

Outcome of Minimally Invasive Percutaneous Plate Osteosynthesis Technique for Management of Extra Articular Distal Tibial Fractures

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Author's Contribution

^{1,2,4,5} Conception of study

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Abstract

Objective: To assess the outcome of the minimally invasive percutaneous plate osteosynthesis (MIPPO) method applied for the management of extra-articular distal tibial fractures.

Materials and Methods: This quasi-experimental study was conducted at the Department of Orthopaedic Surgery, Benazir Bhutto Hospital, Rawalpindi, Pakistan. Total 57 patients have included extra-articular type A distal tibial fracture, duration of injury <1 week, and competent neurological and vascular status of the fractured site. All the patients were treated with MIPPO Technique by using the distal tibial medial locking plate and the outcome of all patients was assessed radiologically in terms of union and functionally by using the Ovadia-Beals clinical scoring system. Data were analysed by using SPSS v. 21.

Results: As per sample size calculation, 57 patients were included with a mean age of 37.19 ± 9.22 years. There were 45 (78.94%) male patients and 12 (21.05%) female patients. According to AO classification; the most common type was 43A1 with 31 patients (54.38%) whereas 18 (31.57%) were in Type 43A2 and 8 (14.03%) in Type 43A3. In our study, fracture union was achieved in a mean duration of 19.6 ± 3.45 weeks. When the functional outcome was analyzed, 41 (71.92%) patients had excellent outcome, 8 (14.03%) had good results, 5 (8.77%) had fair and 3 (5.26%) had poor outcome based on the subjective result and 44 (77.19%) patients had excellent, 7 (12.28%) had good, 3 (5.26%) had fair and 3 (5.26%) had poor result based on an objective result of Ovadia-Beals clinical scoring system.

Conclusion: Thus MIPPO can be highly successful in achieving good to excellent outcomes in the maximum number of patients presented with a distal tibia fracture. So in the future, we can rely on this technique for such types of fractures.

Keywords: Distal tibial fractures, Extra-articular fractures, Minimally invasive percutaneous plate osteosynthesis, MIPPO, Union.

Introduction

Fractures of the distal tibia are complex injuries. The complication rate is very high in these types of fractures.¹ The rate of fractures of the distal tibia is ranged from 3% to 10% of all the tibial fractures while 1% among the fractures of the lower extremity. In 70 - 85% of patients, fibular fractures have also been observed, which can occur in more complex fractures.² The global incidence of tibia fractures is 51.7 per 100,000 population per year. The incidence of proximal tibial fractures is 26.9, diaphyseal tibial fractures are 15.7% while distal tibial fractures are 9.1 per 100,000 population per year.³ The existence of momentous osteoporosis raises the hazard of the compound or more complex fractures that lead to a higher number of complications and even mortality.⁴ More severe tibial fractures result due to high energy trauma, are mostly occurred due to road traffic accidents involving motor vehicle accidents.^{5, 6}

The literature proposes that the plating of these fractures by using a minimally invasive method is an appropriate way to manage such delicate fractures, but further research is needed.^{7, 8} The treatment of distal tibial fractures includes the open reduction and internal fixation of related fibular fracture if present, subsequently the minimally plate osteosynthesis of tibia applying the pre-contoured anatomical plates and cortical screws placed percutaneously. This minimally invasive method for the management of distal tibial fractures is proved to be the most practicable and valuable technique for stabilization while evading the severe morbidities related to the more standard techniques of the internal or external fixation of such fractures.⁹

Extra-articular fractures of the distal tibia are amongst the most complicated fractures faced by Orthopaedic surgeons for management due to the anatomical/subcutaneous position, deprived blood supply, and reduced muscular anterior cover. Complications rate may be high like delay in the bony union, non-union, wound infections, or wound dehiscence are usually observed to be the greatest challenge for the Orthopaedic surgeons. Minimally invasive percutaneous plate osteosynthesis (MIPPO) is one the very well-known, accepted, and successful technique for the management of distal tibial fractures. MIPPO is the method that intends to lessen the iatrogenic injuries to nearby soft tissues and injury to the vascularity of the bone, and also the preservation of the osteogenic fractures haematoma.¹⁰

Through literature, it has been found longer lever arm plate implanted by the MIPPO technique can be beneficial in early and complete union and excellent functionality of the knee. So we planned to conduct this study to get evidence for the local population. This will improve our practice and will also help us to get local magnitude which we will use for future to implement the use of MIPPO technique for prevention of complication and early attainment of good to excellent outcome.

Materials and Methods

Objective: To assess the outcome of the minimally invasive percutaneous plate osteosynthesis (MIPPO) method applied for the management of extra-articular distal tibial fractures.

This quasi-experimental study was conducted from 1st January 2015 to 31st December 2017 at the Department of Orthopaedic Surgery, Benazir Bhutto Hospital, Rawalpindi, Pakistan. A sample size of 57 patients was estimated by using a 95% confidence level, 7.5% margin of error, and incidence of distal tibia fracture i.e. 9.1% in all lower limb fractures.³ Total 57 patients were included by using the non-probability, consecutive sampling technique. The inclusion criteria were all the patients of both genders above 18 years of age presented to the emergency department with extra-articular type A distal tibial fracture, duration of injury <1 week, and normal vascular and neurological status of fractured limb. Exclusion criteria included patients with open fractures, intraarticular extension, pathological fractures, and immunocompromised patients. Radiographs were taken and all the patients were classified as defined by AO/OTA classification. All the patients were treated with MIPPO Technique by using the distal tibial medial locking plate and the outcome of all patients was assessed radiologically in terms of union and functionally by using the Ovadia-Beals clinical scoring system. Data were analysed by using SPSS v. 21.

Results

As per sample size calculation, 57 patients were included with a mean age of 37.19 ± 9.22 years. There were 45 (78.94%) male patients and 12 (21.05%) female patients. According to AO classification; the most common type was 43A1 with 31 patients (54.38%) whereas 18 (31.57%) were in Type 43A2 and 8 (14.03%) in Type 43A3. (Table 1)

In our study, fracture union was achieved in 54 (94.73%) cases within a period of 16-24 weeks; 17 (29.82%) fractures healed within 16 weeks, 15 (26.31%) fractures healed within 19 weeks and 22 (38.59%) fractures healed within 24 weeks (mean: 19.6 ± 3.45 weeks). There were 03 (5.2%) cases in which nonunion occurred that were treated accordingly. 05 patients developed a superficial skin infection, who were later on managed with daily use of dressings and suitable antibiotics according to the culture/sensitivity reports. When the functional outcome was analyzed, 41 (71.92%) patients had excellent outcome, 8 (14.03%) had a good outcome, 5 (8.77%) had fair and 3 (5.26%) had poor outcome based on subjective outcome and 44 (77.19%) patients had excellent, 7 (12.28%) had good, 3 (5.26%) had fair and 3 (5.26%) had poor outcome based on the objective outcome of Ovdia-Beals clinical scoring system. (Table 2)

Table 1: Demographics of Patients

Feature	F (%), mean \pm SD
N	57
Age (years)	37.19 \pm 9.22
Gender	
Male	45 (78.94%)
Female	12 (21.05%)
AO classification	
Type 43A1	31 (54.38%)
Type 43A2	18 (31.57%)
Type 43A3	8 (14.03%)

Table 2: Outcome of Treatment

Outcome	F (%), mean \pm SD
Union achieved	54 (94.73%)
Union achieved within 16 weeks	17 (29.82%)
Non-union occurred	03 (5.2%)
Union achieved within 19 weeks	15 (26.31%)
Union achieved within 24 weeks	22 (38.59%)
Mean duration of union	19.6 \pm 3.45
Superficial infection	05 (%)
Subjective assessment based on Ovdia-Beals clinical scoring system	
Excellent outcome	41 (71.92%)
Good outcome	8 (14.03%)
Fair outcome	5 (8.77%)
Poor outcome	3 (5.26%)
Objective assessment based on Ovdia-Beals clinical scoring system	

Excellent outcome	44 (77.19%)
Good outcome	7 (12.28%)
Fair outcome	3 (5.26%)
Poor outcome	3 (5.26%)

Discussion

Managing the tibial distal third fractures is a great challenge yet. Bearing in mind the anatomy of the distal tibia end, it is usually hard to achieve the complete reduction and conservation of blood supply on such delicate fractures. The reduction process is even more problematic when the fibular fractures are present at the same level where the tibia fracture. This pattern of fracture imitates the high energy mechanism of the trauma producing angular and rotational instability, shortening of the limb, and injuries to the soft tissues.^{11,12} Literature has described many different types of treatment for the distal third tibial fractures.¹³⁻¹⁶ But, MIPPO and intramedullary interlock nail are the two most effective and proposed methods for distal tibial fractures. Intramedullary nailing on the distal tibial fractures is precisely hard to apply and should be applied with special care. Failures while managing the distal fragments of bones may cause deformity and non-union.^{13,17-19}

Recently, MIPPO is used to manage the fractures of the distal radius by using volar locking plates. MIPPO technique has several advantages including the preservation of pronator quadratus and also good esthetics. The MIPPO method was originally designated by making two incisions i.e. one incision as distal transverse or longitudinal while the other incision as proximal longitudinal. But with the advancement of technique, now only one single longitudinal incision of size less than 20 mm is applied. The outcome of MIPPO including functional and radiological can be similar to the outcomes of other conventional methods.²⁰ MIPPO technique using distal tibial medial locking plate is effective in achieving union and excellent functional outcome in extra-articular distal tibial fractures. It preserves most of the osseous vascularity and fracture hematoma and thus provides a more biological repair.²¹

In our study, we included a total of 57 patients with a mean age of 37.19 ± 9.22 years. There were 45 (78.94%) male patients and 12 (21.05%) female patients. According to AO classification; the most common type was 43A1 with 31 patients (54.38%) whereas 18 (31.57%) were in Type 43A2 and 8 (14.03%) in Type 43A3. In our study, fracture union was achieved in a mean duration of 19.6 ± 3.45 weeks. When the

functional outcome was analyzed, 41 (71.92%) patients had excellent outcome, 8 (14.03%) had a good outcome, 5 (8.77%) had fair and 3 (5.26%) had poor outcome based on subjective outcome and 44 (77.19%) patients had excellent, 7 (12.28%) had good, 3 (5.26%) had fair and 3 (5.26%) had poor outcome based on the objective outcome of Ovadia-Beals clinical scoring system.

Applying for the plate by MIPPO technique in distal fractures can be an ideal suggestion, as it does not require a large space or exposure area for bone reduction. But, the failure to attain the perfect pre-outline of the MIPPO plate or the disruption of the bony fragments at the fracture site may lead to angular deformity, non-union, and/or pseudo-arthritis.²²⁻²⁵ In a study it has been noticed that full range of ankle movements was attained in all the patients (100%) after 6 months (n=38).²⁶ But another study has shown that full range of ankle movements was achieved in all 26% cases after 6 months (n=19).²⁷ One more study supported the evidence and also showed that a complete range of ankle movements was attained in all 27% cases after 6 months (n=26).²⁸

Rehman et al. found that there was 68.4% excellent functional outcome while 88.6% radiological union by using longer lever arm plates with MIPPO technique in patients who presented with distal femoral fractures of AO Type C (n=35).²⁹ While Jang et al., also found that there was 57.1% excellent functional outcome while 96.4% radiological union by using longer lever arm plates placed by using MIPPO technique for the management of distal femoral fractures of AO Type C (n=28).³⁰ These findings were similar to the findings of a study conducted by Rizk et al. Out of 35 cases, 32 (91.4%) didn't further require the bone grafting while only three (8.6%) need primary bone grafting because of severe comminution at the fracture site.³¹

Conclusion

Thus MIPPO can be highly successful in achieving good to excellent outcomes in a maximum number of patients presented with a distal tibia fracture. So in the future, we can rely on this technique for such type of fracture. But further long-term studies are needed to compare other relevant outcomes with this treatment modality.

References

1. Joveniaux P, Ohl X, Harisboure A, Berrichi A, Labatut L, Simon P, et al. Distal tibia fractures: management and complications of 101 cases. *Int Orthop* 2010;34(4):583-8.
2. Sitnik A, Beletsky A, Schelkun S. Intra-articular fractures of the distal tibia. *EFORT Open Reviews* 2017;2(8):352-61.
3. Wennergren D, Bergdahl C, Ekelund J, Juto H, Sundfeldt M, Möller M. Epidemiology and incidence of tibia fractures in the Swedish Fracture Register. *Injury* 2018 Nov;49(11):2068-74.
4. Clement N, Beauchamp N, Duckworth A, McQueen M. The outcome of tibial diaphyseal fractures in the elderly. *Bone Joint J* 2013;95(9):1255-62.
5. Chua W, Murphy D, Siow W, Kagda F, Thambiah J. Epidemiological analysis of outcomes in 323 open tibial diaphyseal fractures: a nine-year experience. *Singapore Med J* 2012;53(6):385-9.
6. Madadi F, Farahmandi MV, Ejazi A, Besheli LD, Madadi F, Lari MN. Epidemiology of adult tibial shaft fractures: a 7-year study in a major referral orthopedic center in Iran. *Med Sci Monitor Basic Res* 2010;16(5):CR217-CR21.
7. Newman SDS, Mauffrey CPC, Krikler S. Distal metadiaphyseal tibial fractures. *Injury* 2011;42(10):975-84.
8. Babis G, Kontovazenitis P, Evangelopoulos D, Tsailas P, Nikolopoulos K, Soucacos P. Distal tibial fractures treated with hybrid external fixation. *Injury* 2010;41(3):253-8.
9. Mahajan N. Minimally invasive techniques in distal tibial fractures. *Jk Science* 2008(2):78-80.
10. Zelle BA, Bhandari M, Espiritu M, Koval KJ, Zlowodzki M, Group E-BOTW. Treatment of distal tibia fractures without articular involvement: a systematic review of 1125 fractures. *Journal of orthopaedic trauma* 2006;20(1):76-9.
11. Kumar A, Charlebois SJ, Cain EL, Smith RA, Daniels A, Crates JM. Effect of fibular plate fixation on rotational stability of simulated distal tibial fractures treated with intramedullary nailing. *J Bone Joint Surg Am* 2003;85(4):604-8.
12. Bedi A, Le TT, Karunakar MA. Surgical treatment of nonarticular distal tibia fractures. *Journal of the American Academy of Orthopaedic Surgeons* 2006;14(7):406-16.
13. Robinson C, McLauchlan G, McLean I. Distal metaphyseal fractures of the tibia with minimal involvement of the ankle. Classification and treatment by locked intramedullary nailing. *Bone & Joint Journal* 1995;77(5):781-7.
14. Gorczyca JT, McKale J, Pugh K, Pienkowski D. Modified tibial nails for treating distal tibia fractures. *Journal of orthopaedic trauma* 2002;16(1):18-22.
15. Sarmiento A, Latta LL. 450 closed fractures of the distal third of the tibia treated with a functional brace. *Clinical orthopaedics and related research* 2004;428:261-71.
16. Mosheiff R, Safran O, Segal D, Liebergall M. The unreamed tibial nail in the treatment of distal metaphyseal fractures. *Injury* 1999;30(2):83-90.
17. Konrath G, Moed BR, Watson JT, Kaneshiro S, Karges DE, Cramer KE. Intramedullary nailing of unstable diaphyseal fractures of the tibia with distal intraarticular involvement. *Journal of orthopaedic trauma* 1997;11(3):200-5.
18. Tornetta III P, Casey D, Creevy W. Nailing proximal and distal tibia fractures. Rosemont, IL: Orthopaedic Trauma Association Final Program & Membership Directory 2000:131-2.
19. Richter D, Ostermann P, Ekkernkamp A, Hahn M, Muhr G, editors. Distal tibial fracture--an indication for osteosynthesis with the unreamed intramedullary nail? *Langenbecks Archiv fur Chirurgie Supplement Kongressband Deutsche Gesellschaft fur Chirurgie Kongress*; 1996.
20. Liverneaux P, Ichihara S, Facca S, Hidalgo JD. Outcomes of minimally invasive plate osteosynthesis (MIPO) with volar locking plates in distal radius fractures: a review. *Hand surgery & rehabilitation* 2016;35:S80-S5.

21. Jha AK, Bhattacharyya A, Kumar S, Ghosh TK. Evaluation of results of minimally invasive plate osteosynthesis (MIPO) of distal tibial fractures in adults. *Journal of the Indian Medical Association* 2012;110(11):823-4.
22. Helfet DL, Shonnard PY, Levine D, Borrelli J. Minimally invasive plate osteosynthesis of distal fractures of the tibia. *Injury* 1997;28:A42-A8.
23. Oh C-W, Kyung H-S, Park I-H, Kim P-T, Ihn J-C. Distal tibia metaphyseal fractures treated by percutaneous plate osteosynthesis. *Clinical orthopaedics and related research* 2003;408:286-91.
24. Maffulli N, Toms AD, McMurtie A, Oliva F. Percutaneous plating of distal tibial fractures. *International orthopaedics* 2004;28(3):159-62.
25. Khoury A, Liebergall M, London E, Mosheiff R. Percutaneous plating of distal tibial fractures. *Foot & ankle international* 2002;23(9):818-24.
26. Lakhota D, Sharma G, Khatri K, Kumar GK, Sharma V, Farooque K. Minimally invasive osteosynthesis of distal tibial fractures using anterolateral locking plate: evaluation of results and complications. *Chinese J Traumatol* 2016;19(1):39-44.
27. Ronga M, Longo UG, Maffulli N. Minimally invasive locked plating of distal tibia fractures is safe and effective. *Clin Orthop Relat Res* 2010;468(4):975-82.
28. Mohammad MM, Hafez KMAH, Abdelkader AA, Mohamed EGK. Short-term results for the management of distal tibial fractures by minimally invasive locked plating. *Egypt Orthop J* 2014;49(4):314.
29. ur Rehman MK, Hanif M, Ullah SH, Ghani I. Functional and Radiological Outcome of Longer Lever Arm Plates with Minimally Invasive Plate Osteosynthesis (MIPO) in AO Type C Distal Femoral Fracture. *Journal of Pakistan Orthopaedic Association* 2018;30(03):128-32.
30. Jang JH, Ahn JM, Lee HJ, Moon NH. Surgical outcomes of biologic fixation for subtrochanteric fracture using locking compression plates. *Hip & pelvis* 2017;29(1):68-76.
31. Rizk AS, Al-Ashhab ME. Primary bone grafting with locked plating for comminuted distal femoral fractures: can it improve the results?. *The Egyptian Orthopaedic Journal*. 2015 Apr 1;50(2):77.