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Original Research Article

A Short Term Analysis on Management of Extra Articular Distal Tibial Metaphyseal Fractures by Intramedullary Interlocking Nailing

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Abstract:

Background: Despite improvements in both non-surgical and operational therapy, tibia fractures continue to be a contentious topic. The aim of expert care is early functional recovery, realignment of the fracture, and realignment of limb length. Evaluating the immediate effects of intramedullary interlocking nailing in the treatment of extra-articular distal tibial metaphyseal fractures.

Methods: With a follow-up period from January 2019 to June 2019 (6 months), this prospective comparative randomized study of 28 patients with distal tibial metaphyseal fractures was conducted at the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar. Patients who had high energy axial load injuries disrupting or impinging the ankle plafond were not included, nor were patients with injuries lasting longer than three weeks, nonunion, numerous injuries, or a history of prior knee or ankle pathology.

Results: The articular surface of the plafond was 12 mm away from the distal tip of the nail on average (range: 4 to 15 mm). Ten individuals underwent fibular plating. 26 individuals had two distal locking bolts, while three distal locking bolts were used in two patients.

Conclusions: If thorough preoperative planning is combined with meticulous surgical skill, intramedullary nailing is a safe and successful method for treating extra-articular distal metaphyseal tibial fractures.

Keywords: Distal tibia fractures, Extra-articular, Pilon fractures, Interlocked nailing.

Introduction

Despite improvements in both non-operative and surgical therapy, tibia fractures continue to be a contentious topic. Realigning the fracture, adjusting limb length, and promoting early functional recovery are the objectives of specialist care.[1] Distal tibial metaphyseal fractures can be difficult to treat. There isn't much information in the literature about how to treat fractures in this area, which haven't been distinguished from pilon fractures.[2] These fractures have a unique mechanism of damage, different therapeutic philosophies, and a different prognosis from proximal diaphyseal fractures and distal intra-articular pilon fractures [3].

The fracture's proximity to the plafond, the fracture's displacement, its comminution, and any damage to the soft-tissue envelope all affect the choice of treatment. Traditional surgical fixation techniques including internal fixation and open reduction have been linked to negative outcomes like infection, skin sloughing, and soft tissue devitalization.[4] In an effort to prevent these consequences, conservative treatment has led to unacceptable deformity and a reduction in ankle range of motion. In order to prevent soft tissue issues while yet offering the stability and alignment that internal fixation offers, minimally invasive surgical procedures have been created. Percutaneous plate osteosynthesis, hybrid external fixation, external fixation with limited internal fixation, and intramedullary nailing are some of the newer methods.[5]

For both open and closed tibial shaft fractures, intramedullary nailing has been linked to high rates of radiographic and clinical success; nevertheless, the use of this technique for distal metaphyseal fractures has not gained widespread acceptance. In studies on intramedullary nailing of tibial shaft fractures, fractures distal to the tibial diaphysis and within 5–6 cm of the ankle joint have been left out since they may signify a distinct injury.[4] The metaphyseal flare above the plafond, which enhances the bending moment, makes it harder to manage the distal section of these fractures using intramedullary implants.[5]

The range of fractures susceptible to this kind of treatment has expanded due to recent advancements in intramedullary nail design. However, there are issues with intramedullary nailing as a treatment for distal metaphyseal fractures because it is difficult to reduce, there is a chance that the fracture will spread distally, the hardware may fail, and insufficient distal fixation might result in reduction loss and misalignment.]6] The effectiveness of intramedullary nailing in treating fractures below the tibial isthmus has only been examined in a few number of studies.[7]

Material and Methods

This is a prospective comparative randomized study involving 28 patients with distal tibial metaphyseal fractures at the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar. The study will be followed up for six months, from January 2019 to June 2019. Patients who had high energy axial load injuries that resulted in disruption or impaction of the ankle plafond as well as injuries lasting longer than three weeks, nonunion, and patients with numerous injuries or a history of prior knee or ankle pathology were excluded. Debridement and primary closure were performed on patients who had open fractures before stabilization.A fracture that occurred within the previous week, skeletal maturity, a fracture involving the distal 5 cm of the tibia's metaphysis, an associated fracture of the fibula, and treatment with an intramedullary nail of the fracture pattern that permitted the insertion of at least two distal interlocking screws through the nail were the inclusion criteria. There were 24 men and 4 women, ranging in age from 19 to 55, with a mean age of 33. Muller et al. AO classification method and Robinson et al.'s classification were used to categorize all fractures. The Gustilo system and the Tscherne method were used to track the degree of soft tissue damage in open fractures and closed fractures, respectively.

By using the AO system of rule of squares, biplanar injury radiography was assessed to pinpoint the fracture's position and gauge how much of the tibia's distal end was affected. In every instance, the fracture and concomitant fibular fracture were both within 5.5 cm of the ankle joint. The bulk of patients' injuries were caused by low-energy motor vehicle accidents and falls from great heights that resulted in a torsional or bending stress. A primary reamed intramedullary nailing system that enhanced the distal fixation by passing up to three biplanar distal interlocking screws through the distal 4 cm of the nail was used to treat all fractures. The procedure was carried out only with manual traction on a typical radiolucent table with c-arm guidance. The surgeon's judgment was used to determine the adjunctive fibular stabilization technique as well as the quantity and placement of the distal locking bolts. Two medial to lateral locking bolts were typically preferred. In 8 individuals, the fracture was reduced openly. Debridement and primary closure were performed on patients who had open fractures before stabilization. Closed fractures were initially treated surgically to reduce soft tissue edema after reduction and splinting were applied. During induction and for the first three to five days following surgery, third-generation cephalosporin was administered intravenously to all patients. The average amount of time between the injury and the time the fracture was surgically fixed was 12 days (the range was 6 hours to 20 days).

Results

Patients' ages ranged from 19 to 55, with a 32-year-old average (Table 1). In our series, men outnumbered women by a ratio of 6:1. In our series, injuries to the right side were more frequent, and RTA is the main reason why. In RTA, the most prevalent subtype was pedestrian vs. 2-wheeler.

Table 1: Age incidence

Age (years)	No. of patients
11-20	1
21-30	10
31-40	8
41-50	7
51-60	2
Total	28

Table 2: Fracture of classification

Fracture type		No. of patients
Open	Gustilo type I	5
	Gustilo type II	3
Closed	There type I	14
	There type II	6

According to Table 2, there were eight open fractures in our study, of which five were identified as Gustilo Type I and three as Type II. Six type II and fourteen type I Tscherne fractures were identified among the remaining closed fractures.

Table 3: AO/OTA classification

AO/OTA type	No. of patients
43 A1	16
43 A2	9
43 A3	3

Table 3 demonstrates that sixteen 43A1, nine 43A2, and three 43A3 fractures occurred in accordance with AO/OTA recommendations.

Table 4 demonstrates that, according to Robinson et al. classification, eleven patients had type IIA fractures and seventeen patients had type I fractures.

Table 4: Robinson classification

Robinson type	No. of patients
I	17
III	11

Table 5: Fracture configuration

Type of Tibia Fracture	Level of Fibula Fracture	No. of patients
Transverse	Same level	9
	Proximal level	6
Oblique	Same level	4
	Proximal level	2
Comminuted	Same level	5
	Proximal level/segmental	2

Table 5 reveals that about 60% of the fractures in our series were transverse. The surgeon's judgment was used to determine the adjunctive fibular stabilization technique as well as the quantity and placement of the distal locking bolts. Ten individuals underwent fibular plating. 26 individuals had two distal locking bolts, while three distal locking bolts were used in two patients. In 26 patients, an acceptable alignment was achieved. The two patients (AO43A1 and Robinson type 1) who experienced initial misalignment in the form of a 10^0 valgus deformity also experienced a transverse tibial fracture at the same location. The fibula was not stabilized in either of the cases. The second patient refused surgery and was ultimately lost for follow-up while one patient had fibular plating for corrective surgery.

Two patients out of the 28 who participated in our trial were ultimately lost to follow-up. At the time of follow-up, 25 of the 26 patients who were still alive showed signs of healing on radiographs. The union's average duration was 19 weeks, with a 12- to 26-week range. The average ankle functional assessment score for Iowa was 82 (excellent); the range was 68 to 94. One patient had a comminuted fracture and a segmental fibular fracture, and the other had a transverse fracture and a same-level fibula fracture. These two patients were lost to follow-up. These patients' fracture patterns and initial postoperative alignment did not differ significantly from those of the other patients.

Discussion

Treatment guidelines for proximal diaphyseal fractures and distal intra-articular pilonfractures are distinct, while extra-articular distal tibial metaphyseal fractures require a different approach.[8] Muller constructed a square to represent the distal tibial metaphysis, with the width of the tibial plafond serving as the sides of the length. In our review, we classified fractures as distal metaphyseal fractures if they occurred within 5.5 cm of the tibial plafond and did not extend to the plafond.[9]

Differentiating low energy tibial fractures from axial high energy loading injuries with or without primary articular involvement is the main challenge in choosing candidates for intra medullary fixation of a distal tibial fracture. The AO/OTA classification of tibial pilon fractures is frequently used in published studies, but it is insufficient, ignores the fibula, and fails to distinguish between high energy axial load fractures and low energy extra-articular fractures. Published studies also frequently include fractures with intra articular extension.[10] In our investigation, all patients had an associated fibular fracture with the primary fracture location being in the metaphysis, without articular extension. Both the new classification created by Gorczyca et al. and the AO/OTA classification were used for comparison.[11]

The flaws we found in this new categorization were that it includes a category of intraarticular and malleolar extensions that are difficult to see on X-rays and did not address stability of the offibula. The

fracture patterns described were not common in our setup.[12] Extra-articular distal tibia fracture nailing is difficult, technically demanding, and should be done cautiously. Loss of reduction can happen during follow-up due to undiagnosed instability, in addition to malalignment that is noticed in the initial postoperative period, particularly due to problems controlling the short distal fragment and technical errors.[13]

Few studies have examined the causes and prevention of loss of reduction during follow-up. Although important surgical principles such as central placement of the guide wire and reamers, maintenance of the reduction at the time of nail passage, and placement of the nail in the sub chondral region are described in detail to avoid intraoperative malalignment.[14] In our investigation, we discovered that more than eight individuals (or 25%) experienced reduction and malunion loss. To evaluate the risks and success rates of the various methods used to treat this injury, Konrath et al conducted a meta-analysis of the English-language literature. The intramedullary nailing group had the highest complication rates, with a malunion rate of 16.2%, according to the review's findings.[15]

An 8% risk of malunion was documented in the study by Krettek et al. on fractures repaired with nails that were less than 5 cm from the ankle joint. Throughout the observation period, no patient showed signs of alignment loss. The use of several screws frequently in the distal fragment and ipsilateral fibular plating were two factors that may have contributed to the better outcomes seen in this series, at least in part. Therefore, after ruling out patient-related explanations for late malalignment, adjunct fibular stabilization and the quantity and placement of the distal locking bolts appear to have the greatest impact on the stability of the fracture construct.[16]

In their study, Kumar et al. examined the impact that fibular plating has on the rotational stability of distal tibial fractures repaired with an IM nail. When a torque of 1 to 5 N was applied to the proximal end of the tibia, the fibrular plate reduced axial rotation by around 1.5 deg.[17] The preservation of reduction was strongly correlated with the plating of the fibular fracture in the multivariate-adjusted analysis. The scientists discovered that using at least two distal locking bolts provided further defense against reduction loss.

In our experience, fibular plating is a helpful adjunct when the associated fibular fracture is at the same level as a dislocated transverse or oblique tibia fracture and when there is significant metaphyseal comminution, making rotational and sagittal alignment difficult to maintain with nail fixation alone.[19] Before intramedullary nailing, fibular plating also helps to achieve and maintain the reduction of a distal tibia fracture with considerable valgus angulation, potentially lowering the chance of a misalignment. Although there is considerable disagreement in the literature regarding the direction of the two distal locking bolts' effects on fracture construct stability, they undoubtedly strengthen fracture stability.[20]

In contrast, Morrison et al.'s study discovered a substantial difference in stability between constructs locked with parallel locking bolts and those placed perpendicularly, with the latter being a better build. Both sorts of conceptions were included in our investigation, and both failed to keep alignment.[21] For the purpose of achieving the reduction and alignment, several researchers have suggested the use of supplementary blocking screws. Due to the patients' utilization of alternate reduction techniques, such as plate fixation of the fibula prior to intramedullary nailing, reduction with a percutaneous clamp, and manual manipulation, these screws were not employed in our series. In our study, all 26 patients had a union of the fracture, which took 19 weeks to complete (range 12-26 weeks).[22]

In no patient was bone grafting necessary to achieve union. After a dynamization technique was performed on a patient who had delayed union, the fracture healed. This outcome is comparable to other research on the interlocking nailing therapy of such fractures. Four individuals reported experiencing anterior knee pain. The mean score for the IOWA ankle functional assessment was 82 (excellent); the range was 68–94.[23]

Numerous studies highlight the significance of reducing distal tibial fractures with secure fixation to enable early recovery. However, there haven't been any prospective, randomized studies done on the various ways to treat this injury. The ability to distinguish which fractures are suitable for supplementary fibular stabilization and intramedullary nailing was mostly qualitative and depended on experience and knowledge of the fracture pattern.[24,25]

Conclusion

If thorough preoperative planning is combined with meticulous surgical skill, intramedullary nailing is a safe and successful method for treating extra-articular distal metaphyseal tibial fractures. For a successful functional outcome, the short distal piece must be aligned properly during surgery. To enable stable fixation and prevent loss of reduction on follow-up, it is vital to understand and recognize the short distal fragment's inherent fragility. To help with stable attachment of the distal piece by fibular plating, we suggest a new classification. To ascertain the effectiveness of internal fixation techniques in the treatment of extra-articular distal met-

aphyseal tibial fractures, prospective, randomized clinical trials are required.

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