Available online at www.medicinescience.org

ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2018;7(1):58-61

Factors affecting the results of tibial pilon fractures treated with open reduction internal fixation

Mehmet Yavuz Baser[1], Aydin Arslan[2], Ali Utkan[3], Bulent Ozkurt[3]

[1] Batman Yasam Hospital Department of Orthopaedics, Batman, Turkey
[2] Istanbul Gelişim University, Medicalpark Anatolian Hospital, Department of Orthopedics, Istanbul, Turkey
[3] Ankara Numune Research and Training Hospital, Department of orthopaedics, Ankara, Turkey

Received 25 September 2017; Accepted 12 December 2017
Available online 11.02.2018 with doi: 10.5455/medscience.2017.06.8746

Abstract

The purpose of this study is to evaluate the short and medium term functional results of tibial pilon fractures treated in our clinic with the open reduction and internal fixation method and to investigate the factors affecting such results. 41 patients who were treated in our clinic between 1995 and 2009 with open reduction and internal fixation were included in this study. Looking at the postoperative radiographs, quality of reduction was evaluated as per the criteria of Ovadia and Beals. Functional results of the patients were assessed in line with the criteria of Teeny and Wiss. With the evaluation of postoperative radiographs, 17 (41.5%) excellent and good, 21 (51.2%) fair and 3 (7.3%) poor results were obtained. Functionally speaking, 26 patients (63.5%) displayed excellent and good, 8 displayed (19.5%) fair and 7 displayed (17%) poor results. It was found out that age, sex, the time spent before the operation, the period of immobilization following the operation and the presence of an accompanying fracture did not have a significant impact on the functional results. It was revealed that the type of fracture affects functional results. A positive correlation was found between the quality of reduction and the functional results. In the light of the findings of this study, it was concluded that in tibial pilon fractures treated with the internal fixation method, the type of fracture and the quality of reduction are important in identifying the short and medium term prognosis.

Keywords: Pilon Fractures, tibia, open reduction

Introduction

At large, pilon fractures are fractures which develop due to high-energy traumas as a result of axial overload accompanied by rotational forces, starting from the distal metaphysis of the tibia and reaching to the articular surface, wherein joint integrity is disrupted in varying degrees. 1-5% of all lower extremity fractures and 7-10% of all tibia fractures are tibial pilon fractures [1,2]. In addition to the difficulty faced in the anatomic reduction and the stable fixation of such fractures, the accompanying soft tissue damage increases the frequency of postoperative complications [3-6]. Identifying the timing of surgery and the surgical method to be applied in a manner that suits the case is important, particularly for high-energy fractures [3,4,6-8]. While anatomic reduction is of importance for intra-articular fractures, for pilon fractures whether the clinical results are related with to what extent the joint is anatomically restored is still debated [9].

There is not enough study investigating factors affecting functional outcomes of tibia pilon fractures treated via open reduction and internal fixation.

***Coresponding Author:** Aydin Arslan, Development Istanbul University, Faculty of Medicine Department of Orthopedics and Traumatology, Istanbul, Turkey
E-mail: draarslan@hotmail.com

Thus, in this study, the short and medium term functional results of tibial pilon fractures treated in our clinic with the open reduction and internal fixation method were evaluated and the factors affecting such results were examined.

Materials and Methods

Between 1995 and 2009, 72 patients with tibial pilon fractures were treated at our clinic. 26 patients treated with external fixators and 5 patients treated with long leg circular casts after skeletal traction were not included in the study. 41 patients who were treated with open reduction and internal fixation were included in this study.

All patients were evaluated over the standard AP and lateral radiographs, traction radiographs and computed tomography. Fractures were assessed as per the Rüedi-Allgöwer classification. Tscherne classification was utilized in order to evaluate the local soft tissue damage. Open fractures were evaluated with the Gustillo-Anderson classification.

The timing of surgical intervention was planned in accordance with the status of soft tissue damage. In cases where the intra-splint conservation of reduction would pose difficult, skeletal traction was utilized. In connection with the methodology proposed by Rüedi for the surgical operation, first of all the open reduction

and internal fixation of the fibula was performed for the leg length restoration, and then the articular surface of the tibia was reconstructed and metaphyseal defects, if any, were grafted and interfragmentary screw or plate screw application was carried out.

Anteromedial, anterolateral and lateral incisions were opted for. Distal tibia anatomical plate, T-plate, support plate and interfragmentary screws were utilized for the fixation of the tibia. Dynamic compression plate, 1/3 tubular plate, intramedullary K-wire and interfragmentary screws were utilized for the fixation of the fibula. Spongiose autograft taken from iliac crest was utilized as the bone graft.

In all patients, short leg splint was applied to the extremity postoperatively. The prophylactic antibiotic treatment given pre-operationally (1 gr cephalosporin) continued with 3x1 gr postoperatively and terminated on the third day. The prophylaxis for thromboembolism commenced from admission to hospital with 0.4 ml low molecular weight heparin. This treatment was continued for three weeks postoperatively.

For patients for whom no concern of loss of reduction was present, isotonic and isometric exercises were applied to the knee joint from the first day postoperatively. Within the first postoperative week, passive and assisted ankle exercises started first and were followed with active isometric and isotonic exercises. For patients for whom a concern of loss of reduction was present, ankle and knee movement exercises started between the 4th and the 6th postoperative week. In line with the status of the fracture, patients were started to be given loads between the 8th and 16th weeks.

In the postoperative period, patients were called in for checks in the third and the sixth week, and monthly afterwards. In the radiographs of patients taken in their first polyclinic checks, quality of reduction was evaluated as per the criteria of Ovadia and Beals. The displacement of fracture fragments, the status of fixation, the overview of fracture lines, the residual varus or angulation on the articular surface and the status of fixation materials utilized were evaluated over the radiographs.

Functional results of the patients in their final checks were assessed in line with the criteria of Teeny and Wiss [10]. Results were classified as excellent, good, fair and poor as per the said criteria. Patients were followed up for a minimum of 36 months.

Age, sex, type of fracture, the time spent before the operation, the period of immobilization following the operation, the presence of an accompanying fracture and quality of reduction were evaluated in terms of whether they have any effect on functional results.

Statistical analysis

The statistical analysis of the results was carried out by using SPSS 2010 (Version 19.0. Armonk, NY) software. Whether the data displayed a normal distribution was evaluated via the Shapiro-Wilk test. The Kruskal-Wallis analysis was utilized to compare the functional results when grouped according to the types of fracture. The impact of age, sex, the time spent before the operation, the postoperative period of immobilization, the presence of an accompanying fracture and the quality of reduction was investigated over a regression analysis. $P<0.05$ was deemed a statistically significant difference.

Results

Of the 41 patients included in the study, 28 were male and 13 were female. The average age was found out to be 47.5 (22-70). The cause of fracture was determined as fall from height for 26 patients (63.4%), in-car traffic accident for 11 patients (26.8%) and out-of-car traffic accident for 4 patients (9.8%).

According to the Rüedi-Allgöwer classification, 13 patients (31.7%) had Type I, 20 patients (48.8%) had Type II and 8 patients (19.5%) had Type III fractures. According to the Tscherne classification, five patients had grade I, 19 patients had grade II and 12 patients had grade II soft tissue injuries. According to the Gustillo-Anderson classification, open fracture was identified for five patients (12.1%), with two being type I and three being type II. While thirty patients (73.1%) had an accompanying fibula fracture to the pilon fracture, eighteen patients also had other bone fractures.

Surgical intervention was delayed for an average of 7 days [2-15] in order for the soft tissue damage to recover. During this period, 26 patients were applied with skeletal traction from the calcaneus. The remaining 15 patients were kept under observation at the hospital with cast splint fixation. No patients were applied with temporary external fixators.

For 28 patients anteromedial, for 10 patients anterolateral and for 3 patient's lateral incision was preferred. Distal tibia anatomical plate was utilized for 23 patients (56.1%), T-plate for 8 patients (19.5%), support plate for 4 patients (9.8%), and interfragmentary screws for 6 patients (14.6%). For the fixation of the fibula, dynamic compression plate was utilized for 19 patients (63.3%), 1/3 tubular plate for 6 patients (20%), intramedullary K-wire for 3 patients (10%), and interfragmentary screws for 2 patients (6.7%). In eleven cases (26.8%), autograft taken from the wing of the ilium was utilized.

In all patients, bone union was achieved in an average of 16.2 weeks [12-22] without the need for a second intervention aimed at union. No implant failure or varus collapse was observed. Skin necrosis developed near the wound for two patients (4.8%) and skin graft was applied. Three patients (7.3%) developed superficial infection during the postoperative period and recovery was achieved through debridement and oral antibiotic administration. No deep wound infection occurred. Two patients (4.8%) were treated for Sudeck's atrophy. Ankle and knee movement exercises started for 25 patients in the first postoperative week. Due to concerns of loss of reduction, ankle and knee movement exercises started for 16 patients between the 4th and 6th weeks. Patients were given partial load in 11 weeks in average [8-16]. The average follow-up duration of the patients was 43 months.

According to the Teeny and Wiss (source) clinical evaluation scoring, excellent and good results were achieved for 26 patients (63.5%), fair results for 8 patients (19.5%) and poor results for 7 patients (17%). According to the criteria of Ovadia and Beals, anatomical and good results were achieved for 17 patients (41.5%), fair results for 21 patients (51.2%), and poor results for 3 patients (7.3%). It was observed that those patients with functionally poor results were patients whose radiological results were also poor.

It was found out that age, sex, the time spent before the operation, the period of immobilization following the operation and the presence of an accompanying fracture did not have a statistically significant impact on the functional scores.

When compared in terms of the types of fractures according to the Rüedi-Allgöwer classification, clinical evaluation results belonging to type I and type II fractures were found to be statistically more significant than type III fractures ($p<0.001$). Additionally, according to the Tscherne classification, no difference was found between the groups in terms of the results of the clinical evaluation. Besides that, a positive correlation was found between the quality of reduction and the clinical evaluation results. ($p<0.01$, coefficient of relation =0.495).

Discussion

The purpose of treating tibial pilon fractures is achieving joint mobility in the soonest possible time through the stable fixation and anatomic restoration of the injured joint [11]. There are significant factors that complicate the treatment of such fractures. One of such factors is the insufficiency of soft tissue support and blood supply at the fracture area [3,6,11]. Another important factor is the fact that mostly such fractures occur as a result of high-energy traumas. Especially, as much as the presence of a segmental fracture and bone loss at the distal metaphysis of the tibia as a result of the fragmentation and collapse of varying degrees stemming from vertical compression complicates a stable osteosynthesis, soft tissue damage also disrupts the local blood flow, hampering bone union [1,2,12].

63.4% of the cases in this study were fractures that occurred due to vertical compression related to fall from height. For the remaining patients, the fracture occurred due to high-energy injuries such as in-car or out-of-car traffic accidents.

It is reported in the literature that wound closure defects and infection complications are observed at a rate of 0-55% after the open reduction and internal fixation method [13,14]. Due to the fact that in our clinic, all patients with type 3 open fractures whose internal fixation was found to be risky were opted to be treated with minimal invasive operations and external fixation methods by considering comorbidities or the status of soft tissues, a critical rate of complication was not observed for the patients included in this study and bone union was achieved in all fractures.

It is recommended in the literature that for cases wherein the patient cannot be operated upon in the early stages, the surgical intervention be delayed 7-10 days in order to avoid complications related to the healing of the wound [15,16]. In this study, the surgical treatment took place in an average of 7 days [2-15] after admission to the hospital. Within this period all patients were under observation at the hospital with skeletal traction or cast splint fixation. In this study, 2 patients (4.8%) developed skin necrosis near the wound. Those two patients were subjected to a full-thickness skin graft. Three patients (7.3%) developed superficial infections. Recovery was achieved through debridement and antibiotic treatment. In their 142-case series, Ovadia and Beals report a 6% rate of deep infection [17]. In this study, no evidence of osteomyelitis was found in the follow up of any patient. The most probable reasons for the fact that the rate of infection in this study is low are that soft tissue recovery before the operation was expected and that operations were performed with minimal soft tissue damage.

The fact that in multi-fragmented and defective fractures requiring a surgical approach with the open reduction and internal fixation method proposed by Rüedi and Allgöwer, the fracture area cannot recover easily and wound healing problems are prominent, brought the option of minimally invasive plate osteosynthesis (MIPO) that acts like an internal fixator to the forefront.(3) In the recent years, some articles were also published which report that alignment is deemed more important that the anatomic reduction of the articular surface. (3,9) In this study, however, a positive correlation between the quality of reduction as determined in accordance with the criteria used by Ovadia and Beals and the functional results was found. In this study, for eleven patients (26.8%), autograft taken from the wing of the ilium was utilized. Such rate was in congruence with the literature [8,19].

In many studies carried out formerly, it was reported that clinical results worsen as the type of fracture gets more complex [20-23]. In former studies it was stated that Type I and Type II fractures as per the Rüedi-Allgöwer classification displayed better results than Type III fractures [22,24]. In this study, it was found that when compared in terms of the types of fracture, the functional results of type I and type II fractures are significantly better than type III fractures. On the other hand, it was found out that the age and sex of the patient, the time spent before the operation, the period of immobilization following the operation and the presence of an accompanying fracture did not have a statistically significant impact on the functional results. Future studies should be designed as prospective and evaluate long term functional results.

Conclusion

In the light of the findings of this study, it was concluded that in tibial pilon fractures treated with the internal fixation method, the type of fracture and the quality of reduction are important in identifying the short and medium term prognosis.

Acknowledgements, none, Conflict of Interest No conflict of interest was declared by the authors. Financial Disclosure: The authors declared that this study has received no financial support.

References

1. McCann PA, Jackson M, Mitchell ST, Atkins RM. Complications of definitive open reduction and internal fixation of pilon fractures of the distal tibia. Int Orthop. 2011;35(3):413-8.

2. Güven M, Ceviz E, Demirel M, Özler T, Kocadal O, Onal A. Minimally invasive osteosynthesis of adult tibia fractures by means of rigid fixation with anatomic locked plates. Strategies Trauma Limb Reconstr. 2013;8(2):103-9.

3. Jansen H, Fenwick A, Doht S, Frey S, Meffert R. Clinical outcome and changes in gait pattern after pilon fractures. Int Orthop. 2013;37(1):51-58.

4. Bacon S, Smith WR, Morgan SJ, Hasenboehler E, Philips G, Williams A, Ziran BH, Stahel PF. 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.

5. Conroy J, Agarwal M, Giannoudis PV, Matthews SJ. Early internal fixation and soft tissue cover of severe open tibial pilon fractures. Int Orthop. 2003;27(6):343-7.

6. 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.

7. 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.

8. Pollak AN, McCarthy ML, Bess RS, Agel J, Swiontkowski MF. Outcomes after treatment of high-energy tibial plafond fractures. J Bone Joint Surg Am. 2003;85-A(10):1893-900.

9. Marsh JL, Weigel DP, Dirschl DR. Tibial plafond fractures. How do these ankles function over time? J Bone Joint Surg Am. 2003;85-A(2):287-95.

10. 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.

11. Tarkin IS, Clare MP, Marcantonio A, Pape HC. An update on the management of high-energy pilon fractures. Injury. 2008;39(2):142-54.

12. Schatzker J. Fractures of the distal femur revisited. Clin Orthop Relat Res. 1998;347:43-56.

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

14. Dillin L, Slabaugh P. Delayed wound healing, infection, and nonunion following open reduction and internal fixation of tibial plafond fractures. J Trauma 1986;26(12):1116-9.

15. Blauth M, Bastian L, Krettek C, Knop C, Evans S. Surgical options for the treatment of severe tibial pilon fractures: a study of three techniques. J Orthop Trauma. 2001;15(3):153-60.

16. Ebraheim N, Sabry FF, Mehalik JN. Intraoperative imaging of the tibial plafond fracture: a potential pitfall. Foot Ankle Int. 2000;21(1):67-72.

17. Muhr G, Breitfuss H. Complications after pilon fractures. In: Major Fractures of the Pilon, the Talus, and the Calcaneus, ed by Tscherne H, Schatzker J. Berlin, Springer-Verlag, 1993;65-8.

18. Sands A, Grujic L, Byck DC, Agel J, Benirschke S, Swiontkowski MF. Clinical and functional outcomes of internal fixation of displaces pilon fractures, Clin Orthop Relat Res. 1998;347:131-7.

19. .Kao KF, Huang PJ, Chen YW, Cheng YM, Lin SY, Ko SH. Postero-medio-anterior approach of the ankle for the Pilon fracture. Injury. 2000;31(2):71-4.

20. Bone L, Stegemann P, McNamara K, et al. External fixation of severely comminuted and open pilon fractures. In: Major Fractures of the Pilon, the Talus, and the Calcaneus, ed by Tscherne H, Schatzker J. Berlin, Springer-Verlag, 1993;53-8.

21. Ovadia DN, Beals RK. Fractures of the tibial plafond, J Bone Joint Surg Am. 1986;68(4)543-5-51.

22. Etter C, Ganz R. Long trem results of tibial plafond fractures treated with open reduction and internal fixation. Arch Orthop Traum Surg. 1991;110(6):277-83.

23. Wyrsch B, McFerran MA, McAndrew M, Limbird TJ, Harper MC, Johnson KD, Schwartz HS. Operative treatment of fractures of the tibial plafond: A randomized, prospective study, J Bone Joint Surg Am. 1996;78(11):1646-57.

24. Kellam JF, Waddell JP. Fractures of the distal tibial metaphysis with intra-articular extension--the distal tibial explosion fracture. J Trauma 1979;19(8):593-601.