ORIGINAL ARTICLE

COMPARATIVE STUDY OF PLATING VERSUS NAILING IN DISTAL TIBIA METAPHYSEAL FRACTURES

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ABSTRACT

Introduction: Distal tibial metaphyseal fracture is unique. The best option for surgical treatment of distal metaphyseal fractures of tibia is still unclear.

Objectives: This study was conducted to set the indications for both modalities of fixation in various fracture subtypes; and also to compare the functional outcomes of distal metaphyseal fractures of tibia managed by both methods at 2 years interval. Complication rates with different modalities of fixation were also studied.

Method: We have studied 40 pt in Sir JJ hospital group of hospitals from periods May 2009 to April 2011. The study was prospective and comparative for the methods used for management of the fracture.

Results: Age range of the patients was 18-65 yr. Most common mode of trauma in both the groups is road traffic accident. Associated fibula fracture was present in 18 (90%) participants in group 1 and 17 (85%) patients in group 2. Difference between 2 groups regarding duration of surgery is not significant. No significant intraoperative complications were noted in both groups. Time after which partial weight bearing and full weight bearing was started were significantly shorter in group1 (p=0.005). The average time before union was 23.45 weeks (range, 16-36 weeks) in group 1 and 26 weeks (range,19-41 weeks), (p=0.09). Malalignment was found in 25% of patients in group 1 and 10% of patients in group2. Angulation in group 1 was 3.4 degree (range, 0-12) and 1.0 degree (range,0-9) in group2 (p=0.04).

Conclusion: The overall results were comparable and most patients were satisfied with the results. These results indicate that both modalities of treatment deserve a place in treating distal metaphyseal fractures of tibia.

Keywords: Plating, Nailing, Distal Tibia Metaphyseal Fractures

INTRODUCTION:

Distal metaphyseal tibial fractures are unique. Fractures of distal tibia metaphysis occur typically as a result of axial and rotational forces on lower extremity and represents approximately 10% of the fractures of distal end of tibia [1,2]. The degree of associated soft tissue injury is higher in distal metaphyseal fractures than with shaft fractures [3].This fracture can be treated by plating or with closed reduction and reamed intramedullary nailing. Open plating of the medial aspect of distal tibia caused a statistically significant greater disruption of extraosseous blood supply of the metaphyseal area than percutaneous applied plates [4]. The purpose of this study 1. To set the indications for both modalities of fixation 2.To compare the clinical and radiologic outcomes of patients treated by both methods.

OBJECTIVES

The objective of the study were to set the indications for both modalities of fixation in various fracture subtypes; to compare the functional outcomes of distal metaphyseal fractures of tibia managed by both methods at 2 years; and to study

complication rates with different modalities of fixation

MATERIAL AND METHODS

This is prospective study conducted in Department of Orthopaedics, Sir JJ Group of hospitals, Mumbai between May 2009 and April 2011. The study consisted of 40 patients metaphyseal fracture of tibia with either reamed intramedullary nailing or locked plating with open reduction method or minimally invasive techniques.

Biplanar injury radiography was evaluated to determine the fracture location and involvement of distal part of tibia.

Inclusion Criteria: Skeletally mature patient, involving distal 5cm of tibia (AO types A1, A2, A3 and B1) and all closed and Gustilo-Anderson type 1 fractures.

Exclusion Criteria: Skeletally immature patient and Fractures with intra-articular extension (AO type B, C2, C3) 3), Open fractures of Gustilo-Anderson type 2&3, all cases with DM where excluded.

The eligible patients were randomly divided into two groups ,Group 1 includes patients managed with closed reduction and reamed nailing and Group 2 includes patients treated with locked plating techniques either open reduction or minimally invasive method.

The patients in both groups were matched for various confounding variables (age, sex, fracture types, comorbid condition, and associated fractures) and twenty Patients in each group were selected for final outcome study.

Follow ups took place at 6 weeks and 3, 5, 7, 9 and 12 months after surgery with clinical and radiological examination

RESULTS

Forty patients included in study and compared group1 (treated with interlock nailing) with group 2 (treated with distal tibia locked plate). Age range of the patients was 18-65 yr.

Most common mode of trauma in both the groups is road traffic accident (10 in group1 and 9 in group 2), followed by sports related injury in group 1 and fall from height in group.

Associated fibula fracture was present in 18 (90%) participants in group 1 and 17 (85%) patients in group 2.

Table 1: Age distribution of patients

Age group	Group 1	Group2
21-30	3	3
31-40	6	8
41-50	8	5
51-60	1	2
61-70	2	2

Table 2: Mode of trauma to patients

Mode of trauma	Group 1	Group 2
Fall from height	2	3
Fall at home	1	2
Road traffic accident	10	9
Assault	2	2
Staircase injury	1	2
Sports related injury	4	2

Table 3: Morphology of fractures AO type

AO type	Group 1	Group 2
43 A1	5	4
43 A2	10	8
43 A3	3	5
43 B1	2	3

Duration of surgery: The average duration of surgery in group 2 was 94 minutes (range,70-120 minutes) whereas average duration of surgery in group 1 was 85 minutes (range,65 to 105 minutes), (p=0.21) meaning that difference between 2 groups regarding duration of surgery is not significant.

Intraoperative complications: No significant intraoperative complications were noted in both groups. Difficult reduction was observed in 3 patients in group 1 and 4 patients in group 2.

Time to weight bear: Average time after which partial weight was started in group1 was 7.6 weeks (range,6to 11 weeks) and in group 2, 9.5 weeks (range,8 to 12 weeks),(p=0.005). Average time after which patient was allowed full weight bear on the operated limb was 14.25 weeks (range,11-18 weeks) in group1 and 17.32 weeks (range,14-22 weeks) in group2, (p=0.001).

Time to union: The average time before union was 23.45 weeks (range, 16-36 weeks) in group 1 and 26 weeks (range,19-41 weeks), (p=0.09). Two patients in group 1 (10%) failed to achieve union by 24 weeks. One of them required autogenous bone grafting and went to union by 34 weeks and other patient required dynamization with bone grafting and went to union by 36 weeks.

Four patients failed to achieve union by 24 weeks in group 2(20%).

Table 4: Angulation and complication in study subjects

	Group 1(%)	Group 2(%)
Angulation*	3.4° (0-12)	1.0°(0-9)
Angular deformity		
Malalinment	25%	10%
Valgus deformity(>5°)	5%	5%
Varus deformity(>5°)	20%	5%

*P =0.04; °Degree; Figure in parenthesis indicate renge

Table 5: Implant related complications

Implant related complications	Group1	Group2
Screw breakage	10%	5%
Implant failure	_	5%

Table 6: Outcome of patients in both groups

Outcome	Group 1	Group2
Ankle range of motion (degree)		
Dorsiflexion	15 (9-20)	9 (5-15)
Plantar flexion	22 (15-26)	13 (8-20)
Fuctional evaluation*		
Excellent (91-100)	7	3
Good (61-90)	13	15
Fair (31-60)	00	2
Poor (0-30)	00	00

***Olerud and Molander functional evaluation score; Figure in paranthesis indicate range**

Two patients required autogenous iliac bone grafting and union was achieved by 36 weeks. One patient had implant failure with plate rupture and required revision plating with autogenous bone grafting and achieved union by 41 weeks.

Angular deformity: Malalignment was found in 25% of patients in group 1 and 10% of patients in group2. Angulation in group 1 was 3.4 degree (range, 0-12) and 1.0 degree (range,0-9) in group2 (p=0.04). Varus deformity of >5 degree was found in 4 cases and valgus deformity >5 degree in single case in group 1. 2 cases in group 2 had deformity >5 degree, one had varus and other had valgus deformity.

Average shortening was 0.8 cm (range,0-1.5) in group1 and 0.3 cm (range,0-1.3) in group2 (p=0.012). More than 1 centimeter shortening was present in 20% in group 1 and 10% in group 2.

Operative site infection was seen in 15% (all superficial) cases in group 1 and 25% (4 superficial and one deep) cases in group 2. Superficial infection subsided with intravenous antibiotics and continued dressing, one patient in group 2 with deep infection required wound wash with secondary suturing and healed eventually.

2 patients in group1 had screw breakage which was removed with uneventful healing, and 1 patient had screw back out which was removed percutaneously but it had no effect on healing. One case had implant failure with plate rupture in group2 due to premature weight bearing and was treated with revision plating and bone grafting.

Functional outcome was assessed by Olerud and Molander functional evaluation score (% of normal). Both the group has good outcome scores with slightly better in group 1.

DISCUSSION

Both groups were comparable with regards to age, sex and fracture types. Mean age of cases was 40 years in group 1 compared to 42 years in group 2.Most common mode of trauma in both groups was road traffic accident (50 % cases) followed by sports related injury in group 1(20% cases) and fall from height in group 2 (15% cases).This is similar to previous study conducted by Aso Mohammed et al in which mean age of cases was 42 years with male to female ratio 4:1 and most common mode of trauma was road traffic accident[5].

Associated fibula fracture was present in 90% in group 1 and 85% patients in group 2. We fixed fibula in all cases either with plating or intramedullary rod. Kumar et al reported that an intact fibula or fibular plate fixation provides initial rotational stability and minimizes varus or valgus angulation in distal tibia fractures treated with either nailing and plating group[6]. 65% were closed and 35% grade 1 open type in group 1 cases compared to 75% closed and 25% grade 1 open in group 2. Both groups were comparable in this regard.

The average duration of surgery in group 2 was 94 minutes (range,70-120 minutes) whereas average duration of surgery in group 1 was 85 minutes (range,65 to 105 minutes), (p=0.21) meaning that difference between 2 groups regarding duration of surgery is not significant. No significant intraoperative complications were noted in both groups. Difficult reduction was observed in 3 patients in group 1 and 4 patients in group 2.Proximity to ankle joint amplifies the bending moment of the distal segment and may facilitate fracture propagation into the ankle joint[7,8]. No such complication was observed in our cases.

Average time after which patient was allowed full weight bear on the operated limb was 14.25 weeks (range,11-18 weeks) in group1 and 17.32 weeks (range,14-22 weeks) in group2, (p=0.001). The cases in group 1 were able to bear weight on the operated limb in significant earlier time and able to perform independent activities at earlier time compared to group 2.

There was no significant difference in union time between two groups. Higher rate of delayed union was found in group 2(20%) compared to group 1(10%). Two patients in group 1 failed to achieve union by 24 weeks. One of them required autogenous bone grafting and went to union by 34 weeks and other patient required Dynamization with bone grafting and went to union by 36 weeks.

Four patients failed to achieve union by 24 weeks in group 2(20%). Two patients required autogenous iliac bone grafting and union was achieved by 36 weeks. One patient had implant failure with plate rupture and required revision plating with autogenous bone grafting and achieved union by 41 weeks.

Angular deformity was found in 25% of patients in group 1 and 10% of patients in group2. Mean angulation in group 1 was 3.4 degree (range, 0-12) and 1.0 degree (range,0-9) in group2 (p=0.04). Varus deformity of >5 degree was found in 4 cases and valgus deformity >5 degree in single case in group 1. 2 cases in group 2 had deformity >5 degree, one had varus and other had valgus deformity. This shows that angular malalignments were more common in group1.This complication may initially result from an incorrect entry site and entrance angle. In addition, the incidence of malalignment may be caused by instability due to the large difference between the diameter of the implant and medullary cavity of distal metaphysis. The nail does not contact the metaphyseal cortex ; therefore it may translate along the interlocking screws unless anteroposterior locking is also performed[9,10,11]. The use of Pollar screws has been described as additional stabilization technique and reduction tool to increase the strength of bone implant construct [12].

Malalignment can lead to complaints from the patient with regard to walking, practicing sports and so forth. Puno et al evaluated 27 patients with 28 tibial fractures at an average of 8.2 years (range, 6-12.5 years). They found a correlation joint malalignment and clinical outcome for fractures of tibia. Analysis showed that a greater degree of ankle malalignment produces poor clinical outcomes[13]. Long term effect of malalignment needs to be evaluated further.

Shortening (>1 cm) was found in 20% of patients in group1 and 10% of patients in group2. Average shortening was 0.8 cm (range,0-1.5) in group1 and 0.3 cm (range,0-1.3) in group2 (p=0.012).clinically significant shortening was found in only 2 cases treated with intramedullary nailing and one case treated with plating.

Most important postoperative complication in nailing group anterior knee pain and postoperative infection patients treated with plating group. Incidence of anterior knee pain in nailing cases was 30%. This complication is seen exclusively in nailing group. Operative site infection was seen in 15% (all superficial) cases in group 1 and 25% (4 superficial and one deep) cases in group 2. Superficial infection subsided with intravenous antibiotics and continued dressing, one patient in group 2 with deep infection required wound wash with secondary suturing and healed eventually.

Failure of nail or locking screws and nail is reported complication in intramedullary nailing of distal tibial fractures[14].2 patients in intramedullary nailing group had screw breakage which was removed with uneventful healing, and 1 patient had screw back out which was removed percutaneously but it had no effect on healing. One case had implant failure with plate rupture in group2 due to premature weight bearing and was treated with revision plating and bone grafting. Nail failure did not occur in our patients because we reamed the intramedullary canal and tried to use the nails of larger diameter.

Patients treated with intramedullary nailing have statistically better ankle range of motion. Average ankle dorsiflexion was 15 degree and plantarflexion 22 degree in nailing group compared to dorsiflexion of 9 degree and plantarflexion of 13 degree in plating group.

Additional procedures required in plating group were higher in plating group (8 case) compared to nailing group (5 case). 3 patients required Dynamization and 2 patients bone grafting to achieve union in nailing group. 3 patients required bone grafting, 1 case wound wash, 2 case secondary suturing and one case revision plating due to implant failure.

Higher average functional ankle score was found in nailing group compared to plating group. The average Olerud and Molander score was 86 (range,75-93) in group 1 and 80 (range, 59-93) in group 2 (p=0.008).

CONCLUSION

These results indicate that both modalities of treatment deserve a place in treating distal metaphyseal fractures of tibia.

1)Both modalities of fixation deserve place in management of distal metaphyseal tibia fractures.2) Overall results were comparable in both groups.3)Union time was shorter with intramedullary nailing compared to plate and screw method.

4)Locked intramedullary nailing has an advantage in restoration of ankle motion and reduced wound problems.5) Locked plate and screws can restore alignment better than intramedullary nails but the long term effect of malalignment needs further evaluation.6) Better alignment can be achieved with the use of locked intramedullary nails by careful attention to the technique of central guide wire placement and avoiding eccentric reaming.7)Use of blocking screws improves alignment and strength of bone implant construct.8) Additional procedures required to achieve union were higher in locked plates.9)Simple intra-articular extension (AO type B1) is not contraindication to locked intramedullary nailing.

10) Use of minimally invasive technique in plating reduces the wound problems and successively employed with bridge plating of communited metaphyseal fractures of distal tibia.11) Functional ankle scores were higher in nailing group compared to plating group. 12) Anterior knee pain is noted only with intramedullary technique and no knee complications were noted with plating group.13) Intramedullary nail being load sharing device, comparatively early mobilization can be started. Prolonged duration of protected weight bearing was required in patients treated with locked plate and screws.14) We recommend locked intramedullary nailing with at least two distal locking screws in AO type 43A1, 43A2, 43B1 and plating by minimally invasive technique in 43A3 fracture types.

Due to small number of patients involved in our study, we cannot draw any definitive conclusions from our preliminary results but view them as valuable basis for further studies.

Further research is necessary, in order to evaluate whether this surgical technique in long term provides us with the safe and effective management options for distal tibia fractures.

REFERENCES

1. Fan CY, Chiang CC, Chuang TY, et al. interlocking nails for displaced metaphyseal fractures of distal tibia. *Injury*, 2005; 36; 669-674.
2. Ovadia DN, Beals RK. The fractures of tibial plafond. J of bone joint surgery America. 1986;68; 543-551.
3. Robinson CM, McLauchlan GJ, McLean IP, et al. Distal metaphyseal fractures of tibia with minimal involvement of ankle: classification and treatment by locked intramedullary nailing. J of bone joint surgery British. 1995;77; 781-787.
4. Borelli J Jr, Prickett W, Song E, Becker D, Ricci W (2002). Extraosseous blood supply of tibia and the effect of different plating techniques: a human cadaveric study. Journal of Orthopaedic Trauma 16 (10): 691-695.
5. Aso Mohammed, Ramaswamy Sarawan, Jason Zammit, Richard King. Intramedullary nailing in distal third tibial fractures: distal locking screws and fracture nonunion.
6. Kumar A, Charlebois SJ, Cain EL, et al. Effect of fibular plate fixation on rotational stability of simulated distal fractures treated with intramedullary nailing. J Bone J Surg (Am)2004;85:604-8.
7. Steinberg EL, Geller DS, Yacoubian SV, et al. intramedullary fixation of tibial shaft fractures using an expandable nail ; an early results of 54 acute tibial shaft fractures. Journal of orthopaedics trauma 2006; 20; 303-309.
8. Rockwood and Green's, fractures in adults 7th edition, volume 2 . Fractures of tibia and fibula, 1884-87.
9. Freedmen EL, Johnson EE. Radiographic analysis of tibial fracture malalignment following intramedullary nailing. Clinical Orthop. 1995;315:25-33.
10. Henley BM, Meier T, Tencer AF. Inflences of some design parameters on biomechanics of the unreamed tibial intramedullary nail. J Ortho Trauma 1993;7:311-319.
11. Watson JT. Treatment of the unstable fractures of shaft of tibia. J Bone J Surg(Am). 1994;76: 1575-84.
12. Krettek C, Meclau T, Schandeimaier p, et al. The mechanical effect of blocking screws (Pollar screws)in stabilizing tibia fracture with short proximal or distal fragments after insertion of small diameter intramedullary nails. J Ortho Trauma 1999;12:550-3.
13. Puno RM, Vaughan JJ, Stetten ML, et al. Long term effects of angular malunion on the knee and ankle joints. J of Orthop Trauma 1991; 3:247-54.
14. Boenisch UW, de Boer PG, Journaeux SF. Unreamed intramedullary tibial nailing-fatigue of locking bolts. Injury, 1996;27:265-70.