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Cover Letter

The corresponding author certifies that this manuscript is the original work of the author. All data, figures, etc. used in the manuscript are prepared originally by the authors. This manuscript has not been and will not be published elsewhere or submitted elsewhere for publication. The author(s) declare that they have no competing interests. This study complies with current ethical considerations. Written informed consent was obtained from the patient for publication of this case report and any accompanying images. This paper is an endeavor to showcase a simple technique for MIPPO in distal tibia which is cheap and easily reproducible. This is even more helpful in developing countries where usually the only plentiful things available are the number of patients.

Dear Reviewers,

I thank you for giving me the chance to correct the inadequacies in my paper. As per the guidelines, I have attempted to correct the same. All the demographic data regarding the variables have been entered in a table as desired. Also, the mention of the use of intraoperative fluoroscopy has been mentioned in the manuscript and highlighted in yellow. I hope this will suffice and if any other discrepancies remain, I will be eager to correct them.

Regards

Dr Nasir Muzaffar

Plate on Plate Technique of MIPPO In Distal Tibial Fractures- An Easy And Inexpensive Method Of Fracture Fixation

Nasir Muzaffar, Rafiq Bhat, Mohammad Yasin

Study reported from the Hospital for Bone and Joint Surgery, Barzalla, Srinagar, Kashmir, India

Address correspondence to:

Dr Nasir Muzaffar

Bone and Joint Surgery Hospital, Barzalla, Srinagar,

Kashmir, J&K, India PIN 190005

Tele: 91-0194-2430155/2430149 Fax: 91-0194-2433730 Mobile: 919858812593

Email: drnasir@in.com

Conflict of interest: The author certifies that he has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article. No financial aid was received for this study.

Ethical Board Review statement: This is to certify that the subjects gave informed consent to participate in the study and that the study has been approved by an institutional review board. The author certifies that his institute has approved or waived approval for the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

ABSTRACT

Aim: Evaluate the outcomes of minimally invasive percutaneous plate osteosynthesis (MIPPO) using plate on plate technique of locking plate fixation for closed fractures of distal tibia in a prospective study.

Material and methods: 25 patients with distal tibial fractures were treated by MIPPO using locking plate by plate on plate technique. Pre operative variables were age of patient, mode of trauma, type of fracture and soft tissue status. Perioperative variables included surgical time and radiation exposure. Post operative variables included wound status, time to union, return to activity and AO foot and ankle score.

Results: At one year all the fractures had united. The average time to union was 16.8 weeks. There were two cases of superficial infection and two cases of deep infection which required removal of hardware after the fracture was united. The average AO foot and ankle score was 83.6 in our study.

Conclusion: We found MIPPO using locking plate by plate on plate technique to be a safe, effective, inexpensive and easily reproducible method for the treatment of distal tibial fractures in properly selected patients which minimised operative time and soft tissue morbidity.

INTRODUCTION

The management of fractures of distal end of tibia is a source of controversy and debate (1,2). The methods of treatment of distal tibia fractures vary from closed reduction and cast application to open reduction and internal fixation and each method of treatment has its own merits and demerits. Certain anatomic and physiologic factors peculiar to the distal tibia like subcutaneous location, precarious blood supply, high incidence of open fractures and presence of neighbouring

hinge joints allowing for little rotational malalignment(3,4) make management of distal tibial fractures very controversial. Fracture pattern, soft tissue status, bone quality, age and activity level of patient influence the selection of treatment methods (2). MIPPO is a method of fracture fixation which is gaining wide popularity because it reduces surgical trauma without substantial exposure of fractured zone. The proposed advantages of MIPPO include limited soft tissue dissection, reduced wound related complications, preservation of osteogenic fracture haematoma and improved union rates (1,4,5,6). The various techniques of screw placement include giving stab incisions and placement of screws employing the use of fluoroscopy and jigs. These are more time consuming or expensive. The use of our plate on plate technique employs placement of an identical plate to the one already placed percutaneously and fixed provisionally by k wires over the skin using the same K wires already used to temporarily fix the underlying plate to bone and utilizing its holes for placement of mini skin incisions for accurate placement of screws thus reducing amount of surgical trauma, operation time, radiation exposure and cost of treatment without any untoward effect on fracture or implant.

MATERIAL AND METHODS.

The present study included 25 cases of distal tibial fractures treated by plate on plate technique of MIPPO using locking plate between November 2010 to October 2012. The study was approved by ethics committee of our institute and a written and informed consent was taken from all the patients before operation. Patients with pathological fractures and open fractures were excluded from the study. The fractures were either intraarticular or extraarticular fractures of distal tibia corresponding to OTA 43 A, B and C fractures. Pre operative variables documented included age of patient, mode of trauma, type of fracture and soft tissue status. Perioperative

variables comprised surgical time and radiation exposure. Post operative variables included wound status, time to union, return to activity and AO foot and ankle score (Table 1).

The surgery was performed after the stabilisation of soft tissue condition averaging 9.98 days which ranged from 5 to 16 days in our study (1,7,8). All the patients with fractures of distal tibia were initially assessed and stabilised in the emergency department of our hospital. After identifying and managing the life threatening emergencies the fractured extremity was splinted and elevated in order to reduce swelling (1). Detailed radiographic evaluation in two perpendicular planes including knee and ankle were done. CT scan was done in case of complex intraarticular fractures (8,9). Fractures were classified using orthopaedic trauma association OTA classification (10). Surgery was performed on a standard radiographic table under tourniquet control(1,11). Pre operative prophylactic antibiotics were administered intravenously before surgery before inflation of tourniquet (1). Fractures were reduced using indirect means of reduction like manual traction, calcaneal pin traction, use of femoral distractor, using k wires as joy sticks or rarely by small incisions and using bone clamps (1,2,8,12,13) and reduction confirmed under image intensifier fluoroscopy. Associated fibular fractures if deemed necessary for fixation were fixed first (11,14). After checking for reduction under C arm, especially in case of intraarticular fractures (which were provisionally fixed with K wires) a small approximately 3 cm incision was made over the medial malleolus for passing the locking plate (1,15). A subcutaneous extraperiosteal tunnel was created using Cobb elevator or blunt end of the plate (1,16). The plate was temporarily fixed to the bone using K wires by passing them through the holes meant for them and they were left projecting from skin. Then an identical plate of same side having same number of holes was put over the skin by passing it through the same k wires which were used for plate fixation thus creating a plate on plate construct with superimposition

of holes of one plate over the holes of another plate. The holes of the plate over skin were used for giving small incisions and passing of screws thus reducing the amount of surgical trauma, operation time and radiation exposure. The plate was fixed to the bone using locking or non locking screws proximally via stab incisions and distally via previous oblique incision made for passage of plate. Wound was closed and postoperatively limb was elevated in a removable splint. Intravenous antibiotics were continued for 24 hours after surgery (1,17). Post operatively toe touch weight bearing was started with the help of crutches as soon as pain and swelling subsided. Partial weight bearing was allowed at 4-6 weeks and full weight bearing at 10-12 weeks depending upon clinical and radiographic assessment of fracture healing. Use of postoperative bracing was decided on patient and fracture related factors like comminution and articular involvement as well as rigidity of fixation as assessed intraoperatively (1,2,8,12,18). Delayed wound healing and superficial infection were defined as persistent drainage from the wound for at least two days or separation of wound edges to a width > 1cm and a length > 1 cm(15,19). The patients were followed up clinically and radiographically at two weekly intervals initially and then monthly till the fracture united then every six months and final follow up was done at one year post surgery. The patients were assessed objectively by physical and radiographic examination. The development of any complication was carefully observed and documented at each follow up visit. The final outcome was assessed at one year follow up by American Orthopaedic foot and ankle score (12,20).

RESULTS

All the 25 patients operated by plate on plate technique of MIPPO using locking plate were reviewed at one year follow up. All the fractures united at an average duration of 16.8 weeks ranging from 12 to 30 weeks. There were two cases of superficial wound infection and two cases

of deep infection. The superficial infections were cured with wound care and antibiotic administration. The deep infections were of delayed onset occurring after two months which required removal of hardware but fractures were united by the time hardware was removed with further uneventful course. There were four cases of ankle stiffness and three cases of palpable implant and one case of delayed union. One patient has to be re operated because of inadequate reduction after first attempt because it was a complex intraarticular fracture. The average AO foot and ankle score in our patients was 83.6 with greater than 92% of patients having ankle score greater than 60.

DISCUSSION

The management of distal tibia fractures remains controversial because of limited soft tissue cover, subcutaneous location and poor vascularity (2,8,21). The methods of treatment for distal tibial fractures include closed reduction and cast application(22,23), external fixation(7,24) , open reduction and internal fixation using plates, staged open reduction(8,25,26,27) , Intramedullary nailing(19,28) and minimally invasive percutaneous plate osteosynthesis(MIPPO) using locking plate. MIPPO balances the amount of soft tissue dissection with anatomic reduction and preserves periosteal blood supply, osteogenic fracture haematoma and soft tissue cover. Initial clinical series using this method of treatment demonstrates favourable results with low rates of infection and non union but complications like palpable implant, ankle stiffness and hardware failure have been reported(2,4,7,8,25,29,30,31). MIPPO is reported to have increased radiation exposure, operation time and sometimes difficulty in achieving fracture reduction(32). The use of jigs has reduced operation time and radiation exposure but it makes surgery more expensive and jigs may not be available at every centre. The use of plate on plate technique is an easy, inexpensive and easily reproducible alternative to jigs to decrease operation time and

radiation exposure without adding cost to surgery. Moreover it is an easy to master technique and can be practiced very easily without any untoward effect on fracture reduction or fixation. We studied the clinical results, union rate, complications and return to pre injury daily and sports activities in a selected group of patients with closed fractures of distal tibia using plate on plate technique of MIPPO. The limitation of our study is mainly the relatively small number of patients and lack of a control group. We used pre contoured distal tibial locking compression plate having nine distal holes. Borg et al reported limitation of conventional low contact plates as the number of screws that can be placed in a short distal fragment (15). The union rate, incidence of delayed and nonunion and other complication and AO foot and ankle score are comparable to other studies that included only closed distal tibial fractures with decreased operation time, intra operative radiation exposure and cost of surgery with plate on plate technique of MIPPO. The average time to union in our study was slightly less as compared to other studies like Mario Ronga and D J Redfern because we included only closed fractures and also there was only one case of OTA type C fracture. Our union rate was comparable to 18.1 weeks of S Hazarika et al who only included closed fractures (1,2,11,18). We fixed the fractures on an average of 9.98 days after injury as was recommended by Helfet et al giving time for swelling to subside and to minimise soft tissue related complications associated with distal tibia fractures(9). The use of plate on plate technique of MIPPO greatly eases the surgical procedure reduces the operative time and radiation exposure and does not require expensive jig system or other costly instrumentation required for passing screws and is an easily reproducible method with consistently good results. Two cases of our study developed external rotation deformity but were having no functional limitation or requiring any further surgical procedure. Malunion was seen in 20% of cases as reported by Helfet et al (9). Deep infection was seen in 8% of our cases

requiring removal of hardware whereas deep infection was seen in nearly 14% of cases of Mario Ronga et al(2). The average AO foot and ankle score in our study was 83.6 and AO foot and ankle score in Syah Bahari et al 90(8). Redfern et al did not advocate for routine fixation of fibula except for reconstruction of length of tibia in case of extensive comminution (1). Helfet et al recommend routine fixation of fibular fractures in case of distal tibial fractures(9). We recommend that fixation of fibula should be done to reconstruct the length and alignment of fractured tibia in case of severe comminution of tibia and in cases of syndesmotic involvement. Most of the patients were mobilized on first postoperative day and need for postoperative brace or cast was judged on case to case basis depending on fracture pattern and comminution as well as patient related factors. Redfern et al also did not recommend routine postoperative bracing or casting allowing for early postoperative range of motion exercises of ankle(1).

CONCLUSION

Minimally invasive percutaneous plate osteosynthesis (MIPPO) by the plate on plate technique offers an useful and reproducible method of treatment of distal tibial fractures with or without articular extension in properly selected patients reducing the cost, operation time and radiation exposure, but further long term studies including a large number of patients are required before any definitive conclusion can be drawn out.

BIBLIOGRAPHY

1. D.J. Redfern, S.U. Syed, S.J.M. Davies. Fractures of distal tibia : minimally invasive plate osteosynthesis. *Injury, Int.J.Care Injured* (2004) 35,615-620.

2. Mario Ronga MD, Umile Giuseppe Longa MD, Nicola Maffulli. Minimally invasive locked plating of distal tibia fractures is safe and effective. *Clin Orthop Relat Res* (2010) 468:975-982.
3. Borrelli J Jr, Prickett W, Song E, Becker D, Ricci W. Extra osseous blood supply of the distal tibia and the effects of different plating techniques: a human cadaveric study. *J Orthop Trauma* 2002;16(10):691-695.
4. Lau TW, Leung F, Chan CF, Chow SP. Wound complications of minimally invasive plate osteosynthesis in distal tibia fractures. *Int Orthop* 2008;32:697-703.
5. Andrew D Toms, McMurtie A, Maffulli N. Percutaneous plating of the distal tibia. *Journal of Foot and Ankle surgery* 2004;43:199-203.
6. Whiteside LA, Lesker PA. The effects of extraperiosteal and subperiosteal dissection on fracture healing. *Journal of Bone and Joint Surgery (Am)* 1978;60:26-30.
7. Mockford BJ, Ogenda L, Warnock D, Barr RJ, Andrews C. The early management of severe tibial pilon fractures using a temporary ring fixator. *Surgeon* 2003;1:104-107.
8. Syah Bahari, Brian Lenehan, Hamad khan, John P. McElwain. Minimally invasive percutaneous plate fixation of distal tibia fractures. *Acta Orthop Belg*, 2007;73:635-640.
9. Helfet DL, Koval K, Pappas J, Sanders RW, Di Pasquale T. Intraarticular "pilon" fractures of tibia. *Clin Orthop*1994;298:221-228.
10. Muller ME, Nazarian S, Koch P, Schatzker J. The comprehensive classification of fractures of long bones. Berlin:Springer-Verlag;1990.

11. D L Helfet, PY Shonnard, D Levine, J Borrelli. Minimally invasive plate osteosynthesis of distal fractures of the tibia. *Injury*;1997;28(1):42-48.
12. M. Leonard, P. Magill et al. Minimally invasive treatment of high velocity intraarticular fractures of the distal tibia. *International Orthopaedics* 2009;33:1149-1153.
13. M Leunig, R Hertel, KA Sienbenrock, FT Ballmer. The evolution of indirect reduction techniques for the treatment of fractures. *Clin Orthop* 2000;375:7-14.
14. Kenneth A. Egol, Weisz R, Hiebert R, Tejwani NC, Koval KJ, Sanders RW. Does fibular plating improve the alignment after intramedullary nailing of distal metaphyseal tibia fractures? *J Orthop Trauma* 2006 Feb;20(2)94-103.
15. Borg T, Larsson S, Lindsjou. Percutaneous plating of distal tibia fractures. Preliminary results in 21 patients. *Injury* 2004;35:608-614.
16. Mehmet Hakan Ozsoy, Tuccar E, Demiryurek D, Bayramoglu A, Hayran M, Cavusoglu AT, Dincel VE, Sakaogullari A. Do we really sacrifice saphenous vein and nerve? A cadaver study. *Journal of Orthop Trauma*. 2009 Feb;23(2):132-8.
17. Chang Wug Oh, Hee-Soo Kyung, IL-Hyung Park, Poong-Taek Kim, Joo-Chul Ihn. Distal tibial metaphyseal fractures treated by percutaneous plate osteosynthesis. *Clinical Orthopaedics and Related Research*. 2003;408:286-291.
18. S. Hazarika, Chakravarthy J, Cooper J. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia: results in 20 patients. *Injury* 2006 Sep;37(9):877-87.

19. Im GI , Tae SK. Distal metaphyseal fractures of tibia: a prospective randomised trial of closed reduction and intramedullary nail versus open reduction and plate and screw fixation. *J Trauma* 2005;59:1219-1223.
20. Kitaoka HB, Alexander IJ et al. clinical rating systems for the ankle-hindfoot, midfoot, hallux and lesser toes. *Foot and Ankle International*. 1994;15(7):349-353.
21. Bedi A, Le TT, Karunakar MA. Surgical treatment of non articular distal tibia fractures. *J Am Acad Orthop Surg*. 2006;14:406-416.
22. Augusto Sarmiento. A Functional below the knee brace for tibial fractures. *Journal of Bone and Joint Surgery (Am)* 1970 Mar 01;52(2):295-311.
23. Othman M, Strzelczyk P. Results of conservative treatment of “pilon” fractures. *Orthop Traumatol Rehabil* 30;2003;5(6)787-794.
24. M.B. Mitkovic, M.Z. bumbasirevic, A. Lesic, Z. Golubovic. Dynamic external fixation of comminuted intraarticular fractures of the distal tibia. *Acta Orthopaedica Belgica*, 68(5)2002.
25. Pattersen MJ, Cole JD. Two staged delayed open reduction and internal fixation of severe pilon fractures. *J Orthop Trauma* 1999;13(2):85-91.
26. Sirkin M, Sanders R, Di Pasquale T, Herscovici D Jr. A staged protocol for soft tissue management in the treatment of complex pilon fractures. *J Orthop Trauma* 1999 Feb;13(2):78-84.
27. Teeny SM and Wiess OA. Open reduction and internal fixation of tibial plafond fractures. *Clinical Orthopaedics* 1993 ; 292 : 108-117.

28. M O Shieff R, Safran O, Segal D, Liebergall M. The unreamed tibial nail in the treatment of distal metaphyseal fractures. *Injury*1999;30(2):83-90.
29. Borens O, Kloen P, Richmond J, Roedrer G, Levine PS, Helfet DL. Minimally invasive treatment of pilon fractures with a low profile plate: preliminary results in 17 cases. *Arch Orthop Trauma Surg.* 2009 May;129(5):649-59.
30. Chezhiyan Shanmugam, Aziz Rahmatalla, Nicola Maffulli. Percutaneous fixation of distal tibial fractures using locking plates. *Techniques in Orthopaedics* 2007;22(30):162-166.
31. Collinge C, Protzman R. Outcomes of minimally invasive plate osteosynthesis for metaphyseal distal tibia fractures. *J Orthop Trauma* 2010 Jan;24(1):24-9.
32. J.J. Guo, N. Tang, H.L. Yang, T.S. Tang. A prospective, randomised trial comparing closed intramedullary nailing with percutaneous plating in the treatment of distal metaphyseal fractures of the tibia. *J Bone Joint Surg(Br)* 2010;92-B:984-8.

FIGURE LEGENDS:

Fig 1: Preop Xray AP view

Fig 2: Preop Xray Lat view

Fig 3: Stab being given in skin over plate.

Fig 4: Last screw hole placement with locking sleeve in place.

Fig 5: Final view of operated limb after completion of MIPPO.

Fig 6: Final follow up Xray AP view at 1 yr.

Fig 7: Final follow up Xray Lat view at 1 yr.

Table 1: Demographic data

Sex	Side	Mode of trauma	AO type	Associated injury	Injury surgery interval (Days)	Hospital stay (Days)	Operation time (Min)	Fibula fracture	Fixed or not	PWB Weeks	FWB weeks	Union weeks	Complications	AO Score	Functional Results as per AO score	Nicola B
F	R	Fall	43A1	Nil	14	5	60	Yes	No	6	12	14	Inf< palp implant	73	Good	Good
F	L	RTA	43B1	Nil	9	14	55	NO	-	6	14	16	AS	80	Good	Exc
F	L	FALL	43A2	NIL	14	5	60	YES	NO	6	12	16	NIL	85	Excellent	Exc
M	R	FFH	43C3	Nil	10	15	120	Yes	Yes	10	18	24	Infection, Reoperation, Ankle stiffness, pain	60	Satisfactory	Good
M	L	Direct impact	43B1	Patella fracture	16	18	120	Yes	Yes	6	14	16	nil	97	Excellent	Exc
F	R	Fall	43A3	Nil	9	12	60	Yes	Yes	6	12	18	Pain	87	excellent	Exc
M	R	RTA	43A2	Nil	7	10	40	yes	No	6	12	16	Superficial infection	85	Excellent	Good
F	L	RTA	43A3	Nil	10	15	90	Yes	Yes	6	14	18	nil	87	Excellent	Exc
M	L	RTA	43A1	Nil	6	9	60	No	-	6	12	18	nil	87	Excellent	Exc
M	L	RTA	43A1	Nil	7	11	90	yes	no	8	14	20	nil	85	Excellent	Exc
F	L	RTA	43A2	Nil	5	7	60	Yes	No	6	12	12	Ext rotation.	82	Excellent	Good
F	R	Fall	43B1	Nil	9	11	120	Yes	yes	12	24	30	Palpable implant	84	Excellent	Exc
M	L	FFH	43A2	Nil	10	12	60	yes	no	6	10	12	nil	97	Excellent	Exc
F	R	FFH	43A3	Compression fracture L1	6	8	60	yes	no	8	14	16	nil	85	Excellent	Exc
M	R	FFH	43B1	Shoulder dislocation, head injury, subtroch fracture	10	15	130	yes	no	8	14	18	ankle stiffness	85	Excellent	Exc
M	R	RTA	43A1	Nil	10	12	60	No	-	6	10	18	nil	92	Excellent	Exc

F	L	Fall	43A2	Nil	9	12	70	yes	No	6	10	18	Palpable implant	85	Excellent	Exc
F	R	Fall	43A2	Nil	10	13	70	Yes	No	6	12	16	Mal union (external rotation)	87	excellent	Go
F	R	Fall	43A2	Nil	10	5	60	Yes	No	6	12	12	nil	85	excellent	Exc
F	R	Fall	43A3	Nil	10	14	90	yes	Yes	8	16	20	Superficial infection, Ankle stiffness, pain	60	SATISFACTORY	Go
M	R	RTA	43A1	Nil	10	15	60	Yes	Yes	6	10	12	nil	87	excellent	Exc
M	R	RTA	43A1	Nil	10	12	90	Yes	No	8	14	18	nil	85	excellent	Exc
F	L	RTA	43A2	Nil	10	12	120	Yes	Yes	6	12	18	nil	87	Excellent	Exc
M	L	RTA	43B2	Nil	5	8	40	Yes	No	6	12	12	nil	87	Excellent	Exc
M	R	RTA	43A1	Nil	10	12	60	Yes	No	6	12	12	nil	87	excellent	Exc

RTA: Road traffic accident, FFh: Fall from height, PWB: Partial weight bearing, FWB: Full weight Bearing,R; Right, L: Left, M: Male, F: Female, MIPPO: Minimally invasive percutaneous plate osteosynthesis, AO Score: American Orthopedic Foot and Ankle Score

FIGURES

Fig 1: Preop Xray AP view



Fig 2: Preop Xray Lat view



Fig 3: Stab being given in skin over plate.



Fig 4: Last screw hole placement with locking sleeve in place.



Fig 5: Final view of operated limb after completion of MIPPO.



Fig 6: Final follow up Xray AP view at 1 yr.



Fig 7: Final follow up Xray Lat view at 1 yr.

