Clinical characteristics and outcome of tibial pilon fractures treated with open reduction and plating in a tertiary medical college

Manoj Das[1*], Suresh Pandey[1], Hemanta Kumar Gupta[1], Suraj Bidary[1], Anilata Das[2]

[1]Department of Orthopaedics, College of Medical Sciences-Teaching Hospital, Bharatpur, Chitwan, Nepal,
[2]Department of Pediatrics, Chitwan Medical College, Bharatpur, Chitwan, Nepal

ABSTRACT

Introduction: Tibial pilon fracture possess a challenge to achieve optimum outcome because of soft tissue related complications and intra-articular nature of the fracture. Surgical treatments and outcomes vary in literature. The objective of this study was to assess the functional and radiological outcome of tibial pilon fractures treated with open reduction and internal fixation with plate and screws. **Methods:** This was a descriptive study of retrospective data of displaced tibial pilon fractures treated with open reduction and internal fixation with plate and screws. Functional outcome was assessed by American Orthopaedic Foot and Ankle Society (AOFAS) score and fracture union with plain radiography. **Results:** There were total of 20 cases of tibial pilon fractures with mean age of 41.4 years (SD±14.36). The mean AOFAS score was 81.60 (range 42-100) at mean follow up of 18.2 months (range 9-48). Good to excellent results was found in 12(60%) and fair results in 6(30%) cases. All the fractures united at mean of 5.8 months (range 5-7). Partial wound dehiscence was seen in 1(5%) case and marginal skin necrosis occurred in 3(15%) of the cases. **Conclusions:** Current study showed favorable radiological and functional outcome in most of the tibial pilon fractures treated with open reduction and internal fixation with plate and screws with acceptable rate of minor wound related complications.

Keywords: AOFAS score, functional outcome, ORIF, pilon fracture, union.

***Correspondence:**
Dr. Manoj Das
Department of Orthopaedics
College of Medical Sciences-Teaching Hospital,
Bharatpur, Chitwan, Nepal
Email: manojdas3145@gmail.com

Submitted: February 12, 2023
Accepted: November 14, 2023

To cite: Das M, Pandey S, Gupta HK, Bidary S, Das A. Clinical characteristics and outcome of tibial pilon fractures treated with open reduction and plating in a tertiary medical college. JGMC Nepal.2023;16(2):75-9.
DOI: 10.3126/jgmcn.v16i2.60721

INTRODUCTION

Tibial pilon fractures, constitute 5 to 7% of tibia fractures and 1% of lower extremity fractures.[1] Pilon fracture results from high velocity injury leading to intra-articular fracture and severe soft tissue damage.[2] Managing these fractures is challenging due to poor soft tissue coverage in the affected anatomical region.[3] Optimal results require anatomical reduction, restoration of distal tibial alignment, stable fixation and proper soft tissue handling.[4]

Treatment options include closed reduction with cast application, closed reduction and percutaneous pinning, external fixation and open reduction and internal fixation (ORIF) with plate and screws.[1] The results of these treatment vary in literatures.[5] Close reduction with cast application or external fixator increases the risk of non-anatomical reduction whereas open surgery allows for anatomical reduction and stable fixation.[5,6] ORIF with plate and screws is considered as standard treatment for tibial pilon fracture, despite higher soft tissue related complications.[7-9]

The aim of this study was to assess the functional and radiological outcome of tibial pilon fracture treated with ORIF with plate and screws.

METHODS

A retrospective cross-sectional study was conducted among 20 cases of displaced tibial pilon fracture treated by ORIF with plating at College of Medical Sciences and Teaching Hospital, Bharatpur, Chitwan between August 2018 to June 2022. Prior approval for study was taken from Institutional Review Committee (IRC No. COMSTH-IRC/2023-22). Inclusion criteria was close and displaced tibial pilon fracture and open fracture Gustilo Anderson grade I in the age group of 16 to 75 years admitted and operated by ORIF with plate and screws. The exclusion criteria were undisplaced fractures, associated neurovascular injury, associated fractures in ipsilateral limb, reoperation, pathological fracture, extra articular fracture of distal tibia, open fracture Gustilo Anderson grade II and III and treatment of pilon fractures by method other than ORIF.

The definitive fixation by ORIF with plate and screws was done after swelling subsided. Lateral malleolus was first fixed with reconstruction plate following standard technique via lateral approach or posterolateral approach. Standard anteromedial approach was used to access and fix anteromedial fragment and medial malleolus fracture. Anterolateral approach was used to address anterolateral fragments and posterolateral approach was used when there was posterolateral major fragment. Non-weight bearing crutch walking was started on the next day of surgery. Range of motion of ankle was started after suture removal. Full weight bearing was initiated once the fracture was consolidated.

The demographic data, clinical characteristics of fracture and perioperative details were collected from case chart. The clinical and radiological outcome and possible complications (infection, wound dehiscence, nonunion and malunion) were assessed from OPD card and OPD assessment. Functional outcome was assessed by the American Orthopaedic Foot and Ankle Score (AOFAS score).[1] It consists of three variables; pain (40 points), function (50 points) and alignment (10 points). Out of total 100 score, a score of 90-100 was regarded as excellent, 75-89 as good, 50-74 as fair and <50 as poor outcome.[10] All the data were entered into Excel master chart and analysis was done using Statistical Package for the Social Sciences (SPSS) 16.0 software. Descriptive statistics was used for the data analysis. Frequency and percentage were calculated for categorical data and mean, range and standard deviation were calculated for the continuous data.

RESULTS

A total of 20 cases were studied with mean age of 41.4 years and male predominance. Further age and gender distribution of patients is presented in table 1.

Table 1: Age and gender distribution of patients with tibial pilon fracture (N=20)

Parameters	n(%)
Age (years)	
16-30	6 (30%)
31-45	6(30%)
46-60	6(30%)
61-75	2(10%)
Mean±SD	41.4±14.36 years
Gender	
Male	18 (90%)
Female	2 (10%)

The commonest mode of injury was road traffic injury with predominance of AO type C fracture. Further clinical characteristics of injury is presented in table 2. Mean time to definitive surgery was 4.8 days (range 3-9) after injury. Mean follow up period was 18.2 months (range 9 to 48 months).

Table 2: Clinical characteristics of tibial pilon fracture (N=20)

Mode of injury	n(%)
Road traffic injury	17(85%)
Fall from height	3(15%)
AO classification	
B	4(20%)
C	16(80%)
Rüedi and Allgöwer classification	
Type II	4(20%)
Type III	16(80%)

Anteromedial (Fig.1B) and anterolateral approach was used in 14(70%) of cases and posterolateral approach was used in 6(30%) of cases. The mean AOFAS score was 81.60 (range 42-100) at the mean of follow up of 18.2 months. Excellent score was obtained in 8(40%), good score in 4(20%), fair score in 6(30%) and poor score in 2(10%) cases. All AO type B and Rüedi-Allgöwer Type II had excellent score whereas AO type C and Rüedi-Allgöwer type III had poor to excellent functional outcome. Radiological union (Fig. 1D, E) occurred in all the cases with mean union time of 5.8 months (range 5-7). Partial wound dehiscence was seen in 1(5%) case which was re-sutured and healed uneventfully. Marginal skin necrosis at surgical wound occurred in 3(15%) cases which healed with secondary intention after proper dressing. None of the patients required revision surgery either with bone graft or soft tissue reconstruction procedure.

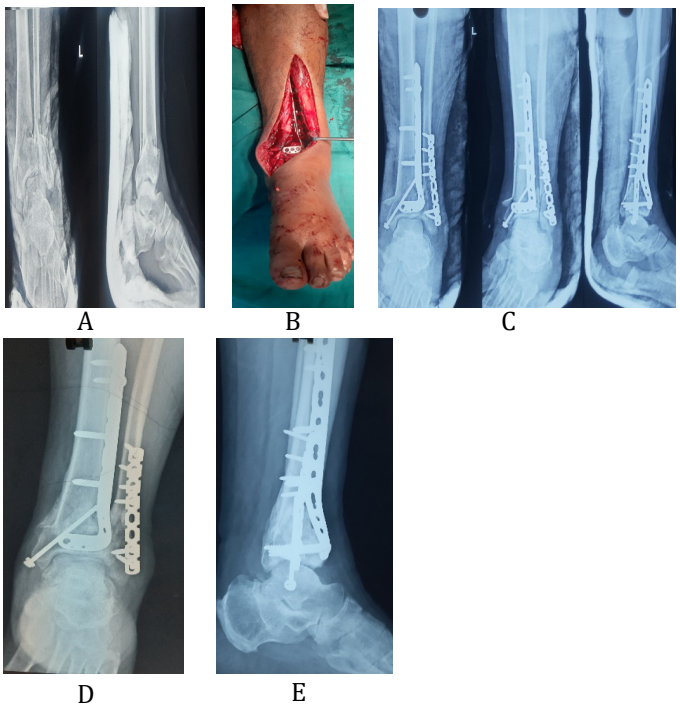

Figure 1. (A) Preoperative X-ray of tibial pilon fracture; (B) Anteromedial approach with anatomical anterolateral locking plate; (C) Immediate post operative X-ray; (D, E) Follow up X-ray showing union.

DISCUSSION

Management of tibial pilon fracture is challenging because of intra-articular nature, comminution of fracture, poor soft tissue coverage and requirement of more than one surgical incision and implants. Mean age of the patient and male predominance in the current study were comparable to the findings of other studies.[8,11,12] Road traffic accident was the commonest mode of injury in our study followed by fall from height. In contrast to our findings, fall from height was the commonest mode of injury in studies done by Topliss et al. and Duckworth et al.[11,13] The mean AOFAS score of this study were comparable to findings of other studies. Duckworth et al. studied long-term outcome of 102 type C tibial pilon fracture treated with ORIF and showed mean AOFAS score of 76.2 at mean follow up of six years.[11] Zhao et al. studied 25 tibial pilon fractures treated with ORIF and found mean AOFAS score as 88.4 (range 80-100).[14] Silluzio et al. reported mean AOFAS score of 71.5 (range 40-95) in 14 cases of complex open tibial pilon fractures treated with ORIF.[15] Wang et al. treated 24 tibial pilon fracture with MIPPO technique and showed mean AOFAS score of 85.1±5.1.[16] White et al. reported AOFAS score of 69.6 in 95 tibial pilon fractures treated by early definitive ORIF.[17] Various studies have shown different rate of non-union in pilon fractures treated with ORIF. Minator et al. showed non-union in 2(4.87%) out of 41 cases of tibial pilon fractures treated with ORIF.[1] Chen et al. reported non-union in 4.7% out of 128 pilon fractures managed with ORIF.[4] White et al. found delayed union or non-union in 6% of cases.[17] Contrary to these findings, all fractures united in this study. This difference could be due to relatively small number of sample size and exclusion of open fracture Gustilo and Anderson grade II and III in the current study.

Results of wound related complications in our study were comparable to the findings of other studies. Chen et al. reported skin sloughs in 14.1% of cases.[4] White et al. reported wound dehiscence or deep wound infection in 6(6%) cases.[17] Zhoa et al. found one superficial and one deep infection out of 25 patients treated with ORIF.[14] Duckworth et al. reported superficial wound infection in 9(8.8%) cases.[11] In our study, none of the patients had superficial or deep wound infections.

There is controversy about the appropriate timing for the definitive surgery. In our study, all cases were operated after the subsidence of swelling. Several studies suggest the staged protocol and delayed definitive surgery to avoid wound related complications.[18-20] However, recent studies have challenged the concept of delayed surgery.[1,17] White et al. performed ORIF within 24 hours in 70% of cases and within 48 hours in 88% of cases, concluding that early ORIF can be done effectively with relatively low complications rate.[17] Minator et al. compared the outcome of type C tibial pilon fracture treated with primary ORIF vs two stage surgery and found no significant difference between the two groups.[1]

The limitations of the current study are retrospective nature of the study, relatively small sample size, lack of comparison group and single-centered study. A multicentered study with large number of cases with long term follow up is recommended to strengthen the findings of the present study.

CONCLUSIONS

Current study showed favorable radiological and functional outcome in most of the displaced closed and grade I open tibial pilon fractures treated by ORIF with plate and screws with acceptable rate of minor wound related complications. The findings underscore the importance of proper selection of approach, meticulous handling of soft tissue, and proper reduction and fixation.

CONFLICTS OF INTEREST: None declared

SOURCE OF FUNDING: None

AUTHORS CONTRIBUTION

MD did concept designing, literature search, clinical studies, data acquisition and compilation, statistical analysis, manuscript preparation, editing and review; SP developed concepts, manuscript preparation, editing and review; HKG and SB did manuscript preparation, editing and review; AD data compilation, statistical analysis and manuscript preparation.

REFERENCES

1. Minator Sajjadi M, Ebrahimpour A, Okhovatpour MA, Karimi A, Zandi R, Sharifzadeh A. The Outcomes of Pilon Fracture Treatment: Primary Open Reduction and Internal Fixation Versus Two-stage Approach. Arch Bone Jt Surg. 2018;6(5):412-9.
2. Jacob N, Amin A, Giotakis N, Narayan B, Nayagam S, Trompeter AJ. Management of high-energy tibial pilon fractures. Strategies Trauma Limb Reconstr. 2015;10(3):137-47. DOI: 10.1007/s11751-015-0231-5 PMID: 26407690.
3. Assal M, Ray A, Stern R. Strategies for surgical approaches in open reduction internal fixation of pilon fractures. J Orthop Trauma. 2015;29(2):69-79. DOI: 10.1097/BOT.0000000000000218 PMID: 25072286.
4. Chen SH, Wu PH, Lee YS. Long-term results of pilon fractures. Arch Orthop Trauma Surg. 2007;127(1):55-60. DOI: 10.1007/s00402-006-0225-3 PMID: 17004076.
5. Calori GM, Tagliabue L, Mazza E, de Bellis U, Pierannunzii L, Marelli BM, et al. Tibial pilon fractures: Which method of treatment? Injury. 2010;41(11):1183-90. DOI: 10.1016/j.injury.2010.08.041 PMID: 20870227.
6. Pugh KJ, Wolinsky PR, McAndrew MP, Johnson KD. Tibial pilon fractures: a comparison of treatment methods. J Trauma. 1999;47(5):937-41. DOI: 10.1097/00005373-199911000-00022 PMID: 10568726.
7. Bacon S, Smith WR, Morgan SJ, Hasenboehler E, Philips G, Williams A, et al. A retrospective analysis of comminuted intra-articular fractures of the tibial plafond: Open reduction and internal fixation versus external Ilizarov fixation. Injury. 2008;39(2):196-202. DOI: 10.1016/j.injury.2007.09.003 PMID: 18241864.
8. Gülabi D, Toprak O, Sen C, Avcı CC, Bilen E, Sağlam F. The mid-term results of treatment for tibial pilon fractures. Ulus Travma Acil Cerrahi Derg. 2012;18(5):429-35. DOI: 10.5505/tjtes.2012.86094 PMID: 23188605.
9. Thordarson DB. Complications after treatment of tibial pilon fractures: prevention and management strategies. J Am Acad Orthop Surg. 2000;8(4):253-65. DOI: 10.5435/00124635-200007000-00006 PMID: 10951114.
10. Engelmann EWM, Roelofs A, Posthuma J, Schepers T. Evaluation of Functional Outcome and Complications in Bridge Plating Compared to Transarticular Screws for Lisfranc Injuries: A Systematic Review and Meta-analysis. J Foot Ankle Surg. 2022. DOI: 10.1053/j.jfas.2022.03.002 PMID: 35459613.
11. Duckworth AD, Jefferies JG, Clement ND, White TO. Type C tibial pilon fractures: short- and long-term outcome following operative intervention. Bone Joint J. 2016;98-b(8):1106-11. DOI: 10.1302/0301-620X.98B8.36400 PMID: 27482025 .
12. Esposito JG, van der Vliet QMJ, Heng M, Potter J, Cronin PK, Harris MB, et al. Does Surgical Approach Influence the Risk of Postoperative Infection After Surgical Treatment of Tibial Pilon Fractures? J Orthop Trauma. 2020;34(3):126-30. DOI: 10.1097/BOT.0000000000001655 PMID: 32084089.
13. Topliss CJ, Jackson M, Atkins RM. Anatomy of pilon fractures of the distal tibia. J Bone Joint Surg Br. 2005;87(5):692-7. DOI: 10.1302/0301-620X.87B5.15982 PMID: 15855374.
14. Zhao Y, Wu J, Wei S, Xu F, Kong C, Zhi X, et al. Surgical approach strategies for open reduction internal fixation of closed complex tibial Pilon fractures based on axial CT scans. J Orthop Surg Res. 2020;15(1):283. DOI: 10.1186/s13018-020-01770-y PMID: 32718324.
15. Silluzio N, De Santis V, Marzetti E, Piccioli A, Rosa MA, Maccauro G. Clinical and radiographic outcomes in patients operated for complex open tibial pilon fractures. Injury. 2019;50Suppl2:S24-s8. DOI: 10.1016/j.injury.2019.01.041 PMID: 31171351.
16. Wang B, Zhao K, Jin Z, Zhang J, Chen W, Hou Z, et al. A new surgical strategy for the treatment of tibial pilon fractures with MIPO facilitated by double reverse traction repositor. Sci Rep. 2022;12(1):7074. DOI: 10.1038/s41598-022-11150-7 PMID: 35490177.

17. White TO, Guy P, Cooke CJ, Kennedy SA, Droll KP, Blachut PA, et al. The results of early primary open reduction and internal fixation for treatment of OTA 43.C-type tibial pilon fractures: a cohort study. J Orthop Trauma. 2010;24(12):757-63. DOI: 10.1097/BOT.0b013e3181d04bc0 PMID: 21076248.

18. Sirkin M, Sanders R, DiPasquale T, Herscovici D, Jr. A staged protocol for soft tissue management in the treatment of complex pilon fractures. J Orthop Trauma. 1999;13(2):78-84. DOI: 10.1097/00005131-199902000-00002 PMID: 10052780.

19. Patterson MJ, Cole JD. Two-staged delayed open reduction and internal fixation of severe pilon fractures. J Orthop Trauma. 1999;13(2):85-91.

20. Höntzsch D, Karnatz N, Jansen T. [One- or two-step management (with external fixator) of severe pilon-tibial fractures]. Aktuelle Traumatol. 1990;20(4):199-204. 10.1097/00005131-199902000-00003 PMID: 10052781.