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Comparative analytical research results for distal tibial fractures using multidirectional locked nailing and plating

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Abstract
Introduction: Distal tibial fractures are a common condition seen by orthopaedic physicians each year. The purpose of this study is to compare and evaluate the healing, functional, and complication rates of extra articular distal tibia fractures treated with anterolateral locking compression plates and multidirectional interlocking intramedullary nails.
Materials and Methods: Our study utilized a sample size of 20 individuals who presented with distal tibial fractures. The age range of participants in the nail group was 33 to 55 years, whereas in the plating group, the age range was 27 to 60 years. The current investigation was carried out from February 2015 to December 2015 at the Department of Anesthesiology, Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India, utilizing both retrospective and prospective methodologies.
Results: In the plating group, the average time for union was 6.2 months, whereas it was determined to be 4.3 months in the multidirectional interlocking intramedullary group. A statistically significant difference was present. Furthermore, the nailing group's mean duration for both partial and full weight bearing was 4.2 weeks and 9.6 weeks, respectively. This was a statistically significant decrease from the plating group's 6.12 weeks and 12.42 weeks. Compared to the plating group, the interlocking group saw fewer cases of infection, ankle stiffness, and implant discomfort.
Conclusion: Based on our findings, closed intramedullary interlocking nailing is the preferred treatment for distal tibia fractures because it minimizes implant-related problems, facilitates early weight bearing, and encourages early fracture union. Intramedullary nailing or locking plate fixation is recommended for distal tibiofibular fractures.

Keywords: Fibular fixation, locking plate, interlocking nails, distal tibia fractures

Introduction
Road traffic accidents and other high-energy injuries frequently result in distal tibia fractures without articular involvement. In terms of the cause of injury, course of treatment, and prognosis of the displaced bones, these fractures are different from pilon fractures [1]. Compared to diaphyseal or middle-third traumas, these fractures' closeness to the ankle joint causes higher problems [2]. Treatment for distal tibia fractures is therefore still difficult [3].
The damage mechanism involves torsional forces, compression, and axial loading. Distal tibial fractures are most frequently caused by high-speed auto accidents, steep falls, and twisted ankles. Because the surrounding vascular structure is so fragile, treating ankle fractures is a notoriously difficult task. Additionally, the tibia is subcutaneously in plane, which complicates fracture management [4, 5].
Internal fixation tools like intramedullary nails or locking compression plates are frequently used to treat distal tibial fractures. Understanding the distal tibia fracture pattern and the available fixation options is crucial [6]. 85% of distal tibia breaks were associated with fibula fractures. It is debatable in several publications whether or not the fibula has to be corrected. Although it is not necessary to fix the fibula fracture in the event of stiff fixation, such as multidirectional interlocking nailing, it may be fixed for improved reduction. Comorbid conditions such as diabetes mellitus, peripheral vascular diseases, smoking, and drinking might exacerbate an already unstable state [7, 8].
Ruedi *et al*. developed the standard of care for distal tibial fractures in 1980 and recommended internal fixation using plate osteosynthesis. Following open reduction and internal fixation

with plating, high energy fracture patterns have been associated with higher rates of sequelae, including wound dehiscence, infection, and chronic osteomyelitis [9]. To maintain the same length and position of the bones, plate osteosynthesis was used to treat the fibular fractures. Hybrid external fixators have taken the place of monolateral external fixators due to the advantages of early weight bearing and stability. When external fixators are used as the last resort for treating open distal tibial fractures, there are several concerns involved, including ankle stiffness, pin tract infection, subsequent loss of reduction, and instability [10, 11].

Given our increased knowledge of managing soft tissue injuries and the unsatisfactory results of external fixation, it is necessary to reconsider the use of internal fixation following soft tissue recovery. Non-surgical care has a restricted role in people with compromised medical conditions. Patients receiving treatment with traction or plaster of Paris are more likely to experience complications such shortening, malunion, later osteoarthritis of the ankle, and decreased range of motion. Patients who are confined to bed for prolonged periods of time are at an increased risk of developing pressure sores, deep vein thrombosis, and pneumonia. Open reduction and internal fixation of distal tibial fractures have been questioned since the AO group developed the Tscherne classification of soft tissue injuries to grade and evaluate the epidermis, neurovascular tissue, and musculotendinous structure [12, 13]. There are established techniques for internally repairing distal tibial fractures. When treating wound dehiscence and severe infection, the adoption of a low-profile medial locking compression plate has less problems than standard AO plating [14].

Our study intends to assess the efficacy of plating and multidirectional locking nailing in the management of distal tibial fractures.

Methodology

Our study utilized a sample size of 20 individuals who presented with distal tibial fractures. The age range of participants in the nail group was 33 to 55 years, whereas in the plating group, the age range was 27 to 60 years. The current investigation was carried out from February 2015 to December 2015 at the Department of Anesthesiology, Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India, utilizing both retrospective and prospective methodologies.

Inclusion Criteria

- An adult patient who is older than eighteen but less than seventy years.
- Distal tibial fractures that are closed and grade I compound fractures without intra-articular extension.

Exclusion Criteria

- Below the age of eighteen and over seventy years.
- Distal tibia compound fractures, grades II and III.
- Fractures that extend intraarticular.

Clinical Evaluation

When patients present with lower limb injuries, they are evaluated with the express purpose of finding distal tibial fractures. An evaluation of the injured ankle is carried out when the patient's general state has stabilized. Obtaining a complete history is essential since it offers insightful information that may be used to assess the damage mechanism and, in turn, indirectly determine the injury's velocity. Since the presence of comorbid disorders is known to be a major factor in determining the functional outcome of surgical intervention, it should be considered when gathering a patient's medical history. The presence of edema, deformity seen on inspection, soreness, abnormal mobility, and crepitus felt on probing are all signs of a fracture based on the examination. Evaluating the skin's state is more important, especially in light of the open wound, bruises, and soft tissue edema around the ankle. Blisters on the skin, edema in the limbs, and localized skin temperature elevation should all be closely watched for possible signs of progression. It is advised to routinely evaluate the affected extremity's capillary refill in the early stages of damage. A thorough evaluation of the neurovascular system and an assessment of the functions of the extensor tendon are essential. It is essential to take into account the chance of both a concurrent knee joint injury on the same side and a distal tibiofibular syndesmotic injury.

Results

The data analysis for this study was done with SPSS 16.01. The McNemar Chi Square test and the paired sample t-test were two of the statistical techniques used. These analyses' findings demonstrated statistical significance.

Table 1: Age distribution

Age Groups	Nailing		Plating	
	Number of Patients	%	Number of Patients	%
25 - 35	2	20.00	2	20.00
36 - 45	2	20.30	2	20.30
46 - 55	6	60.00	6	60.00
≥ 56	00	00	00	00
Total	10	100	10	100

The typical age range of patients receiving multidirectional interlocking nailing treatments is thirty-three to fifty-five years old. For plating, the typical age range is frequently between 27 and 60 years old. In both the nail and plate groups, patients were primarily between the ages of 46 and 55.

Table 2: Sex distribution

Sex	Nailing		Plating	
	Number of Patients	%	Number of Patients	%
Male	4	40.00	6	60.00
Female	6	60.00	4	40.00
Total	10	100	10	100

There was an equal distribution of 10 men and 10 women among the sample size of 20 people. The distribution of gender in the nail industry, particularly in terms of men and women.

Table 3: Nailing and plating

Status	Nailing		Plating	
	Number of Patients	%	Number of Patients	%
Closed	08	80.00	02	20.00
Open	02	20.00	08	80.00
Total	10	100	10	100

Among the twenty patients in the cohort, ten were selected to have intramedullary nail application, and ten more patients were selected to receive bone plate implementation. Eight patients in the nailing cohort underwent surgery using the closed approach, while two patients underwent open reduction and fibular fixation. Open reduction and internal fixation were used in the surgical operation. A low profile 3.5 mm locking compression plate was used for tibial fixation, and a one-third tubular plate was used for fibular fixation.

Table 4: Mode of injury

Mode of Injury	Nailing		Plating	
	Number of Patients	%	Number of Patients	%
Fall From Height	4	40.00	2	20.00
Road Traffic Accident	6	60.00	3	30.00
Twisting of Ankle	0	0	5	50.00
Total	10	100	10	100

Road traffic accidents are the main cause of both plating and nailing operations. While plating has a success percentage of about 100.0%, nailing has a success rate of about 100.00%. In the context of nailing, the incidence of falls from height is 30.00%; in the context of plating, it is 20.00%.

Table 5: Weight bearing

Weight Bearing	Nailing		Plating	
	Number of Patients	%	Number of Patients	%
Delayed	2	20.00	10	100.00
Immediate	8	80.00	0	0
Total	10	100	10	100

Since these implants are meant to withstand stresses, the nail group begins to bear weight 48 hours after implantation. In this case, patients start to bear weight immediately.

Discussion

Distal tibia fractures can result from high energy axial loading procedures or low energy torsional stresses. High-energy fractures are frequently accompanied by comminuted fractures of the distal fibula, fragmentation of the metaphyseal and articular fracture components of the tibial plafond, and substantial injury to the surrounding soft tissues. Less than 10% of lower extremity fractures are tibial pilon fractures, which usually occur in adults as a consequence of falls from higher levels of elevation or involvement in auto accidents. The academic community is still divided on what is still the best course of action for treating these fractures. This phenomenon can be explained by the significant soft tissue damage and the distal tibia's susceptible vascular supply. Because of its superficial location, impaired blood supply, and limited soft tissue coverage, distal tibia fractures are extremely difficult to treat [13-15].

The evaluation of the degree of concurrent soft tissue damage is the main factor that determines how these injuries are managed. Both open and closed fractures were included in our study to provide a thorough analysis of the topic. We used the Tscherne soft tissue injury categorization method to assess and quantify soft tissue damage. It is advised to wait until the soft tissue injury has healed before attempting definitive fixation. Following the clearance of limb edema, the skin wrinkle indication becomes noticeable. The internal fixing procedure was applied in the current study on average two to three weeks after the wrinkle symptom first appeared [16-18].

It has been demonstrated that the use of minimally invasive plating techniques can successfully reduce iatrogenic soft tissue injury and bone vascularity damage while maintaining the osteogenic fracture hematoma. Nonetheless, it is advised that MIPPO operations be carried out only following the full recovery of soft tissues. In some cases, a three-week wait can make MIPPO deployment impractical. In this study, anterolateral plating and multidirectional locking nailing are used in conjunction to treat distal tibial fractures. The start of fracture repair was purposefully delayed for a duration of roughly one to three weeks to reduce the possibility of problems resulting from soft tissue damage. Depending on the unique characteristics of each patient, the length and diameter of the nails are adjusted throughout the multidirectional locked nailing technique. When it comes to plating, a third tubular plate is usually used for fibular fracture fixation, whereas a 3.5 mm locking compression plate is usually used for tibia fixation [19-21].

Ten of the twenty patients in the sample were treated with multidirectional nailing, and the other ten patients received anterolateral plating. Two patients were treated using an open technique, whereas the remaining eight patients in the sample size of ten had a closed method operation. For internal fixation, the study used AO type categorization 43 A1, 43 A2, and 43 A3 kinds. There were a total of 20 participants in our study. The age range of 35 to 55 years old is the one where our study's highest incidence rates occur. One method that can successfully achieve both good reduction and strong fixing is plating. It is crucial to remember that this procedure may impair the periosteal blood supply, which increases the risk of infection, delayed union, and nonunion [22, 23]. Out of ten plating instances, the study found that the overall infection incidence was 25%, with two cases of wound dehiscence and one case of severe infection leading to plate exposure. For these patients, the average follow-up duration was ten months. In the nailing technique, there was one incidence of superficial infection; in the plating operation, there were two cases of superficial infection and one case of deep infection. The infection rates are comparable to those seen in the research by Sean E. Nork *et al*. According to studies by Tyllianakis M. *et al*. and Sean E. Nor *et al*., the average length of time for a union was roughly 4-5 months. According to the results of the experiment, the plating group had a mean union duration of 6.4 months, whereas the nailing group had a mean duration of 4.5 months [24, 25].

Within the nail group, there were two cases of delayed union found after four months. At the six-month milestone, the components were successfully linked without any issues, having undergone dynamaization at the four-month mark. This result is consistent with other studies conducted by A Mohammad *et al*. and Fan CY *et al*. In the plating group, two cases of nonunion were reported along with implant failure, whereas no nonunion cases were seen in the nailing group [23-25].

The ankle score for plating ranged from good to extraordinary, but the ankle score for nailing in our study demonstrated a respectable degree of performance. This result suggests that all of the patients' ankle function was successfully restored. The results show similarities with the ankle functionality outcomes found in the study conducted by Shon OJ *et al*. In most cases,

the restoration of knee function was found to be successful. The results that have been provided bear resemblance to the conclusions drawn from the study conducted by Paraschous and colleagues concerning knee functionality. As a result, the patients in our study had generally good functional outcomes [24-26].

Three cases of malunion were noted; these patients' ankle and knee scores were significantly lower than those of the other research participants. In one study, interlocking nails were used to treat a sample of 51 cases of distal tibial fractures. The results showed a 16% incidence rate of malunions. Compared to previous research, ours found a marginally higher frequency of malunion. With the use of plating, Ahmed *et al*. reported a 76.4% success rate in a group of 17 patients. Because of the limitations of intramedullary nailing, plating was previously preferred over the latter treatment. Within modern medicine, the use of intramedullary nails has become more and more common. This method is preferred because it can protect the blood supply, decrease the risk of infection, lessen damage to soft tissues, and lower the possibility of delayed healing [25-27]. When compared to plating, the main problem with the nailing process was misalignment. In nailing situations, achieving and maintaining appropriate reduction without malalignment presented difficulties. A quarter of the total axial angulation was observed in two out of ten cases, where an axial angulation larger than five degrees was observed. In our examination, we discovered that the nail group's operating time was shorter than the plate's. Because intramedullary nails have a lower risk of infection than plate fixation, many writers advocate for their usage despite the shorter surgical time [26, 27]. Our study's results showed that the fracture union rate in the nail group was significantly lower than the overall rate. On the other hand, the nail group saw a higher rate of malunion, which could be explained by the fact that their union took a shorter time than that of the plate group. Furthermore, it was observed that the nail group started functional activity earlier than the other groups, most likely as a result of the previously indicated shorter union period. Patients in the plate-receiving group had a higher prevalence of infection, which led to sequelae like wound dehiscence, tendon exposure, implant exposure, implant failure, and nonunion. Therefore, one could contend that the multidirectional intramedullary nail performs better than the plate [26].

Conclusion

Interlocking intramedullary nails with multi-directional locking properties are an effective treatment for distal tibial fractures, yielding good results. The method of operation that was used was brief and easy to understand. We only ran upon a few issues during our inquiry. No cases of non-unionization were noted. It was discovered that post-operative infections were quite rare. There were no signs of wound healing problems. Because nails serve as weight-sharing mechanisms, immediate weight bearing is possible. Ankle and knee ratings and range of motion were used to evaluate the surgical outcome, and the results were favorable to extraordinary. Combining fibular fixation with nailing has shown positive results in some cases where it is considered suitable. Thus, for appropriate cases of distal tibial fractures, the combination of multidirectional locking with interlocking intramedullary nailing represents an extremely effective treatment strategy.

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None.

Conflict of Interest

None.

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