

Role of Fibular Plating in Management of Distal Both Bone Fracture of Leg

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Abstract: Treatment of distal both bone leg fractures include intramedullary nailing, hybrid external fixation, plate fixation or combining any of these modalities. While Interlocking nailing of tibial fractures is advantageous in allowing load sharing without disturbing the extra osseous blood supply and less damage to soft tissues with relatively easy learning curve. For correction of alignment before the insertion of nail and maintaining the alignment and to improve the rotational stability of bone implant complex, fibular plating plays a vital role in the management. Hence in our study we analysed the role of fibular plating in the management of distal both bone fractures of the leg. This is prospective comparative study where 10 patients each in control and study group were chosen and fibular plating was done prior to routine nailing in the subject group and only interlocking nailing was done in control group. The alignment and reduction preoperatively, postoperatively and at healing was the main outcome measured with an emphasis on loss of initial reduction on follow up. Kalstrom-Olerud score was used to assess the functional outcome which is an independent measurement, not influenced by other co-morbid conditions and associated injuries.

Keywords: distal both bone fracture of leg, fibular plating

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I. Introduction

The distal tibia fractures occur in around 7 to 9% cases of lower extremity fractures, out of them 85% are associated with fibular fractures. The distal tibia fractures occur by various mechanisms like road traffic accidents, fall from heights or low energy mechanism like rotational strain, etc. The amount of swelling, blisters, and open wounds are taken into account while managing distal tibia and fibula fractures. Despite all measures, treating distal both bone fractures of leg remain as a challenge. The goals of surgery are maintaining the length and rotation, correction of sagittal and coronal alignment, and quicker return of functional range of movements of knee and ankle. Treatment of distal both bone leg fractures includes intramedullary nailing, hybrid external fixation, plate fixation or combining any of these modalities. Interlocking nailing of tibial fractures is advantageous as this technique allow load sharing, does not disturb extra osseous blood supply, and soft tissues are less damaged and have a relatively easy learning curve. Intramedullary nailing of distal tibial fractures with short distal fragment is associated with malalignment problem particularly in coronal plane, non-union and need for secondary procedures to achieve union because of muscular forces which result in displacement of fracture and instability due to mismatch. As there is a mismatch between the diameters of the medullary canal and the nail, with absent nail-cortex contact, the nail may sway laterally along coronally placed locking screws and stress is increased on the locking holes to maintain alignment of the fracture after surgery resulting in failure. So various techniques have evolved to improve nailing the distal both bone fractures of leg including fibular plating (distal third fractures), unicortical plating, different nail design with different proximal bends (proximal third fractures) and blocking screws (poller screws). In our study we analyse the functional outcome of distal both bone leg fractures treated with Tibial Interlocking nail with and without supplementary fibular plating.

Fibular plating was selected for the following reasons,

1. Correction of alignment before insertion of nail
2. Maintaining the alignment or to improve the stability of bone implant complex
3. For achieving rotational stability

II. Review of Literature

Intramedullary nailing with locking bolts is widely accepted as satisfactory treatment for tibial diaphyseal fractures. But there are varied reviews about the use of this technique for fractures in distal metaphysis. Various supplementary procedure was used by different authors to effectively manage the metaphyseal fractures of tibia with intramedullary nailing.

In “1997 Thompson KA et al and Weber TG et al showed excellent results when supplemented with fibular plating. In 2000 Tyllianaki also found fibular plating as an effective supplement”. In 2002 Goezyca et al “published their results of modified tibial nails for the distal metaphyseal fractures”. “Kenneth A Egol compared the loss of alignment in distal metaphyseal fractures treated with intra medullary nailing alone. They had immediate post-operative malalignment in three cases in those treated with nailing alone, which were eventually corrected by using fibular plating or poller screws”. “Tyllianakis in his retrospective review of intramedullary nailing in distal tibial fractures showed excellent results in 86% of patients. In their study, they fixed the concomitant lateral malleolar fractures and if not fixed they used plaster. They noted that patients with concomitant fibular fractures treated with plasters showed permanent swelling and stiffness. They also noted that fixation of fibula helped to align the tibial fracture and facilitate nail insertion” Moscato and his colleagues recommended “fibular plating to ensure overall alignment in supramalleolar fractures, the lateral malleolar fractures when associated with the tibial fractures can lead to incongruity of the ankle joint which may lead to post traumatic arthritis”. Robinson et al. showed that “distal metaphyseal fractures of the tibia with minimal involvement of the ankle can be treated successfully with intramedullary nailing; of 63 patients, all but five had satisfactory clinical outcomes. The authors emphasized that this technique is inappropriate for pilon fractures with significant articular involvement caused by an axial loading mechanism”. In “2003 James Kellam stated that fibular plating or poller screws were effective as supplementary techniques in intramedullary nailing of distal tibial metaphyseal fractures”. In “2005 Sean E Nork et al compared the results of those treated with nailing alone and those treated with supplementary fibular plating”. In “2006 Kenneth A Egol et al advocated fibular plating and temporary unicortical plating”¹. As advocated by Robinson et al., some investigators believe that plating same-level fibular fractures helps prevent malalignment in distal tibial fractures treated with intramedullary nailing. Fibular plating has been found to be an excellent supplementary technique to intramedullary interlocking nailing in distal both bone fractures of leg as it helps in reduction and alignment preoperatively and helps in maintaining fracture alignment till union, preventing loss of initial reduction.

III. Materials & Methods

This is a prospective comparative study of 20 patients with distal both bone leg fractures– 10 patients treated with interlocking nailing alone and 10 patients treated with interlocking nailing with supplementary fibular plating. The study was done after getting clearance from hospital ethical committee. Those who fulfilled the inclusion criteria given below, were invited to participate in the study. Informed consent was obtained from all the patients willing to take part in the study.

3.1 Inclusion Criteria:

1. Lower end of tibia (Lower Metaphysis)
2. Acute Fractures
3. Closed Fractures
4. Grade I and II compound Fractures (Gustilo Anderson Classification)
5. Age above 16 yr.

3.2 Exclusion Criteria

1. Grade III compound Fractures
2. Proximal and Mid shaft Tibial fractures
3. Head injuries and Uncontrolled Medical comorbid conditions (Poorly controlled Diabetes Mellitus)
4. Vascular Injuries

Alignment and reduction preoperatively, postoperatively and at healing was the main outcome measured with an emphasis on loss of initial reduction on follow up. Kalstrom-Olerud score was used to assess the functional outcome. It is an independent measurement, not influenced by other co-morbid conditions and associated injuries

IV. Results

The Fractures treated with tibial interlocking nailing without fibular plating were analysed and 5(50%) cases were malunited and deformed. Karlstrom- Olerud scoring was excellent in one (10%) patient, good in 5 patients (50%), fair in 3 (30%) patients and poor in 1 (10 %) patients. The mean delay in surgery for this group is 2.2 weeks. Radiologically the mean post-operative varus/valgus alignment was 8.6 degrees. The mean

duration of time of union is 12.70 weeks. 4 patients needed cast support. The average follows up is 8 months (lowest – 4 months, longest – 18 months)

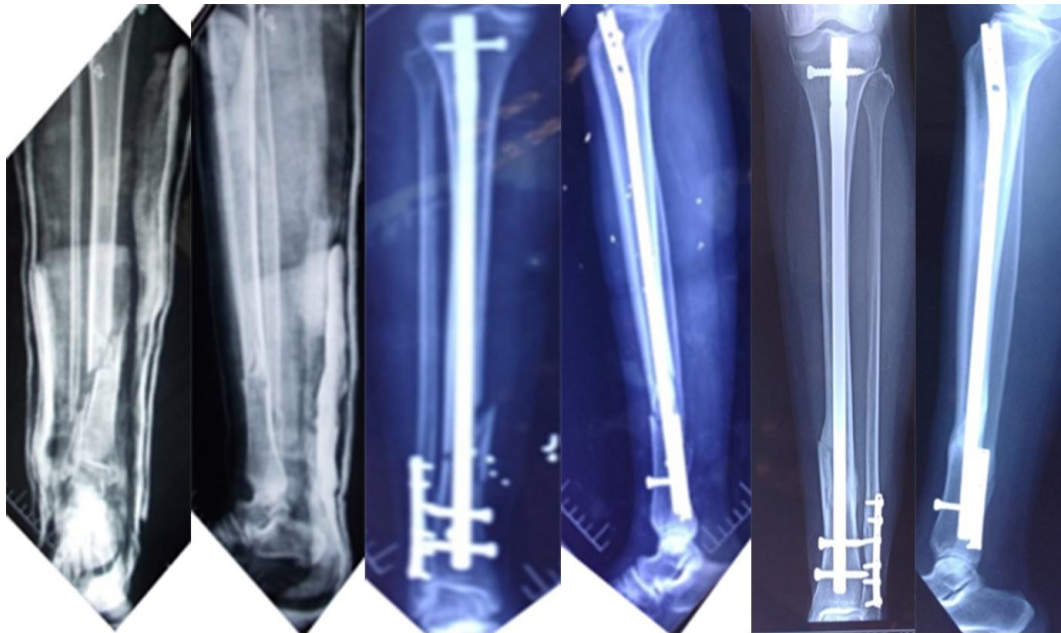


Figure showing the Pre Op, Immediate Post Op and 3 months Post Op X rays of the distal tibial fracture managed with fibular plating and IL Nailing which has resulted in a good union without any angulation or rotaion at union.

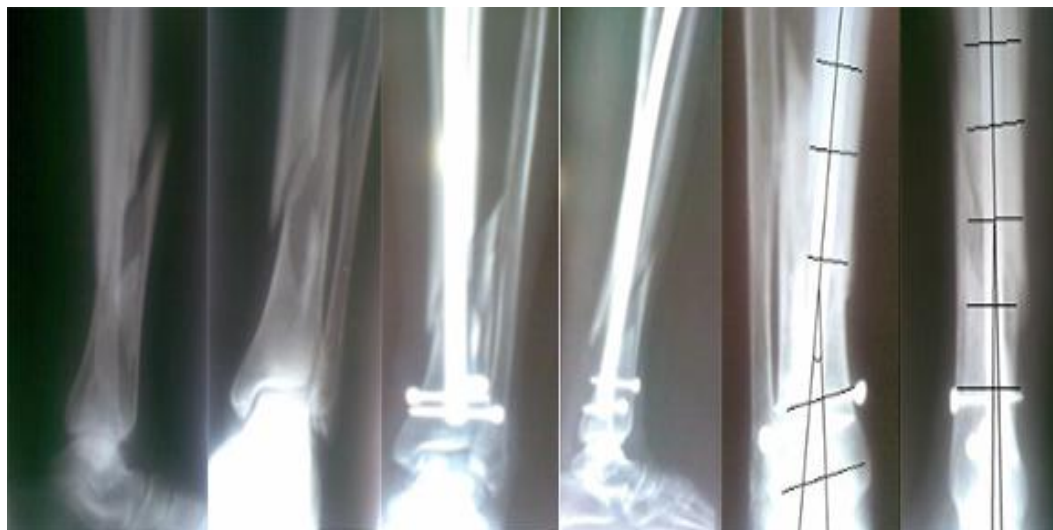


Figure showing the PreOp Immediate P0st Op and 6 months Post op of distal both bone fracture managed with IL Nailing alone which has resulted in 20 degree varus angulation and 6 degree anterior angulation at union of distal tibia.

All the fractures treated with supplementary fibular plating in addition to tibial interlocking nailing eventually united in a mean period of 11.60 weeks Karlstrom-Olerud score was excellent in 6 fractures (60%), good in 3 patients (30%) and fair in 1 patient (10%) The mean delay between the injury and the surgery was 1.8 weeks. Radiologically the mean post-operative varus/valgus alignment was 2.10 degrees. The alignment was maintained till union with the mean remaining the same in the coronal plane. The average follows up is 10.3 months (lowest- 6 months, longest – 24 months)The p- value for varus/ valgus angulation with equal variancesassumed is 0.0016 and with equal variances not assumed is 0.0064. Thus it is statistically significant

that the p- value is < 0.05. The p- value for time of union is 0.3425(p value >0.05), so it is statistically insignificant.

V. Discussion

In our study the mean time of union for patients treated with tibial interlocking nailing alone is 12.70 weeks, whereas the mean time of union for patients treated with tibial interlocking nailing with supplementary fibular plating is 11.6 weeks. The mean varus / valgus angulation for patients treated with tibial interlocking nailing alone is 8.6 degrees whereas the mean varus / valgus angulation for patients treated with tibial interlocking with supplementary fibular plating is 2.1 degrees. Fracture union was rather difficult to define and measure. "Sarmiento et al in 1984 specified criteria for the judgment of union.

1. The ability of the patient to bear weight without pain.
2. Absence of clinically detectable movements across the fracture site.
3. Visible bridging callus across the fracture on plain radiograph".

"Panjabi et al in 1985 proved that cortical continuity was the best predictor of mechanical strength and the author suggested that measurement of number of cortices bridged was the most reliable measure to assess fracture healing". In the current series, the union was defined based on the ability to bear weight in the affected leg without pain and when the radiograph shows us bridging callus in at least three of the four cortices. We cannot over emphasize the potential advantages of intramedullary nailing than any other form of fixation like external fixator or plating in tibial fractures. But the problems in extending the indication to metaphyseal fractures have to be analysed and resolved. The management of tibia fractures has evolved significantly over the last 10 to 15 years. Intramedullary nailing has become the standard of care for most of these injuries, especially in cases with significant soft tissue damages. The lack of interference fit of Intramedullary nails in the distal tibial metaphysis has prompted some surgeons to add fibular plating in the hopes of improving fracture stability. In this study where the fibular fixation with plate is done for distal bothbone fractures it has shown significant difference in varus / valgus angulation when compared to patients without fibular fixation it is comparable with a recent retrospective study by Egol and colleagues that suggests a higher failure rate in patients whose fibulas were not plated.

"These patients present a range of fixation configurations ranging from 1 to 3 distal locking screws. The proximal fixation in these cases is not mentioned. The authors note that the number of distal locking bolts had an effect on the rate of malalignment. Although triple locking distally has become the standard at our institution for this fracture type, other centres commonly use 1 or 2 distal locking screws". It is possible that fibular plating becomes more important when fewer points of fixation are used in the tibia. "In a similar biomechanical evaluation of distal tibia fractures, Kumar and colleagues found some beneficial effect of plating the fibula when a nail is used to stabilize the tibia". In our study for the patients treated with tibial interlocking nailing we encountered 50 % malunion which was comparable with study conducted by Lesch GJ et al²⁹ in his review of 38 cases for distal both bone leg fractures where he encountered 79% of malunion i.e. angulations of 5 degrees or more in frontal or sagittal plane and required secondary procedures to achieve in 38 % of cases and in another study Jen Nork et al³¹, "in their review stated that previously reported rates of unacceptable alignment after medullary nailing of distal third both bone fractures have ranged from 54% to 86%". Hence alternate forms of fixation like supplementary fibular plate or external fixation is suggested. Chen AL "compared the intrinsic stability in tibial intramedullary nail construct in distal third distal physeal fractures without isthmal support, between two medio lateral distal locking screws and two perpendicular (one medio lateral & one antero posterior) distal locking screws. He concluded that fixation stability of intramedullary nail is not significantly influenced by distal locking screw orientation in response to sagittal, coronal or rotational forces".

In contrary, Smucker et al "found two parallel locking bolts being a better construct than perpendicular locking bolts in their study". To overcome these issues various techniques have been developed like slight medial entry point as suggested by Buehler et al and Lembcke O et al and modifications in nail designs including different proximal bends and more oblique screws. In distal third fractures "fibular plating and cutting the distal few millimeters of nail distal to the distal screws hole to allow two cross locking screws in the distal fragment, one cross screw across fractures site as lag screw and use of large reduction forceps and temporary unicortical plating, percutaneous manipulation with Shanz pins, femoral distractor have been the supplementary procedures used to achieve the alignment". According to Egol et al "The authors concluded that fibula fracture stabilization offers protection against loss of fracture reduction when distal metaphyseal tibia-fibula fractures with intramedullary fixation are being managed". Our data support these clinical findings, suggesting that Intramedullary nail fixation of a comminuted unstable distal tibia-fibula fracture without fibular stabilization may be unable to maintain fracture reduction under physiologic loading. The amount of malalignment and shortening considered acceptable is controversial. Tarr et al and Puno et al demonstrated that distal tibial

malalignment may be more poorly tolerated than more proximal malalignment⁹. Trafton's recommendation is generally agreed by many authors. According to our study the acceptable malalignment is less than 5 degrees of varus- valgus angulation, 10 degrees of anteroposterior angulation, and 10 degrees of rotation and 15mm of shortening.

In this study we encountered malalignment in five cases of distal third fractures (50%) treated with interlocking nailing for tibia alone, whereas malalignment was encountered in only one case (10%) of distal tibia fractures treated with interlocking nailing for tibia with fibular plating. We found that interlocking nailing when supplemented with fibular plating did influence the stability or the functional outcome. When compared to other techniques described for preventing metaphyseal malalignment during nailing in distal both bone fractures of leg, fibular plating is not technically demanding, do not require any special instrumentation and do not need any special design modification in the nail. There is no significant increase in radiation exposure for applying fibular plating. In our series the mean ratio of fracture segment to the tibial length was only 16% which denotes that even such short fracture segments can be safely and effectively managed by intramedullary nailing when supplemented with fibular plating in distal both bone fractures of leg. We had excellent to satisfactory outcome in 85% by Kalstrom-Olerud for patients treated with supplementary fibular plating scoring which is comparable to the results of studies conducted by Tyllianikis et al⁷ with 86% excellent to satisfactory. The diameter of medullary canal at the level of isthmus was 9 mm compared to 18 mm at the level of fracture site. The mismatch explained the cause of instability in metaphyseal fractures when treated with intramedullary nailing. The ratio of short metaphyseal fragment to the total tibial length was analysed. The total length of the tibia was approximately derived from the length of the nail used. The mean ratio was found to be 16%. Even such short metaphyseal fragments had been effectively stabilized till union with intramedullary nailing when supplemented with fibular plating.

VI. Conclusion

We conclude that fibular plating, when supplemented the intramedullary nailing of distal both bone fractures of leg are an effective measure in achieving the fracture alignment especially in fresh fractures in improving not only angular stability but also rotational stability along with maintenance of the fracture alignment till union, preventing loss of initial reduction.

The analysis of this group of patients confirmed the hypothesis postulated by emphasizing the importance of the fibular fracture within a single biomechanical and pathological entity of distal fractures of the tibia. In particular, it confirms the value of double surgical fixation, as a complement to stability but also as assistance to reduction when nailing is indicated. In closed nailing procedures, reduction of both tibial and fibular lesions is even more difficult to obtain if treating a torsion injury resulting in a fracture with a rotational component, ensuring fibular osteosynthesis first anatomically reduces any horizontal displacement. These strategies now remain to be validated in a prospective study. In our comparative study we have found statistically significant varus/ valgus angulation difference, the time of union difference is not statistically significant. However, a long term follows up and a larger sample study is needed to further validate our findings. This study is the authentic work of the authors. No financial benefits were received from any commercial party for this study.

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Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Competing Interest

The authors declare that they have no competing interests.

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