

## Research Article

# Surgical dilemma's in treating distal third leg fractures

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### ABSTRACT

**Background:** Of all the long bones, the tibia and fibula have the highest incidence of fractures. These fractures are often caused by high energy trauma. The management of tibial fractures has always been particular interest to orthopaedic surgeons because they are relatively common but difficult to treat. The spectrum of injuries to the tibia is so diverse that there is no single method of treatment applicable to all fractures. In this we are going to analyse distal tibia fracture treated by nailing and minimally invasive plate osteosynthesis.

**Methods:** A prospective study done at Sri Ramachandra Medical Centre between June 2011 and June 2013. The inclusion criteria were closed extra - articular distal third tibia fracture. The exclusion criteria were compound fractures, intraarticular fractures, paediatric fractures and pathological fractures. We had fifteen patients who underwent closed intramedullary interlocking nail and fifteen patients treated with plate osteosynthesis (MIPO).

**Results:** All the fractures united solidly with mean union time of 24.5 weeks ranging from 18 to 38 weeks. The patient who underwent nailing showed mean healing time of 24.9 weeks which has not shown any significant advantage over the healing time of patients treated with plate osteosynthesis by MIPO technique which is 24.2 weeks. In nailing group the infection rate was 20% which is significantly higher when compared to patients who were treated with plate osteosynthesis 6.6%.

**Conclusion:** Plate osteosynthesis by minimally invasive technique and intramedullary interlocking nailing are equally effective methods of stabilisation for distal tibia fracture when considering the union rates and final functional outcome. However malunion, nonunion and secondary procedures were more frequent after intramedullary interlocking nail. Concurrent fibula fixation with plate osteosynthesis will minimise the incidence of malunion for distal tibia fractures.

**Keywords:** Minimally invasive, Intramedullary nailing, Distal third tibia

### INTRODUCTION

Distal third leg fractures commonly affect young males and a severe fracture complicated by nonunion or infection often results in loss of employment or other socio-economic problems. The spectrum of injuries to the tibia is so diverse that there is no single method of treatment applicable to all fractures. The mode of treatment of distal third tibial fractures is still controversial. Distal third tibial fractures differ from proximal third fractures by their difference in anatomy

and difference in healing potential. Intramedullary interlocking nailing is one of the advocated ways of treating distal third tibial fractures. Intramedullary interlocking nailing may sometimes fail to stabilize fractures in the distal metaphysis because of malalignment. The objective of minimally invasive plate osteosynthesis is to assist physiological process of bone healing wisely and optimally with minimal amount of operative intervention, thereby reducing the complications encountered in conventional plating. A comparative study was conducted on the clinical and

radiological union either of the closed intramedullary interlocking nail or plate and screw fixation. The advantages, disadvantages, follow up, complications if any and overall functional outcome will be evaluated in these patients

## METHODS

This was a prospective study done at Sri Ramachandra Medical Centre between June 2011 and June 2013. The inclusion criteria was closed extra-articular distal third tibia fractures (4 to 11 cm from tibial plafond). The exclusion criteria were compound fractures, intra-articular fractures, paediatric fractures and pathological fractures. Total of thirty two patients were included in this study as per the inclusion and exclusion criteria. Two patients lost follow up. Of the 30 patients available for follow up we had fifteen patients who underwent closed intramedullary interlocking nail and fifteen patients treated with plate osteosynthesis (MIPO). The mode of injury in all patients was due to vehicle accidents. The age distribution varied from 21 years to 43 yrs. Among the 30 patients included in our study there were 21 male and 9 female.

Of the 30 patients, 18 fractures were right sided and 12 fractures were left sided. All 30 patients were classified according to AO classification<sup>1</sup> of which 15 belonged to A1, 14 belonged to A2, 1 belonged to A3. In the nailing group, 12 had ipsilateral tibia and fibula fracture and 3 patients had isolated tibia fracture. There was associated superior pubic rami fracture in one patient, ipsilateral clavicle fracture in one patient and ipsilateral foot fracture in another patient. In the plating group there were 13 patients with ipsilateral tibia and fibula fracture and 2 patients had isolated tibia fracture.

All 30 patients were received in emergency room following which trauma series, relevant X-rays including the affected legs with knee and ankle joints antero-posterior and lateral views were taken. Initial management consisted of closed reduction and splinting. All the 15 patients who underwent intramedullary interlocking nail were operated under regional anaesthesia with patient's supine on standard radiolucent table. Patellar splitting approach<sup>2</sup> was used in all the patients. Reduction of fracture was achieved by manual traction using image intensifier. Nailing was done using standard technique and all fractures were fixed with two proximal and two distal locking screws. All 15 patients who underwent plate osteosynthesis by MIPO technique were operated under regional anaesthesia with patient supine on standard radiolucent table. By indirect fracture reduction technique, reduction of the fracture site was achieved and fixed with pre contoured plates and appropriate screws by the minimally invasive technique under the guidance of image intensifier. The decision for adjunctive fibular stabilisation as well as number of orientation of distal locking bolts was made at the surgeon's discretion. Duration of surgery and blood loss

intra operatively was estimated for all 30 patients. None of the patients were operated under tourniquet control.

Post operatively radiographic evaluation was done with standard antero-posterior and lateral view of the tibia with knee and ankle joint. Active range of movements of knee and ankle joint along with quadriceps strengthening exercises were started on the next day of surgery. All patients were given 3 to 5 days of broad spectrum intravenous antibiotics. Wound inspection was done on second, fifth, seventh post-operative day. Suture removal was done on II the post-operative day. Patients were maintained non or toe-touch followed by partial weight bearing until clinical and radiographic signs of healing were seen after which full weight bearing was allowed. Secondary surgeries like bone grafting, dynamization, implant exchange were performed as determined by the surgeon for failure of progression of healing, loss of fracture fixation or infection.

Thirty patients were followed up for clinical and radiological evaluation using modified Klemm and Borner scoring<sup>3</sup> system at 6 weeks, 3 months, 6 months, 1 year. Fracture union was defined as healing of at least 3 or 4 cortices on biplanar radiograph. Delayed union was defined as lack of any healing on plain radiograph within 3 months. Non-union was defined as lack of any healing on plain radiograph within 6 months. Malunion was defined as more than 5 degrees of angular deformity or shortening of more than 1 cm.

## RESULTS

All the fractures united solidly with mean union time of 24.5 weeks ranging from 18 to 38 weeks. The patient who underwent nailing showed mean healing time of 24.9 weeks which has not shown any significant advantage over the healing time of patients treated with plate osteosynthesis by MIPO technique which is 24.2 weeks. All patients who underwent nailing shows a good regain of range of movements in both knee and ankle. Two of the patients in plating group had ankle stiffness which compromised the overall functional outcome. In our series none of the patients had significant limb length discrepancy and no note of limping gait was made. Out of 30 patients with distal tibia fractures 25 patients were associated with distal fibula fractures (Table 1). There were 13 and 12 patients in the plating and nailing group respectively. Fixation of fibula fractures usually results in better alignment. In our series there were 12 out of 13 and 5 out of 12 patients underwent fibula fixation in plate and nailing group respectively.

In plating group 90% of patients underwent fibula fixation. In this group malalignment were resulted in 2 patients (antero-posterior deformity). In nailing group only 40% of patients were treated with simultaneous fibula plating but the fractures were united in valgus/varus malalignment in 6 cases. Even though fibula plating in nailing group will prevent malalignment sometimes it

affects the fracture union rate and results in non-union's. In our series 2 patients in nailing group who had fibula fixation resulted in non-union. These two patients had secondary procedures like implant exchange and bone grafting.

**Table 1: Fibula plating in distal third leg fractures.**

Treat-ment	No. of cases	No. of patients with fibula fractures	No. of patients with fibula plating	Malalign-ment
Plate	15	13	12 (90%)	02 (13.3%)
Nail	15	12	05 (40%)	06 (40%)

In nailing group the infection rate was 20% which is significantly higher when compared to patients who were treated with plate osteosynthesis 6.6%. The final clinical and radiological outcome using modified Klemm and Borner scoring system<sup>3</sup> in our study majority of patients had ended in excellent and good results (Table 2).

**Table 2: Clinical and radiological outcome using modified Klemm and Borner scoring system.**

	Nailing	Plating
Excellent	3 (20%)	6 (40%)
Good	8 (53.3%)	6 (40%)
Fair	2 (13.3%)	2 (13.3%)
Poor	2 (13.3%)	1 (6.6%)

## DISCUSSION

Distal tibial fractures which were treated with plate osteosynthesis especially after high energy injuries had encountered higher complication rates, because of which many surgeons preferred intramedullary interlocking nailing technique to minimise surgical insult to the fracture and adjacent soft tissue. However proximal and distal tibia fractures can be difficult to control with intramedullary device leading to malunion rates of 5-58%. Minimally invasive plating technique reduces surgical trauma and maintain more biological environment for fracture healing.<sup>4</sup> Despite recently reported success of locking plates using minimally invasive plate osteosynthesis for distal tibia fracture the optimal treatment for these remain controversial.

In our study, to analyse these two techniques various parameters like union rate, incidence of malalignment, rate of complications and functional outcome using Klemm and Borner scoring system were used. In our study, there were 11 male and 4 female patients among the nailing group and 10 male and 5 female patients among the plating group. The mean average age incidence was 39 years. The youngest individual was 23 years and oldest was 68 years. In the nailing group, 8 cases were of AO type A2 comprising the majority. In

plating group, there were 8 cases of AO type A1 comprising the majority.

Average period of radiological union was found to be 24.2 weeks for the plating group and 24.9 weeks among the nailing group. In Tzeng et al. study the mean union times were 22.6 weeks in nailing group and 27.8 weeks in the plating group. It has been found that preservation of soft tissue envelope and blood supply surrounding the fractures by using indirect reduction techniques would promote fracture healing regardless of type of fixation.<sup>5</sup> Six cases in the nailing group showed higher than acceptable range of angulation, malalignment or loss of reduction may occur after nailing mostly due to improper reduction, poor nail position (e.g.: not centering the nail in the distal fragment), or loose fixation. Nonetheless, correct nail position, good contact of the nail to the end plate and rigid fixation of the nail-screw-bone construct should certainly be established.<sup>6</sup>

Among the plating group only two cases had significant rotational deformity. It has been found that indirect fracture reduction and fixation with medial plate was effective at restoring and maintaining alignment in high energy, mechanically unstable fractures of distal tibia. Malalignment has been recognised previously as a potential pitfall when using minimally invasive plating techniques because the bone is not directly visualised. Reports of 7% 35% of distal tibia fractures treated with minimally invasive plate osteosynthesis have had problems with malalignment. There were 3 cases of superficial infection in the nailing group, which healed on oral antibiotics. There was one case of infection among the plating group which required debridement with suturing and antibiotics. In both the groups spontaneous union occurred without any further complications. The mechanism resulting in distal tibial metaphyseal fractures usually consists of a high energy trauma that not only creates complicated fracture but also extends the injuries to the soft tissues. This extended soft tissue injury could be further compromised by open reduction and internal fixation. Teeny et al, reported as many as 50 patients with at least one major complication such as skin slough, wound dehiscence, infection, non-union, malunion or implant failure. Furthermore in case of recurrent osteomyelitis or soft tissue dehiscence, 16.6% of these patients eventually go on to amputation. Recently minimally invasive plating of injuries in this area has demonstrated less soft tissue problems and reasonably lessens the risk of infection.<sup>7</sup>

It has been noted that concurrent fibula fixation among the patients treated by intramedullary interlocking nail will prevent malalignment but sometimes it affects the fracture union rate and results in non-union.<sup>8</sup> In our series 2 patients who were treated by intramedullary interlocking nail and concurrent fibula fixation resulted in non-union. Mosheiff et al. and Schmidt et al. recommended routine fixation of the concomitant fibular fractures to lessen the risk of malalignment. However, the

essential benefit of intramedullary nailing in avoiding soft tissue dissection might be compromised in this way. No patient suffered from loss of reduction in the series conducted by them demonstrating that it is not necessary to fix the fibula in the fractures of distal tibial metaphysis.<sup>9</sup> It is possible that fibula fixation improves tibia alignment in some cases, but that an increased potential for delayed healing of the tibia may be seen when the fibula is stabilized concurrently. It has been noted angular malalignment of 5 degrees or more after nailing in 29% of patients, although malunion was not associated with presence of fibula fracture or fixation of fibula. Recent comparative study have also described more malalignment after nailing (50% versus 17% after plating), suggesting that plating of complex fractures may result in less malalignment.<sup>10</sup>

Percutaneous plating has had rates of secondary surgery between 0% and 20% for delayed fracture healing, compared with rates of up to 42% after nailing suggesting that plating may be more efficacious in achieving timely fracture union without any secondary procedures. Our study consisted of 4 patients among the nailing group who had undergone secondary procedures like dynamization, bone grating and implant exchange. None of the patients in the plating group had undergone any secondary surgery. Recently, minimally invasive plating of injuries in this area has demonstrated excellent healing rates and only few required bone grafts. Zelle et al., recently reviewed the literature and found 115 cases of minimally invasive plating for distal tibia fractures, and only 3% of these resulted in non-union.<sup>11</sup>

## CONCLUSION

Our study shows that plating by MIPO technique have given an equally good result when compared with the patients who had undergone intramedullary interlocking nail. In recent times distal tibia fractures treated by MIPO technique show minimal incidence of wound gaping and implant failure. These may be due to the evolution of minimally invasive surgical technique and better anatomical profile plates (thin profile and lock compression plates). Plate osteosynthesis by minimally invasive technique and intramedullary interlocking nailing are equally effective methods of stabilisation for distal tibia fracture when considering the union rates and final functional outcome. However malunion, nonunion and secondary procedures were more frequent after intramedullary interlocking nail. Concurrent fibula fixation with plate osteosynthesis will minimise the incidence of malunion for distal tibia fractures.

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## REFERENCES

1. Ronga M, Longo UG, Maffulli N. Minimally invasive locked plating of distal tibia fractures is safe and effective. Clin Orthop Relat Res. 2010 Apr;468(4):975-82.
2. Bhandari M, Guyatt GH, Tornetta P, Swiontkowski MF, Hanson B. Current practice in the intramedullary nailing of tibial shaft fractures: an international survey. J Trauma. 2002 Oct;53(4):725-32.
3. Klemm KW, Borner M. Interlocking nailing of complex fractures of the femur and tibia. Clin Orthop Relat Res. 1986;212:89-100.
4. Resch H, Pechlaner S, Benedetto KP. Long term results after conservative and surgical treatment of fractures of the distal end of tibia. Aktuelle Traumatol, 1986;16:117-23.
5. Heather. A. Vallier, Toan Le. Radiographic and clinical comparison of distal tibia shaft fractures plating vs. intramedullary nailing. J Orthop Trauma. 2008 May/Jun;22(5):307-11.
6. Cheng-yu Fan, Chao-Ching Chiang. Interlocking nails for displaced metaphyseal fractures of distal tibia. Injury. 2005;36:669-74.
7. Cory Collinge, Mark Kuper, Robert Protzman. Minimally invasive plating of high energy Metaphyseal distal tibia fractures. J Orthop Trauma. 2007 Jul;21(6):355-61.
8. Cory Collinge, Robert Protzman. Outcome of minimally invasive plate osteosynthesis for metaphyseal distal tibia fractures. J Orthop Trauma. 2010 Jan;24(1):24-9.
9. Dorga AS, RuizAL, Thompson NS, Nolan PC. Diaphyseal distal tibial fractures -treatment with a shortened intramedullary nail: a review of 15 cases. Injury. 2000 Dec;31(10):799-804.
10. Egol KA, Weisz R, Hiebert R, Tejawani NC, Koval KJ, Sanders RW. Does fibular plating improve alignment after intramedullary nailing of distal tibia metaphyseal fractures? J Ortho Trauma. 2006 Feb;20(2):94-103.
11. Gun-II Im, Sue-Kee Tae. Distal metaphyseal fractures of tibia: a prospective randomized trial of closed reduction and intramedullary nail versus open reduction and plate and screws fixation. J Trauma. 2005 Nov;59(5):1219-23.

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