



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(2): 837-842
© 2020 IJOS
www.orthopaper.com
Received: 07-02-2020
Accepted: 09-03-2020

Sunil Kulkarni
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

Krishan Kabra
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

Saksham Tripathi
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

Tejas Patil
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

Manojit Basak
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

Prajwal Gowda
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

Corresponding Author:
Krishan Kabra
Department of Orthopaedics
P.G.I. Swasthiyog Pratishthan,
Miraj, Maharashtra, India

A prospective study to evaluate functional outcome of staged management of closed pilon fractures using medial locking compression plates

Sunil Kulkarni, Krishan Kabra, Saksham Tripathi, Tejas Patil, Manojit Basak and Prajwal Gowda

DOI: <https://doi.org/10.22271/ortho.2020.v6.i2n.2148>

Abstract

Aim: This study aims to evaluate functional outcome of staged management of tibia pilon fractures using anatomic medial locking compression plate in adults.

Patients and Methods: A hospital based prospective study was conducted at a tertiary centre between May 2017 to May 2019. All cases were managed in a two-staged protocol- early temporary joint spanning AO external fixator followed by delayed definitive fixation. Postoperatively functional outcome of the ankle was assessed using AOFAS score at 6months. Radiological outcome was assessed using the Teeny- Wiss scoring system and fracture union. Complications like infection and ankle stiffness were documented.

Results: The study included 30 cases with an average follow up of 8.4 months (range 6-13 months). The mean age of the patients was 45.73years. Male predominance 23(76%) was noted. All fractures were caused by high energy trauma. 26 patients had AO type 43C fractures and 4 patients had 43B. Delay between primary external fixator application to definitive ORIF ranged from 7-13 days. Average Duration of surgery was 83±10.3 minutes. The mean AOFAS score was 72.33±4.4. Majority of the patients 73.3% (22 patients) had AOFAS scores between 71-80. Radiological outcome was noted Anatomical in 17 cases (56.67%), Good in 10 cases (33.33%) and Fair in 3 cases (10%). Post-operatively, 5 patients (16.67%) developed superficial skin infection and 5 patients (16.67%) developed ankle stiffness. All fractures united at mean union time of 17.5 ± 1.5 weeks, with 1(4%) case of delayed union.

Conclusions: This study supports staged management protocol accompanied with open reduction and internal fixation through minimally invasive techniques of application of medial locking compression plate has resulted in improved outcomes with reduced postoperative wound complications.

Keywords: Closed Pilon fracture, distal tibia fracture, staged management, anatomic medial LCP

1. Introduction

Distal tibia plafond fractures are caused primarily by an axial load on the tibia which may have an associated rotational component [1] Because of the often high energy involved and the perilous soft tissue cover that surrounds the distal tibia, these fractures command watchful attention to the soft tissue cover for timing and method of surgical fixation [2] Most of these fractures are managed surgically, with a variety of operative interventions advocated to pact with the vicarious soft tissue cover. These array from definitive external fixation, combined external fixation with limited internal fixation, closed reduction with percutaneous plating, or open reduction and internal fixation with plating [3, 5]. Wound dehiscence and/or wound healing problems, infections, and delayed union or non-union are common complications feared with conventional osteosynthesis with plates [5-8] Similarly, infection of the pin tract leading to osteomyelitis, pin loosening, malunion and nonunion are potential complications of external fixators and hence not preferred as definitive fixation method [3-5, 9] Recently, techniques of minimally invasive plate osteosynthesis (MIPO) with locking compression plate (LCP) have emerged as a promising treatment option for pilon fractures. The periosteal blood supply remains unharmed and fracture hematoma is preserved with subcutaneous application of LCP, alongside providing a biomechanically stable construct [10, 11].

We assess the results of management of Distal Tibial intra-articular Fractures by two-staged protocol- early temporary joint spanning AO external fixator followed by delayed definitive fixation when soft tissue becomes favourable.

2. Materials & Methods

A hospital based prospective study was conducted on in-patients in a tertiary center between May 2017 to May 2019 after approval from the ethical committee. In this study, 30 cases of tibia pilon fractures were selected according to inclusion/exclusion criteria and managed by ORIF with Medial Locking Compression Plate using minimally invasive techniques following staged management by joint spanning AO-external fixator -a prospective study.

Inclusion Criteria

1. Patients who gave consent
2. Patients in the age group of 18 to 70 years.

Exclusion criteria

1. Compound/ open Pilon fractures
2. Local or systemic infection

The fractures were classified based on the AO/OTA classification of fractures of the distal tibia. The limb was then immobilized with AO external fixator system within six hours of presentation at our institute. Elevation of the limb was maintained. CT scan was done after application of external fixator. Pin tract care and dressing were done regularly. When favourable soft tissue, noted by subsidence of swelling, the appearance of skin wrinkles and healing of blisters, definitive fixation was done. All patients were operated under regional anesthesia with a tourniquet applied. Prophylactic antibiotic cover was given 30 minutes before tourniquet application. A direct lateral approach or posterolateral approach over the fibula was taken. 4/5 hole one-third or semi-tubular plate or intramedullary square nail was used for fixation. Anatomic length of the fibula was restored and confirmed under fluoroscopy.

A small anteromedial incision was taken over the medial malleolus and Care was taken to make sure that width of the skin bridge between incisions was more than 3 finger breadths or approximately more than 5-6cm. [12]

With anatomic articular reduction achieved 3.5mm LCP was inserted subcutaneously using minimum invasive technique. The wounds were closed without tension in layers. The duration of surgery was recorded from the incision to wound closure. Postoperatively, IV 2nd generation cephalosporins and aminoglycoside antibiotics were continued for 2 days followed by oral antibiotics for 5 days along with limb elevation, analgesics, antacids and serratiopeptidase. Post operatively below knee posterior splint was given which was removed on second postoperative day and passive ankle range of motion exercises were initiated. Weight-bearing was restricted for 6 weeks. Follow-up was done at 2weeks, 6weeks, 3 months and 6 months after discharge till the fracture united. In each determined follow up at and after 6 weeks, clinical assessment of range of motion, radiological evaluation for progression of fracture healing and complications were documented. The functional outcome of the ankle was assessed with the help of AOFAS at 6months. (American Orthopedic Foot and Ankle Society Ankle Score). Complications like surgical site infection, deep infection and ankle stiffness were documented. The radiological outcome was assessed using the Teeny-Wiss scoring system and

fracture union [13] Fracture union was subject to radiographic evidence of union and pain-free weight bearing. Pre-operative and Post-operative radiographs for a patient with 18 months follow up are shown in Figure 2.

Obtained data were analyzed using SPSSvs20. Chi-square test was used p-value of <0.05 was taken as the level of significance.

3. Results

Data collected from the study of 30 cases; with follow up range from 6-13months (mean 8.4 months) and results were recorded; it was evaluated for demographic, injury characteristics, functional outcome, radiological outcome and complications. The age range was from 18-70 years, with the average age of 45.7 ± 11.63 years. 23 (76.6%) patients were males and 7 (23.3%) were females. 14 patients (47%) had fracture of left side and 16 patients (53%) had fracture of right side. In this study, all fractures resulted from high energy trauma. 24 cases (80%) sustained fracture following a road traffic accident. In our study 11 patients had associated bony injuries- femur (2), rib fracture (1), patella (1), head injury (2), humerus (1), forearm (2), IT(1) and ilium (1). Distribution of fractures according to AO/OTA classification is elaborated in Table 1 and soft tissue injury according to tscherne classification in Figure 1.

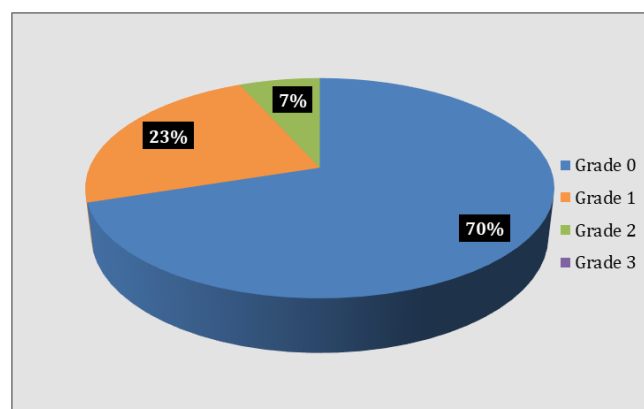


Fig 1: Distribution of subjects based on severity of soft tissue injury according to Tscherne classification.

Delay between primary external fixator application to definitive ORIF ranged from 7-13 days (average 10 days). Mean Duration of surgery was 83 ± 10.3 minutes. Functional and Radiological outcome is illustrated in table 2. There is a significant positive relation between radiological outcome (Teeny Wiss Radiological score) and functional outcome (AOFAS score). ($p=0.014$) Anatomical reductions of the ankle have improved AOFAS functional scores. There was 1(4%) case of delayed union which took 20 weeks to show signs of union. There was no loss of reduction noted on postoperative radiographs on follow up. All the fractures united with mean union time of 17.5 ± 1.5 weeks, with no cases of non-union. No superficial infections affected the union.

3.1 Complications

There were no cases of intra-operative complications. There were no incidences of pin site infections noted. No cases developed deep infections or osteomyelitis. Five of the patients (16.67%) developed superficial skin infections, which were treated with daily dry dressings and appropriate systemic antibiotics after pus culture and sensitivity. All these infections subsided with the care described above. According

to our study results, there is a significant positive relationship between the severity of soft tissue injury at initial presentation and the incidence of complications. $r(28)=0.5$ ($p<0.05$) Five patients (16.67%) had ankle stiffness at final follow up. Restriction ranged from 20 – 50 % in ankle movements. It was noted that these patients were not compliant to the advised physiotherapy and regular follow-ups.

There is a significant positive relationship between the incidence of complications and poor functional outcomes. The presence of complications hampered the functional outcome

in our study. $r(28)=0.64$ ($p<0.05$) In this study open reduction and internal fixation with plate was done for fibula fracture for 16 patients (53.3%) and closed reduction and internal fixation with intramedullary nail (Radius Square Nail) in 8 patients (33.33%). Fibula was not fractured in six patients.

According to this study, in staged management of pilon fractures there was no statistically significant difference noted in terms of AOFAS score ($p=0.19$) and average union time ($p=0.65$) among choice of implant used for fixation of fibula.



(A)



(B)



(C)

Fig 2: (A) Preoperative xrays AP and lateral view (B) Immediate postoperative xrays AP and lateral view, ORIF done 12 days after external fixator application (C) Post operative xrays AP and lateral views at 18 months follow up

4. Discussion

The status of the soft tissues and the degree of bony comminution at the time of injury affect the long term clinical results. The goal of surgical treatment is to obtain anatomic congruity of the joint surface while providing sufficient stability to permit early motion [10, 11]. This should be achieved using techniques that mitigate osseous and soft tissue devascularization in the hopes of reducing the complications resulting from treatment [1, 14-16] Typically open reduction and internal fixation of these complex fractures have witnessed a higher incidence of complications postoperatively. Staging the treatment of the patient can minimize the development of soft tissue complications [1, 17-19].

We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment, our analysis is as follows: In our study, the male preponderance for such kind of injuries were high. This may possibly be due to the fact that in India male dominance over the female in traveling, occupational injures etc. However, this study is comparable to other studies as described in Table 3.

In this study of 30 cases, 73% of cases had excellent and good functional outcomes which are comparable to previous studies. (Table 4)

In a landmark study, that established the open reduction and internal fixation with screws and plate as the standard, the authors T Ruedi and M Allgower, documented good to excellent results in 75 of the 84 patients studied (70%) on an average 6 year follow-up postoperatively. They established that Anatomical reconstruction of the distal tibial articular surface was required for favourable outcomes [10] Our study results confirm that Anatomical and Good radiological outcomes related positively with improved functional AOFAS scores. Cheema *et al.* studied 25 cases of pilon fractures treated with staged medial plating and minimally invasive techniques. Radiographs showed anatomic reduction in 84% cases and fair reduction in another 16% cases. Using the Burwell and Charnley subjective, objective criteria and radiological evaluation, they achieved Subjective and

objective measurements showed 80% good results, 12% fair results, and 8% poor results with No postoperative infections or wound healing complications [20] In a study of 30 patients of tibia pilon fractures treated with medial locking compression plate, Dhansekaran *et al* documented anatomical and good reduction in 22 and 5 patients respectively. They found functional score using IOWA score excellent in 22 cases and good in 5 cases [21].

Our study had an average fracture union of 17.5 weeks which were comparable with studies conducted using the locking compression plates. The average time for fracture union in previous studies conducted using various methods was 14-27 weeks. (Table 5) [16, 22-26]

In our study five of the patients (16.67%) developed superficial skin infections which were managed conservatively. No superficial infections affected the union. There were no cases of deep infections or osteomyelitis. Our observations as compared to previous studies are compliant. Sirkin *et al.* in their landmark study observed 17% superficial wound complications [17]. Andrew Grose *et al.* in their study documented wound dehiscence in 4.5% out of 43 patients studied [27]. In the study by Richard JE *et al.*, 3.7% deep postoperative infections were noted following ORIF [19]. In the study by Ovadia and Beans, 11% rate of local wound infection was noted [28]. Im G *et al.* studied 30 patients treated with ORIF and documented superficial infection in six patients (20%) [25].

5. Conclusion

Our study observations support open reduction and internal fixation through minimally invasive techniques of application of the locking compression plates with staged management protocol. This technique merits improved functional and radiological outcomes with reduced postoperative wound complications.

Although, a larger sample of patients and longer follow up are required to fully evaluate this method of treatment, we strongly encourage its consideration in the treatment of such complex fractures.

Table 1: Distribution of subjects as per AO Classification

Study	Fracture Pattern- AO classification Type 43								
	A1	A2	A3	B1	B2	B3	CI	C2	C3
Hazarika <i>et al.</i> [16]	4	2	4	2	0	1	2	0	5
Andrew Grose <i>et al.</i> [27]	0	0	0	1	2	5	3	5	27
Harris A <i>et al.</i> [15]		0	0	5	4	2	15	10	43
Present study	-	-	-	0	3	1	10	7	9

Table 2: Distribution of subjects based on functional outcomes using the AOFAS (American Orthopedic Foot and Ankle Society) Score at 6 months and Radiological outcome using Teeny Wiss radiological score

AOFAS Score	Number of patients	Percentage (%)
<61	1	3.33
61-65	1	3.33
66-70	6	20
71-75	16	53.33
76-80	6	20
Total	30	100
Mean AOFAS score= 72.33±4.4		
Radiological Outcome	No of cases	Percentage (%)
Anatomical	17	56.67
Good	10	33.33
Fair	3	10
Poor	0	0

Table 3: Comparison of demographic variables

Comparison of demographic variables					
Study	Age (years)	Gender		Mode of Injury	
	Mean	Male	Female	High Energy	Low Energy
Cory collinge <i>et al.</i> [24]	43	76.9	23.1	100%	0%
Heather A Vallier <i>et al.</i> [29]	39.1	69	31	86%	14%
Hazarika <i>et al.</i> [16]	44.7	16	4	85%	15%
Present study	45.7	77	23	100	0%

Table 4: Functional Outcome compared with other studies

Study	Methods	Acceptable	Not acceptable
Ruedi and Allgower [10]	ORIF	74	26
Mast <i>et al.</i> [30]		78	22
Bourne <i>et al.</i> [31]		44	56
Teeny and Wiss [13]		50	50
Ovadia and Beans [28]		67	33
Patterson <i>et al.</i> [18]	Staged ORIF	77	23
Cheema GS <i>et al.</i> [20]		80	20
Im GI <i>et al.</i> [25]	ORIF	88	12
Gao <i>et al.</i> [26]	MIPPO	87	13
Ozkaya U. <i>et al.</i> [22]		81	19
Present study	Staged ORIF with anatomic plates	73	27

NB: The excellent and good results have been tabulated as acceptable and the fair and poor results as not acceptable for easier comprehension.

Table 5: Average fracture union compared with other studies

Study	Method	Average fracture union
Cory collinge <i>et al.</i> [24]	MIPPO	27 weeks
Abidmushtaq <i>et al.</i> [23]	MIPPO	22 weeks
Im GI, <i>et al.</i> [25]	ORIF	20 weeks
Guo <i>et al.</i> [26]	MIPPO	14 weeks
Hazarika <i>et al.</i> [16]	MIPPO	18.1 weeks
Ozkaya U. <i>et al.</i> [22]	MIPPO	18 weeks
Present study	ORIF	17.5 weeks

References

- Egol KA, Wolinsky P, Koval KJ. Open reduction and internal fixation of tibial pilon fractures. *Foot Ankle Clin* [Internet]. 2000; 5(4):873-85. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11232473>
- Bonar S, Marsh J. Tibial Plafond Fractures: Changing Principles of Treatment. *J Am Acad Orthop Surg* [Internet]. 1994; 2(6):297-305. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10709022>
- Martin JS, Marsh JL, Bonar SK, DeCoster TA, Found EM, Brandser EA. Assessment of the AO/ASIF fracture classification for the distal tibia. *J Orthop Trauma*. 1997;
- Sirkin M, Sanders R. The treatment of pilon fractures. *Orthop Clin North Am*, 2001.
- Collinge CA, Sanders RW. Percutaneous plating in the lower extremity. *The Journal of the American Academy of Orthopaedic Surgeons*, 2000.
- Collinge C, Sanders R, DiPasquale T. Treatment of complex tibial periarticular fractures using percutaneous techniques. In: *Clinical Orthopaedics and Related Research*. 2000.
- DLH, PYS, DL. Minimally invasive plate osteosynthesis of distal fractures of the tibia. *Injury*, 1997.
- Hasenboehler E, Rikli D, Babst R. Locking Compression Plate with Minimally Invasive Plate Osteosynthesis in diaphyseal and distal tibial fracture: A retrospective study of 32 patients. *Injury*, 2007.
- Pugh KJ, Wolinsky PR, McAndrew MP, Johnson KD. Tibial pilon fractures: A comparison of treatment methods. In: *Journal of Trauma - Injury, Infection and Critical Care*, 1999.
- Ruedi TP, Allgower M, Rüedi TP, Allgöwer M. The operative treatment of intra-articular fractures of the lower end of the tibia. *Clin Orthop Relat Res* [Internet]. 1979; (138):105-10. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/376196>
- Kellam JF, Waddell JP. Fractures of the distal tibial metaphysis with intra-articular extension—the distal tibial explosion fracture. *J Trauma - Inj Infect Crit Care*. 1979;
- Howard JL, Agel J, Barei DP, Benirschke SK, Nork SE. A prospective study evaluating incision placement and wound healing for tibial plafond fractures. *J Orthop Trauma*. 2008.
- Teeny SM, Wiss DA. Open reduction and internal fixation of tibial plafond fractures. Variables contributing to poor results and complications. *Clin Orthop Relat Res*. 1993; (292):108-17.
- He X, Hu Y, Ye P, Huang L, Zhang F, Ruan Y. The operative treatment of complex pilon fractures: A strategy of soft tissue control. [Internet]. *Indian journal of orthopaedics*. 2013; 47:487-92. Available from: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3796922&tool=pmcentrez&rendertype=abstract>
- Harris AM, Patterson BM, Sontich JK, Vallier HA. Results and outcomes after operative treatment of high-energy tibial plafond fractures. *Foot Ankle Int*. 2006; 27(4):256-65.
- Hazarika S, Chakravarthy J, Cooper J. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia-Results in 20 patients. *Injury*, 2006;
- Sirkin M, Sanders R, DiPasquale T, Herscovici D. A Staged Protocol for Soft Tissue Management in the Treatment of Complex Pilon Fractures. *J Orthop Trauma* [Internet]. 2004; 18(Supplement):S32-8. Available from: http://content.wkhealth.com/linkback/openurl?sid=WKP_TLP:landingpage&an=00005131-200409001-00005
- Patterson MJ, Cole JD. Two-staged delayed open reduction and internal fixation of severe pilon fractures. [Internet]. Vol. 13, *Journal of orthopaedic trauma*, 1999. 85–91. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10052781>
- Richards JE, Magill M, Tressler MA, Shuler FD, Kregor PJ, WT O. External Fixation Versus ORIF for Distal

- Intra-articular Tibia Fractures. Orthopedics. 2012;
20. Cheema GS, Arora S, Sabat D, Singla J, Goel N, Maini L. The results of two-staged operative management of pilon fractures-a review of 25 cases. *J Clin Orthop Trauma*. 2011; 2(2):104-8.
 21. Dhanasekaran DP, Anandan DDS, Sathish DM. Outcome analysis of management of tibial pilon fracture by medial locking compression plating. *Int J Orthop Sci*, 2019,
 22. Ozkaya U, Parmaksizoglu AS, Gul M, Sokucu S, Kabukcuoglu Y. Minimally Invasive Treatment of Distal Tibial Fractures with Locking and Non-Locking Plates. *Foot Ankle Int*, 2009.
 23. Mushtaq A, Shahid R, Asif M, Maqsood M. Distal tibial fracture fixation with Locking Compression Plate (LCP) using the Minimally Invasive Percutaneous Osteosynthesis (MIPO) technique. *Eur J Trauma Emerg Surg*, 2009.
 24. Collinge C, Kuper M, Larson K, Protzman R. Minimally invasive plating of high-energy metaphyseal distal tibia fractures. *J Orthop Trauma*, 2007.
 25. Im G Il, Tae SK. 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 - Inj Infect Crit Care*, 2005.
 26. Gao H, Zhang CQ, Luo CF, Zhou Z Bin, Zeng BF. *J Clin Orthop Relat Res*, 2009.
 27. Vallier HA, Le TT, Bedi A. Radiographic and clinical comparisons of distal tibia shaft fractures (4 to 11 cm proximal to the plafond): Plating versus intramedullary nailing. *J Orthop Trauma*, 2008.
 28. Grose A, Gardner MJ, Hettrich C, Fishman F, Lorich DG, Asprinio DE *et al*. Open reduction and internal fixation of tibial pilon fractures using a lateral approach. *Journal of Orthopaedic Trauma*. 2007.
 29. Mast JW, Spiegel PG, Pappas JN. Fractures of the tibial pilon. *Clin Orthop Relat Res*. 1988; (230):68-82.
 30. Bourne RB, Rorabeck CH, Macnab J. Intra-articular fractures of the distal tibia: The pilon fracture. *J Trauma - Inj Infect Crit Care*, 1983.
 31. Ovadia DN, Beals RK. Fractures of the tibial plafond. *J Bone Joint Surg Am*. 1986; 68(4):543-51.