitch removal was done between 12-14 days. Regular follow-ups were done at monthly intervals till union and thereafter, as and when needed. At each follow-up, clinical and radiological evaluation of the patient was done (Figure 2). Full weight-bearing walking without support was allowed after fracture union.

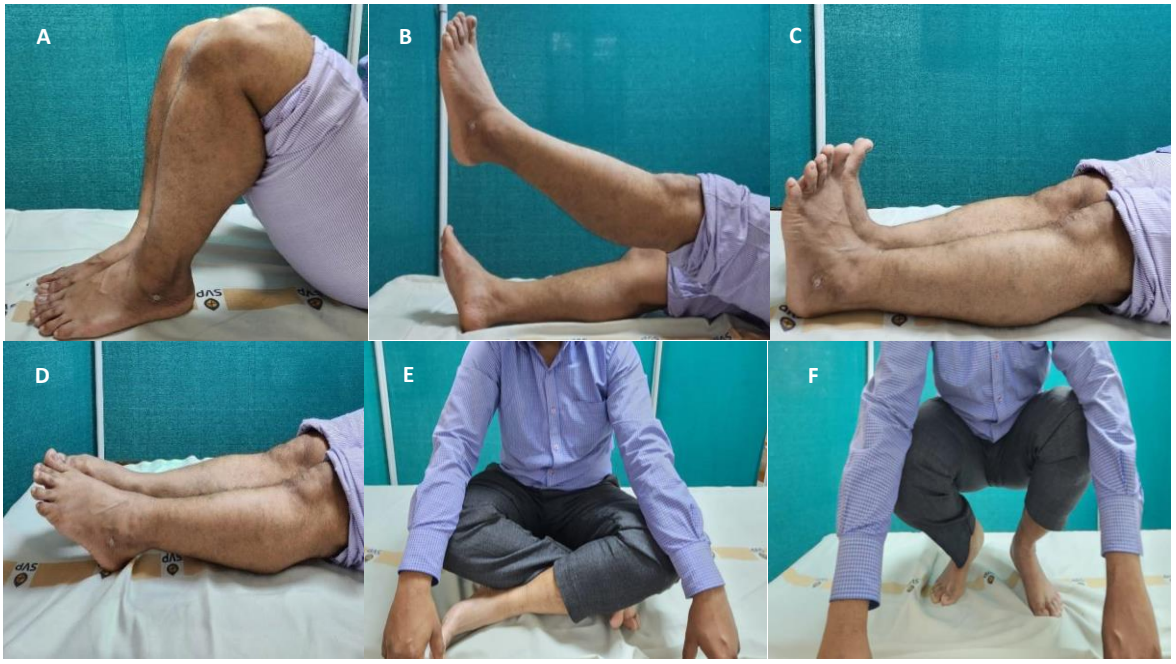

Figure 2. A) Knee flexion; B) Knee extension; C) Ankle dorsiflexion; D) Ankle plantar flexion; E) Cross-legged sitting; F) Squatting

Results

In our study, there were 65% of patients in the age group of 20-50 years, with age group of 41-50 being the most common in this study. Road traffic accidents were the most common mode of injury, causing distal tibia shaft fractures in 34 (85%) patients, followed by domestic falls, which were seen in 6 (15%) patients. In this study, 32 (80%) fractures were closed, six (15%) fractures were Gustilo-Anderson grade 1, and two (5%) fractures were grade 2.

In the present study, 95% of patients were discharged within seven days of surgery. 23 (57.5%) patients had a duration of hospital stay of 0-3 days. Those who required more than seven days of stay had other associated injuries. Weight-bearing was started at four weeks in 32 (77.5%) patients, at six weeks in seven (17.5%) patients, and at eight weeks in one (2.5%) patient due to old age. 38 (95%) patients had radiological union within 24 weeks. Two patients had union after 28 weeks, from which one patient required a secondary procedure in the form of dynamization, while the other patient needed dynamization, fibulectomy, and bone grafting to achieve union (Table 1).

Table 1. Radiological fracture union

Radiological fracture union	n (%)
14 weeks	7 (17.5)
16 weeks	9 (22.5)
18 weeks	14 (35.0)
20 weeks	6 (15.0)
24 weeks	2 (5.0)
> 28 weeks	2 (5.0)
Total	40 (100)

Moreover, 33 (82.5%) patients had excellent outcomes, 5 (12.5%) had good outcomes, and 2 (5%) patients had fair functional outcomes according to the American Orthopedic Foot and Ankle Society (AOFAS) (5) score, as they had union after 28 weeks and needed secondary procedure to achieve union (Table 2).

Table 2. Functional outcome according to American Orthopedic Foot and Ankle Society (AOFAS) score

Results	n (%)
Excellent (90-100)	33 (82.5)
Good (80-89)	5 (12.5)
Fair (79-70)	2 (5.0)
Poor (< 69)	0 (0)
Total	40 (100)

Additionally, 33 (82.5%) patients had excellent outcomes, 5 (12.5%) patients had good outcomes, and 2 (5%) patients had fair outcomes according to Johner and Wruh's criteria (6) (Table 3).

Table 3. Functional outcome according to Johner and Wruh's criteria

Results	n (%)
Excellent	33 (82.5)
Good	5 (12.5)
Fair	2 (5.0)
Poor	0 (0)
Total	40 (100)

Furthermore, one (2.5%) patient had varus fixation, but the patient had no significant deformity, shortening, or limp and had a good functional outcome. Two (5%) patients had superficial surgical site infections, which were treated with oral antibiotics. One (2.5%) patient had non-union at nine months which was treated by bone grafting and fibulectomy. One (2.5%) patient had screw impingement which was removed after radiological union at one year of surgery.

Discussion

This study comprises 40 patients with closed and open grades 1, 2, and 3A, with extra-articular distal tibia fractures treated with a tibia nail. In this study, the gender-based distribution of the distal tibia extra-articular fracture shows predominant prevalence in the male population, with 87.5% of the sample size comprising men (35 out of 40). This observation is consistent with the present literature in which a recent study by Larsen et al. (4) shows a higher prevalence of tibia fracture in the male population than in women. The present study observed near equal incidence for the side of fracture (left = 21 and right = 19).

Moreover, we found road traffic accidents (84%) to be the most common cause of distal tibia fractures. In these accidents, a tremendous amount of energy is dissipated to the surrounding soft tissue, thus causing severe soft tissue damage. Hegazy et al. also observed that 80% of distal tibia fractures were associated with road traffic accidents (6). Padmanaban et al. observed that 60% of distal tibia fractures were associated with road traffic accidents (7). Vallier et al. observed that 51% of fractures were associated with it (8). In this study, 80% of patients had closed injuries, and the rest of the patients had open-grade fractures, while Bhairi et al. (9) observed that 70% of patients were with closed injuries, and Prakash et al. (10) observed that 90% of patients were with closed injuries.

In the present study, we achieved a closed reduction in all patients, and this preserved the fracture hematoma, aiding fracture healing and minimizing the rate of infection. Staying along the mechanical axis of the tibia and being a load-sharing device, intramedullary interlocking nail permits early weight-bearing and thus, early rehabilitation. Reaming the canal into a uniform diameter resulted in the insertion of the largest possible diameter of the tibia nail. Interlocking nails with interlocking screws maintain axial length and rotation of fracture and help in adding strength to the nail.

In our study, the average time for radiological union was 18.5 weeks. Bahari et al. (11) observed a mean radiological union time of 23.4 weeks and Paluvadi et al. (12) observed a mean radiological union time of 21.4 weeks. This is well within the range recommended in the literature. The radiological union of fractures of patients with more valgus/varus malalignment was comparatively delayed. This explains the need for perfect alignment of fractures intraoperatively to achieve better functional outcomes. This perfect alignment can be achieved by several means. The use of poller screws is one such simple method with no extra inventory needed and no need for any modification in the nail with less soft tissue compromise. Thus, the increased rate of malalignment can be controlled. In this study, we did not need a poller screw for fracture alignment. Besides, in the presnt study, one (2.5%) patient had non-union. Hazarika et al. (13) observed that 10% of patients had non-union, and Collinge and Protzman (14) observed 8% non-union rates.

The AOFAS criteria (5) and Johner and Wruh's criteria (15) were used to estimate the functional outcome of the study. According to AOFAS, 33 patients had excellent functional results, 5 had good functional results, and 2 had fair functional outcomes. Johner and Wruh's criteria showed similar results, with excellent results in 33 patients, good results in 5 patients, and fair results in 2 patients. In a study by Burc et al., functional outcome was

excellent in 61.6% of patients and good in 38.4% of patients (16). In a study by Radhakrishna et al., 76.67% had excellent results, 16.66% had good results, and 6.67% had fair results (17). Thus, the results of our series are comparable with those of other series.

The limitations of our study are small sample size and no long-term follow-up.

Conclusion

Intramedullary nailing is a minimally invasive procedure that preserves the soft tissue and the fracture hematoma. It maintains the length, alignment, and rotation and allows micromotion at the fracture site on weight-bearing, which stimulates callus formation. It has a good functional outcome with gratifying results when used in extra-articular distal tibia fractures.

Conflict of Interest

The authors declare no conflict of interest in this study.

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