Jentashapir J Health Res. 2016 February; 7(1):e30014. doi: 10.17795/jjhr-30014.

Published online 2016 February 15. **Research Article**

Outcome Assessment of Hybrid External Fixation in the Treatment of Comminuted Distal Femur and Proximal Tibial Fractures

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Received 2015 May 16; **Revised** 2015 September 29; **Accepted** 2015 October 03.

Abstract

Background: Treatment of comminuted fractures of the distal femur and proximal tibia is difficult, and a challenge in the field of orthopedic trauma.
Objectives: The aim of this study was to assess the short-term results of hybrid external fixation in the treatment of these fractures.
Patients and Methods: In a prospective study, 44 patients with comminuted fractures of the distal femur or proximal tibia, with an overlying soft tissue injury treated by closed reduction and hybrid external fixation, were included. Parameters such as pin-track infection, union, limb shortening, knee motion, and alignment were evaluated during a mean follow-up period of 14 months.
Results: Forty-four patients with distal femoral (n = 23) and proximal tibial (n = 21) fractures were treated using hybrid external fixation. Bone union was seen in 35 (80%) of the patients. Pin tract infection was seen in three patients (6.8%), one case (4.6%) with a PTF and two cases (8%) with DFFs. Malunion was observed in 4 patients (9.1%); of these, three cases (13%) had DFF and one case (4.8%) of pain was detected in the DFF group. One case had malunion and three cases had union. Findings showed satisfactory results in more than 80% of patients. In general, lower postoperative complications were detected in the proximal tibial fractures than the distal femoral fractures. According to a chi-square test, the difference between the patients with PTFs and those with DFFs was not clinically significant.
Conclusions: Closed reduction and hybrid external fixation can be used as a definitive treatment for severe comminuted fractures of the distal femur and proximal tibia, when the concomitant contusion of the skin and soft tissue damage prohibits safe open reduction and internal fixation.

Keywords: Distal Femoral Fracture, Proximal Tibial Fracture, Hybrid External Fixation

1. Background

Distal femur and proximal tibial fractures are treated through various methods. Open reduction and internal fixation of these comminuted fractures may be accompanied by skin or soft tissue necrosis, postoperative infection, and knee stiffness. External fixation is a safe and suitable method for these complicated fractures.

According to the OTA classification, distal femur fractures are divided into type A (extra articular), type B (partial articular), and type C (complete articular) (1). 5 - 10% of these fractures present with open wounds (2). The mechanism of these fractures may be high energy, e.g. motor vehicle accidents, or low energy, e.g. falls. High energy fractures predominantly occur, while low energy fractures are common in elderly patients with osteoporosis (3). Based on Schatzker's classification, tibial plateau fractures are categorized into S-I to S-VI groups (4). Type II is the most common form. Types IV to VI are the major problems for the orthopedic surgeon because both condyles are fractured and displaced (5).

Treatment of distal femur fractures is performed through various techniques, including open reduction and internal fixation (ORIF), less invasive stabilization systems (LISS), limited contact dynamic compression plates (LC-DCP), intramedullary nailing, buttress plating, and external fixation (conventional, Ilizarov ring, or hybrid external fixation) (6-10). In addition, similar procedures and techniques are frequently used for the treatment of proximal tibial fractures (5, 11). Direct ORIF for these comminuted fractures with soft tissue contusion may be associated with postoperative infection, nonunion, and knee stiffness. Risks of an immediate ORIF in severely injured soft tissues can be avoided by using external fixation prior to the ORIF for comminuted fractures (12-15). Hybrid external fixation, in which the fracture is reduced by closed mean with minimal soft tissue dissection, is a suitable option as a primary (temporary) or definitive treatment (16). Among others, El-Alfy et al. declared that hybrid external

fixation for treatment of proximal tibial fractures was associated with minimal soft tissue injury and satisfactory radiographic and clinical outcomes (17-19).

2. Objectives

We investigated hybrid external fixation efficacy in comminuted distal femoral or proximal tibial fractures for which ORIF was not suitable as a definite treatment.

3. Patients and Methods

This prospective study was performed between March 2011 and January 2013 in two general hospitals, in Ahvaz, Iran. Inclusion criteria were distal femoral or tibia plateau fractures in which open reduction and internal fixation was not possible due to severe fracture comminuting, soft tissue damage, or open wounds. Patients older than 65 years or younger than 18 years, patients for whom ORIF was a better choice, and patients who rejected or poorly tolerated external fixation were excluded. 44 patients with distal femoral fractures or proximal tibia fractures entered the study.

The participants included 41 males (93.2%) and 3 females (6.8%), with an average age of 37.29 years (range: 20 - 59 years). All of the fractures were associated with comminuting and associated soft tissue damage (ecchymosed, laceration, bruising, or massive swelling) so the patients were not candidates for ORIF. There were 23 DFF (type C1 and C2, OTA classification) and 21 proximal tibia plateau fractures (Schatzker types IV - VI). The DFFs featured 5 closed fractures and 18 open fractures (Gastillo and Anderson), while the TPFS had 13 closed and 8 open fractures.

In the operating room under spinal or general anesthesia, a closed reduction under fluoroscopy C-arm control was performed. A full ring fixator was fixed in the most distal fragments of the femur or proximal tibia plateau, and fixed by side bars and Schanz pins in diaphysis. Follow-up visits and radiography control were performed at 4 - 6 week intervals. After fracture healing, the fixator was removed and physiotherapy was initiated.

The fractures occurred in 40 patients due to motor vehicle accidents, in 2 patients due to falling down from a height, and in 2 others due to gunshot assaults. Surgeries were performed within 3 - 7 days after hospitalization. Follow-up was performed for an average of 14 months (9 - 18 months). Several parameters were considered during follow-up, and are shown in Table 1. Control radiographs and physical examinations were used for assessment of the follow-up parameters. Patients were free from the hybrid fixators after fracture union had occurred. The study was approved by the AUMS ethics committee, and consent forms were completed by all patients.

Table 1. Parameters Considered for Follow-Up Evaluation According to Modified Society Knee Score (SKS)

Parameter	Normal	Abnormal
Knee ROM	$\geq$ 100° flexion	< 100° flexion
Alignment	$\leq$ 6° valgus	> 6° valgus or varus
Pin-track infection	Slight inflammation, erythema, or pruritus	Bloody or supportive discharge
Union	Bridging of the fracture site at three cortices/ absence of pain or tenderness during weight-bearing	Absence of the normal criteria
Limb shortening	Leg length discrepancy < 2 cm	Leg length discrepancy $\geq$ 2 cm
Pain	Score $\leq$ 5 according visual score; 1 $\geq$	Score > 5 according visual score; 2 $\leq$

Abbreviations: ROM, range of motion; SKS, society knee score.

4. Results

Two patients (4.5%) had abnormal knee range of motion (ROM). They were a 59-year-old woman with an open proximal tibial fracture and a 45-year-old man with a distal femoral fracture. Union was achieved in 40 patients (91.9%) and failed in 4 patients (9.1%). Three cases (13%) with distal femoral fractures and one case (4.8%) with a proximal tibial fracture were nonunion. Iliac bone grafting was performed in the fractures that weren't united. All fractures united after bone grafting. Four months of follow-up indicated pain in four cases. Pain was only detected in the distal femoral fractures; one case had malunion and the other three cases had union. Pin-track infection (supportive and/or bloody discharge) was observed in three patients (6.8%), of which two cases (8.7%) were distal femoral fractures and one case (4.8%) was a proximal tibial fracture. Treatment of pin-track infections consisted of increasing the frequency of local cleaning of the infectious site and oral antibiotic therapy. Limb shortening occurred in 5 patients (11.4%). Four patients (19%) with proximal tibial fractures and one patient (4.34%) with a distal femoral fracture showed limb shortening. The mean shortening was 1.58 cm (1 - 2.7 cm). At the end of study, of the 44 fractures, 11 (25%) were malaligned and 33 (75%) had normal alignment. Out of 11 patients with malalignment, four PTF patients had varus deformity, three DFF patients had valgus deformity, and three DFF patients had varus deformity.

Overall, results were satisfactory in 36 patients (81.8%) (functional scores $\leq$ 1) and unsatisfactory in 8 patients

(functional scores $\geq$ 2). Four patients with proximal tibial fractures (17.4%) and four patients with distal femoral fractures (19%) had functional scores $\geq$ 1. In general, lower rates of postoperative complications were observed in proximal tibia fractures follow-up than in distal femoral fractures. The mean limb shortening was 1.28 cm (1-2.7 cm). Valgus deformity was seen in three patients (43%). Three patients (6.8%) had pin-track infections, of which one case (4.8%) was a proximal tibial fracture and two cases (8.7%) were distal femoral fractures. Malunion was observed in 4 patients (9.1%), of which three cases (13%) were distal femoral fractures and one case (4.8%) was a proximal tibial fracture.

Table 2. Frequency of the Various Follow-Up Parameters in the Distal Femoral Fractures (DFF) and Proximal Tibia Fractures (PTF)

Parameter	DFF[a]	PTF[a]	P Value
Knee ROM			
Normal[b]	22 (95.7)	20 (95.2)	
Abnormal[b]	1 (4.3)	1 (4.8)	0.75
Union			
Normal	20 (87.0)	20 (95.2)	
Abnormal	3 (13.0)	1 (4.8)	0.47
Pain			
Normal	19 (82.6)	21 (100.0)	0.26
Abnormal	4 (17.4)		
Pin-track infection			
Normal	21 (91.3)	20 (95.2)	
Abnormal	2 (8.7)	1 (4.8)	0.79
Limb shorten			
Normal	22 (95.7)	17 (81.0)	
Abnormal	1 (4.3)	4 (19.0)	0.19
Alignment			
Normal	16 (69.6)	17 (81.0)	
Abnormal	7 (30.4)	4 (19.0)	0.63
Functional score			
Normal	19 (82.6)	17 (81.0)	
Abnormal	4 (17.4)	4 (19.0)	0.75

[a]Values are expressed as frequency (%).
[b]These terms are defined in Table 1.
Abbreviations: DFF, distal femoral fracture; PTF, proximal tibia fracture; ROM, range of motion.

5. Discussion

Soft tissue management is a critical problem during surgery on tibial plateau or distal femoral fractures, because normal soft tissues facilitate the fracture healing process. Complicated high energy fractures of the tibial plateau (type V and VI Schatzker classification) and distal femurs should be treated with minimal soft tissue manipulation. Several authors have explained why hybrid external fixation has advantages over ORIF in the treatment of proximal tibial and distal femoral fractures. These advantages include stable fixation (18), soft tissue protection (5, 18, 20), early knee range of motion (17, 21), improvement of HSS score (22), low deep infection rates (19), and early weight-bearing (10). But the accuracy of the reduction in the hybrid external fixation method is lower than in internal fixation methods (20-26). Regenerating new bones, early weight-bearing, and improvement of deformities are provided with difficulty when plate fixation or nailing is used for the treatment of distal femoral fractures. Skin or soft tissue necrosis and postoperative infection are major side effects of ORIF in these fractures (23).

In line with our study, Savolainen et al. (24) indicated that the hybrid external fixation technique is safe and a suitable method for the treatment of AO/ASIF type-C1 and type-C2/C3 proximal tibial fractures. But occasionally open fracture reduction should be performed for type C2/C3 fractures (24). Babis et al. (5) showed that hybrid external fixation, with or without minimal internal fixation, results in satisfactory outcomes in patients with proximal tibial fractures compared to ORIF. Other studies also confirmed hybrid external fixation as a suitable method for treatment of comminuted proximal tibial fractures. In addition, some authors introduced this method as a good to excellent technique for the treatment of distal femoral fractures. Hassankhani et al. evaluated hybrid fixation method efficacy for the treatment of open severe comminuted fractures of the distal femur in 30 patients. Their results were 64.7% excellent/good and 35.3% fair/poor (10). Our results were satisfactory in 82.6% of the patients with distal femoral fractures.

We found no significant correlation between functional score and union and between functional score and type of fracture (P = 0.179 and 0.887, respectively). Correlation between knee ROM and functional score was significant (P = 0.02). In addition, a significant correlation was confirmed within each group (P = 0.026: distal femoral fracture, P = 0.035: proximal tibia fracture). Correlation between age and functional score wasn't significant in distal femoral and proximal tibial fractures (P = 0.470 and P = 0.117 respectively). The correlations between functional score and union and between functional score and type of fracture weren't significant. Knee ROM and functional score had a significant correlation. Our study demonstrated that the hybrid external fixator is an effective method for the treatment of distal femoral and prox-

imal tibial fractures, but our results were better for the proximal tibial fractures than the distal femoral fractures.

Satisfactory results of hybrid external fixation in the treatment of tibia plateau fractures were reported in 85% (5), 50.85% (25), 38.9% (26), 76% (27), and 82% (18) of patients, while fair/poor results were reported in 15% (5), 61.1% (26), 45.76% (25), and 12% (18). Our findings showed satisfactory results (functional score ≤ 1) in 81% of the patients with the proximal tibial fractures. We found a lower rate of postoperative infections (4.8%) in patients with proximal tibial fractures than previously reported investigations. El-Alfy et al. (17), Watson et al. (28), Savolainen et al. (24), Babis et al. (5), and Gaudinez et al. (21) reported infection rates of 42%, 6.8%, 21%, 9.1%, and 25%, respectively. In addition, two DFF patients in our study (8.7%) developed pin-track infections. A previous study by Hutson and Zych observed an infection rate of 6.2% (15).

Previous studies of proximal tibial fracture treatment using hybrid external fixation observed malunion in one case (3.2%) (28), three cases (9%) (24), one case (3%) (5), and two cases (4%) (18). In our study, one patient's (4.8%) proximal tibial fracture was non-union and was treated with bone grafting. In contrast, three cases of malunion (13%) were found in distal femoral fractures. Low rates of nonunion in distal femoral fractures were reported using external fixators by Marsh et al. (29), Hutson and Zych (15), and Maini et al. (30). Ali and Saleh demonstrated external fixation as a definite choice in the treatment of fifteen nonunion distal femoral fractures (19). Malunion in distal femoral fractures resulted from a gap between fracture fragments, infection, bone loss, or extreme motions in the fracture site (19, 31-34). Although malunion may be associated with limb shortening, we didn't observe limb shortening in the malunion cases.

Knee range of motion (ROM) of 115 to 125 degrees was achieved in 95.2% of our patients with proximal tibial fractures. Other investigations reported a mean ROM of 115 degrees (32). El-Alfy et al. (17) described an average ROM of 114 degrees in patients with proximal tibial fractures. In addition, knee ROM was normal in 95.7% of patients with distal femoral fractures. Hassankhani et al. (10) and Hutson and Zych (15) showed a ROM of 87.5 degrees (30 - 115 degrees) and 0 - 92 degrees respectively. We determined normal alignment in 75% of our patients. We found that loss of reduction during follow up was the major cause of the malalignment in the remaining 25% of the patients. We conclude that closed reduction and hybrid external fixation is safe with low rates of postoperative complications, and can be used as a definitive treatment for severe comminuted fractures of the distal femur and proximal tibia, when the concomitant contusion of the skin and soft tissue damage prohibits safe open reduction and internal fixation.

This study had a few limitations. First, it was performed with short-term follow up. Because the results may worsen with time due to degenerative changes in the knee joint, a retrospective long term follow-up is advised. Second, we did not assess the incidence of associated ligament injuries that may affect the final function of the knee joint. Finally, some of the patients didn't carry out physiotherapy programs or performed them irregularly, which may also be a contributing factor to the final motion of their knee joints.

Acknowledgments

The authors would like to thank the deputy research office of Jundishapur University of Medical Sciences for its financial support. Also, we thank Dr. Cheraghian for his statistical analysis in this work. This study is based on the thesis of Samira Nabaeei with the code: u-90286, No.: 5/464.

Footnote

Authors' Contribution: Nasser Sarrafan designed the study; Seyed Abdolhossein Mehdinasab wrote and edited the manuscript and Samira Nabaeefard designed study and collected the data.

References

1. Kregor F, Zlowodzki M. In: Distal femur fractures. 1st ed. Stannard JP, Schmidt AH, Kregor PJ, editors. New York: Thieme medical publisher; 2007.
2. Marsh JL. In: Rockwood and green's fractures in adults. 7th ed. Bucholz RW, Hechman JD, Court-Brown CM, Tornetta P, editors. Philadelphia: Lippincott W; 2010. Tibial plateau fractures.
3. Smith TO, Hedges C, MacNair R, Schankat K, Wimhurst JA. The clinical and radiological outcomes of the LISS plate for distal femoral fractures: a systematic review. *Injury.* 2009;**40**(10):1049–63. doi: 10.1016/j.injury.2009.01.005. [PubMed: 19486966].
4. Schatzker J. In: The rationale of operative orthopaedic care. Schatzker J, Tile M, editors. New York: Springer-Verlag; 1988. pp. 279–95.Fractures of the tibial plateau.
5. Babis GC, Evangelopoulos DS, Kontovazenitis P, Nikolopoulos K, Soucacos PN. High energy tibial plateau fractures treated with hybrid external fixation. *J Orthop Surg Res.* 2011;**6**:35. doi: 10.1186/1749-799X-6-35. [PubMed: 21756337].
6. Walcher F, Frank J, Marzi I. Retrograde Nailing of Distal Femoral Fracture - Clear and Potential Indications. *Euro J Trauma.* 2000;**26**(4):155–68. doi: 10.1007/pl00002439.
7. Krettek C, Schandelmaier P, Miclau T, Bertram R, Holmes W, Tscherne H. Transarticular joint reconstruction and indirect plate osteosynthesis for complex distal supracondylar femoral fractures. *Injury.* 1997;**28 Suppl 1**:A31–41. [PubMed: 10897285].
8. Kumar A, Jasani V, Butt MS. Management of distal femoral fractures in elderly patients using retrograde titanium supracondylar nails. *Injury.* 2000;**31**(3):169–73. [PubMed: 10704581].

9. Leung KS, Shen WY, So WS, Mui LT, Grosse A. Interlocking intramedullary nailing for supracondylar and intercondylar fractures of the distal part of the femur. *J Bone Joint Surg Am.* 1991;**73**(3):332–40. [PubMed: 2002070].
10. Hassankhani EG, Birjandinejad A, Kashani FO, Hassankhani GG. Hybrid External Fixation for Open Severe Comminuted Fractures of the Distal Femur. *Surg Sci.* 2013;**04**(02):176–83. doi: 10.4236/ss.2013.42033.
11. Barei DP, Nork SE, Mills WJ, Henley MB, Benirschke SK. Complications associated with internal fixation of high-energy bicondylar tibial plateau fractures utilizing a two-incision technique. *J Orthop Trauma.* 2004;**18**(10):649–57. [PubMed: 15507817].
12. Apley AG. Fractures of the tibial plateau. *Orthop Clin North Am.* 1979;**10**(1):61–74. [PubMed: 450404].
13. Delamarter R, Hohl M. The cast brace and tibial plateau fractures. *Clin Orthop Relat Res.* 1989(242):26–31. [PubMed: 2706855].
14. Scotland T, Wardlaw D. The use of cast-bracing as treatment for fractures of the tibial plateau. *J Bone Joint Surg Br.* 1981;**63B**(4):575–8. [PubMed: 7298688].
15. Hutson JJ, Zych GA. Treatment of comminuted intraarticular distal femur fractures with limited internal and external tensioned wire fixation. *J Orthop Trauma.* 2000;**14**(6):405–13. [PubMed: 11001414].
16. Parekh AA, Smith WR, Silva S, Agudelo JF, Williams AE, Hak D, et al. Treatment of distal femur and proximal tibia fractures with external fixation followed by planned conversion to internal fixation. *J Trauma.* 2008;**64**(3):736–9. doi: 10.1097/TA.0b013e31804d492b. [PubMed: 18332816].
17. El-Alfy B, Othman A, Mansour E. Indirect reduction and hybrid external fixation in management of comminuted tibial plateau fractures. *Acta Orthop Belg.* 2011;**77**(3):349–54. [PubMed: 21846003].
18. Weiner LS, Kelley M, Yang E, Steuer J, Watnick N, Evans M, et al. The use of combination internal fixation and hybrid external fixation in severe proximal tibia fractures. *J Orthop Trauma.* 1995;**9**(3):244–50. [PubMed: 7623178].
19. Ali F, Saleh M. Treatment of distal femoral nonunions by external fixation with simultaneous length and alignment correction. *Injury.* 2002;**33**(2):127–34. [PubMed: 11890914].
20. Mahadeva D, Costa ML, Gaffey A. Open reduction and internal fixation versus hybrid fixation for bicondylar/severe tibial plateau fractures: a systematic review of the literature. *Arch Orthop Trauma Surg.* 2008;**128**(10):1169–75. doi: 10.1007/s00402-007-0520-7. [PubMed: 18175135].
21. Gaudinez RF, Mallik AR, Szporn M. Hybrid external fixation of comminuted tibial plateau fractures. *Clin Orthop Relat Res.* 1996(328):203–10. [PubMed: 8653958].
22. Hall JA, Beuerlein MJ, McKee MD, Canadian Orthopaedic Trauma S. Open reduction and internal fixation compared with circular fixator application for bicondylar tibial plateau fractures. Surgical technique. *J Bone Joint Surg Am.* 2009;**91 Suppl 2 Pt 1**:74–88. doi: 10.2106/JBJS.G.01165. [PubMed: 19255201].
23. Young MJ, Barrack RL. Complications of internal fixation of tibial plateau fractures. *Orthop Rev.* 1994;**23**(2):149–54. [PubMed: 8196973].
24. Savolainen VT, Pajarinen J, Hirvensalo E, Lindahl J. Hybrid external fixation in treatment of proximal tibial fractures: a good outcome in AO/ASIF type-C fractures. *Arch Orthop Trauma Surg.* 2010;**130**(7):897–901. doi: 10.1007/s00402-009-0931-8. [PubMed: 19582470].
25. Catagni MA, Ottaviani G, Maggioni M. Treatment strategies for complex fractures of the tibial plateau with external circular fixation and limited internal fixation. *J Trauma.* 2007;**63**(5):1043–53. doi: 10.1097/TA.0b013e3181238d88. [PubMed: 17993949].
26. Chin TY, Bardana D, Bailey M, Williamson OD, Miller R, Edwards ER, et al. Functional outcome of tibial plateau fractures treated with the fine-wire fixator. *Injury.* 2005;**36**(12):1467–75. doi: 10.1016/j.injury.2005.05.008. [PubMed: 16243333].
27. Katsenis D, Athanasiou V, Megas P, Tyllianakis M, Lambiris E. Minimal internal fixation augmented by small wire transfixion frames for high-energy tibial plateau fractures. *J Orthop Trauma.* 2005;**19**(4):241–8. [PubMed: 15795572].
28. Watson JT, Coufal C. Treatment of complex lateral plateau fractures using Ilizarov techniques. *Clin Orthop Relat Res.* 1998(353):97–106. [PubMed: 9728164].
29. Marsh JL, Jansen H, Yoong HK, Found EJ. Supracondylar fractures of the femur treated by external fixation. *J Orthop Trauma.* 1997;**11**(6):405–10. [PubMed: 9314146] discussion 411.
30. Maini L, Chadha M, Vishwanath J, Kapoor S, Mehtani A, Dhaon BK. The Ilizarov method in infected nonunion of fractures. *Injury.* 2000;**31**(7):509–17. doi: 10.1016/s0020-1383(00)00036-x.
31. Scuderi C, Ippolito A. Nonunion of supracondylar fractures of the femur. *J Int Coll Surg.* 1952;**17**(1):1–18. [PubMed: 14898109].
32. Mandt PR, Gershuni DH. Treatment of nonunion of fractures in the epiphyseal-metaphyseal region of long bones. *J Orthop Trauma.* 1987;**1**(2):141–51. [PubMed: 3333516].
33. Zum Brunnen C, Brindley H. Nonunion of the Shafts of the Long Bones. *Jama.* 1968;**203**(9):637. doi: 10.1001/jama.1968.03140090021005.
34. Whittle PA. In: Campbell's operative orthopeadics. 11th ed. Canal ET, Beaty JH, Daugherty LJ, editors. Philadelphia: Mosby; 2008. pp. 3146–15.Fractures of lower extremity.