International Journal of Research in Medical Sciences
Jahan A et al. Int J Res Med Sci. 2017 Oct;5(10):4582-4587
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20174601

Original Research Article

Treatment of high energy tibial plateau fractures with hybrid external fixator: intermediate term outcome

Alamgir Jahan[1], Muhammad Haseeb[2]*, Fahad Wazir[3]

[1]Medical Officer, J and K Health Services, Jammu and Kashmir, India
[2]Department of Orthopaedics, Government Medical College Jammu, India
[3]Resident Orthopaedics, Artemis Health Institute, New Delhi, India

Received: 11 August 2017
Accepted: 07 September 2017

***Correspondence:**
Dr. Muhammad Haseeb,
E-mail: quicksilver.hsb@gmail.com

ABSTRACT

Background: High energy tibial plateau fractures pose a management challenge because of the complexity of bone and soft tissue trauma. Because of the frequency and magnitude of soft tissue of soft tissue injury in these fractures, early internal fixation becomes difficult. Wound breakdown and deep infection are common complications in plating of these difficult fractures. Primary management with hybrid external fixator can be a useful alternative to internal fixation in such cases.
Methods: The study was a prospective case series done in the orhtopaedic department of a teaching hospital. 20 patients were studied. There were 13 Schatzker VI, 5 Schatzker V and 2 Schatzker IV fractures included. 4 patients had open fractures and 1 had compartment syndrome. Open fractures were operated in emergency department. Those with severe swelling and blisters were allowed few days to settle. Primary fixation using a hybrid external fixator was done. Mobilisation was started early. Patients were followed up to 1 year.
Results: Union was obtained in all patients within 18 weeks. There was only deep infection. 95% patients had range of motion of 90 degrees or more. No patient had an extensor lag.
Conclusions: Primary management of high energy tibial plateau fractures using hybrid external fixator is a reasonable option for cases that are not immediately amenable to internal fixation. It provides adequate stabilization to allow early motion and hastens patient rehabilitation. We have a good experience with this technique and recommend it for judicious use.

Keywords: Hybrid fixator, Schatzker, Soft tissue, Tibial plateau

INTRODUCTION

Tibial plateau fractures are peculiar in that they vary in complexity from relatively straightforward, low energy injuries to comminuted, high energy fractures with bad soft tissue status.[1] Schatzker, in 1979, introduced his classification system, which differentiates tibial plateau fractures in order or increasing complexity.[2] Thus, Schatzker V and VI represent a subset of fractures which are caused by a high energy mechanism, primarily axial loading with added angular force.[3] The high energy also takes toll on the skin and soft tissue overlying the proximal tibia in the form of extreme swelling, blebs and compartment syndrome.[1] Open injuries are also not uncommon, and can make even a relatively simple split fracture inappropriate for internal fixation.[4] Surgery of these complex tibial plateau fractures is fraught with the risk of complications like wound breakdown and deep

infection. Standard plating of tibial plateau fractures involves significant soft tissue dissection, which can prove devastating in already compromised soft tissues.[5-7] At the same time, early stabilization of the fracture is necessary for healing and restoration of function of the limb.

Hybrid external fixators combine the benefit of least disruption of soft tissue and good fracture stability, and hence are an attractive option in high energy tibial plateau fractures.[8] Although a special design is available from various manufacturers, the same can also be built with existing fixator systems at a much-reduced cost. The term 'hybrid' denotes a fusion of the conventional threaded pin fixator and the tensioned wire "Ilizarov" type ring fixator. The condyles are stabilized with tensioned wires and a ring/half ring with additional percutaneous screws/limited internal fixation as necessary, and the construct is connected to a monolateral pin fixator on the shaft. This fixation allows stabilization of high energy fractures with minimal operative trauma to soft tissues, preserving critical blood supply, encouraging early use of the limb and weight bearing, and permits simultaneous wound care if any.[9] We used this technique in a series of patients to study the intermediate term outcomes.

METHODS

The study was a prospective design case series and done in the orthopaedic department of a teaching hospital between May 2013 and April 2015. Approval from the institutional ethics committee was sought beforehand. The patients selected for this study had intra-articular tibial plateau fractures with severe soft tissue injury (Tscherne grade2/3) or open grade 3 fractures precluding immediate internal fixation. Fractures with associated vascular injury were excluded from the study.

We studied 20 patients in all. 17 were males (85%). The patient age varied from 25 to 60 years with mean age 37.9 years. 14 patients (70%) were between 20 and 40 years of age. All patients had sustained injury following motor vehicle accidents.

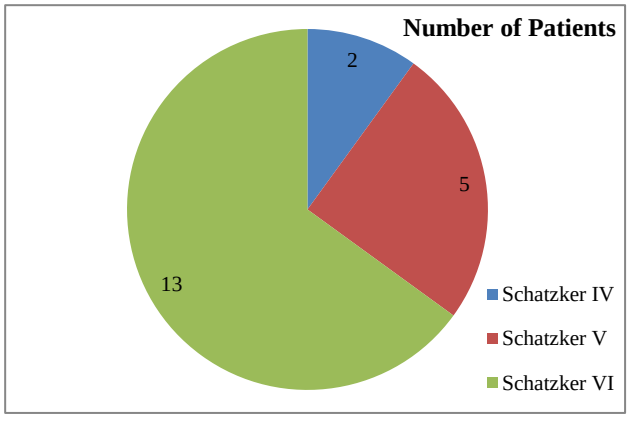

Figure 1: Distribution of fracture types.

Initial management was directed at assessing the patient in general and excluding other systemic injuries. The limb was splinted, and radiographs of the knee were obtained. The Schatzker (S) class of the fracture was decided on the X ray picture. There were 13 S-VI (65%), 5 S-V (25%) and 2 S-IV (10%) fractures (Figure 1). 4 patients had open fractures, all of whom were Gustilo grade 3. One patient had a compartment syndrome. 5 patients had associated skeletal injuries: 1 fracture contralateral leg bones, 1 contralaeral 5TH metatarsal fracture, 1 Colles fracture, 1 ipsilateral hip dislocations, 1 contralateral distal femur fracture. All these injuries were also managed simultaneously. CT scans of the proximal tibia were also obtained prior to surgery to better delineate fracture morphology and help in proper reduction/stabilization.

Surgery was undertaken in the emergency department in patients with open fractures, or with compartment syndrome. In the rest, a few days were allowed for the soft tissue to recover, and blisters/blebs to settle. Operation was carried out on a radiolucent table under spinal anesthesia in all our patients. Meticulous wound debridement was carried out first in open injuries. Fractures were reduced by manual traction/manipulation, and then stabilized with the hybrid external frame. In 2-cases we used percutaneous 6.5mm cancellous screws to compress the condyles together before applying the fixator. In case satisfactory closed reduction could not be achieved, a minimal open reduction was done and the fragment elevated/manipulated using a blunt surface of a long curette, and fixed provisionally with K-wires. Two 1.8mm olive wires were then introduced in the condyles of the tibia 15mm below the joint, angled at least 60 degrees from each other, and passed through the safe zones at the level of the fibular head. They were secured to an 5/8th ring of appropriate size and then tensioned to compress the condyles against each other. Tensioning was done to 1400N. In 2 patients with large condylar fragments with S-VI fractures, a drop wire was placed below the ring to further stabilize the proximal fragment. After reconstituting the articular block, two or three 4.5mm cortical Shanz pins were placed into the diaphysis of the distal fragment anteriorly, and connected with a tubular rod. The metaphyseal fracture was then reduced accurately, and the epiphyseal and diaphyseal assemblies connected. Reduction was confirmed under image and the pin sites and wounds dressed. A single incision fasciotomy was done in the patient with compartment syndrome. Prophylactic antibiotics were given in all patients.

The first dressing was done on the 2nd post-operative day, following which the patients were taught knee mobilization and range of motion exercises by the residents in the ward. Patients were discharged between the 5th and 15th postoperative day, and taught pin site care. Progressive joint motion was encouraged. Partial weight bearing was initiated at 8 weeks, and increased gradually thereafter as per the progression of fracture

healing on X rays. Fixator dynamisation was done 4 weeks prior to removal, when full weight bearing was advised. X rays were obtained at 6 weeks, 3 months, 6 months and 1-year post surgery, and clinical results recorded and rated on a 100-point scale (Modified Insall Knee score.[10] Complications if any were also noted.

RESULTS

All patients were followed for 1 year. All fractures united in an average 12.6 weeks in our study (10-18 weeks) (Figure 2). The average duration of fixator use was also the same. Varus malunion of 10 degrees was seen in 2 patients. 17 patients (85%) had a condylar widening of less than 5mm; the mean condylar wideing was 3.7mm.

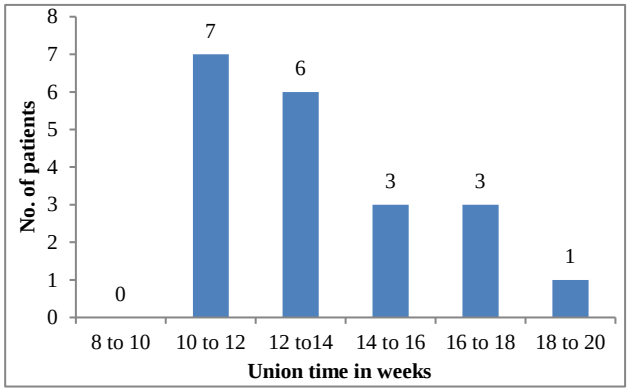

Figure 2: Union times in weeks.

The range of motion at 1 year follow up was 0 to beyond 90 degrees or more in 19 patints (95%). 10 patients had a range of 120 degrees or more. There were no patients with an extensor lag (Figure 3).

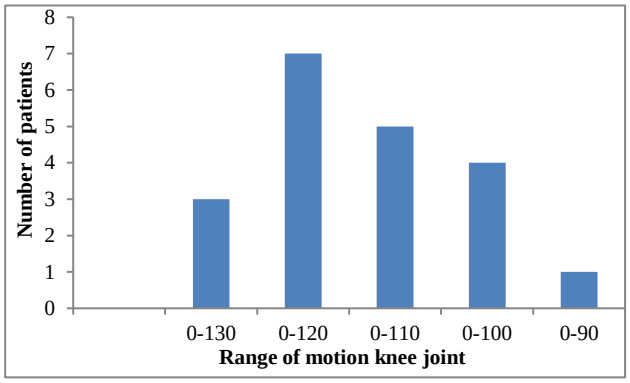

Figure 3: Range of motion at follow up.

Degenerative changes in the knee at the end of 1 year were also noted and graded according to the system developed my Marsh et al.

5 patients (25%) were classified to have grade 1 degeneration of their knee, and 1 patient (5%) had a grade 2 degeneration. The rest did not have any evidence of degeneration.

Superficial wound infection occurred in 2 patients. Pin sites got infected in 3 patients (15%), but were overcome with vigorous pin site care and did not require change of pins. One patient had deep infection that required surgical debridement, and antibiotic cement beads, but no modification of the fixator. There were no incidences of septic arthritis, nerve or vessel injury.

Figure 4: AP and lateral views of a Schatzker VI tibial plateau fracture.

Figure 5: Despite innocuous looking X ray, this was the clinical picture of the same patient.

Figure 6: Post-operative radiographs after debridement and hybrid external fixation.

The results were good or excellent (Insall score 80 or more) in 15 patients. 1 patient had a poor score (<70) and 4 had a fair score (70-79). The average score was 82.5.

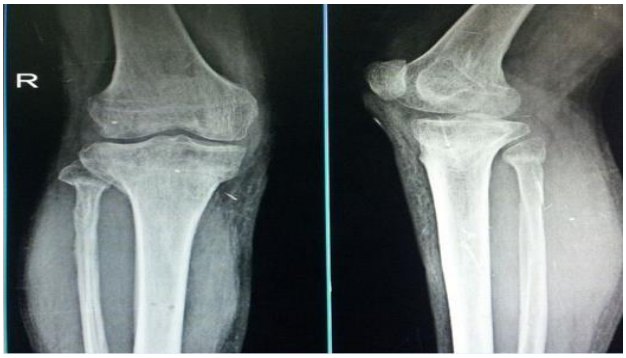

Figure 7: Radiographs at union, showing a well aligned knee joint.

Figure 8: Function at one year follow up.

DISCUSSION

The fact is well established that a healthy soft tissue envelope is indispensable to successful healing of a fracture.[11] Tibial plateau fractures, especially S-V and S-VI are high energy fractures that are frequently associated with a compromised soft tissue.

Operating early through such a field may spell disaster for the patient (and surgeon!), given the high risk of wound breakdown and deep infection.[1,5,6,12] It may be argued that such patients are better off without surgery, and indeed these fractures have been managed non operatively by some.[13] Tscherne himself treated tibial plateau fractures conservatively, and compared them with an operated group.[14] He found that non operatively treated patients had decreased range of motion and higher rates of malunion. Internal fixation with plates has been the gold standard of treatment of these fractures, but when operating through compromised soft tissue complication rates increase substantially; more so when using dual plates in unstable bicondylar (S-VI) fractures.[15,16] Such complications may result in an unsatisfactory result despite good reduction and stabilization.[17] Deep infection rate in primary dual plating has been as high as 80% in some studies.[2,7] Using a single lateral locked plate with the idea of decreasing the quantum of surgical trauma may be inadequate for S_VI fractures, leading to varus collapse, malunion and implant failure.[18,19]

Joint spanning external fixators have been used as temporizing devices to stabilize high energy tibial plateau fractures and buy time for soft tissue healing. Although a well-documented technique, it lengthens the treatment and delays patient rehabilitation. It has also shown by some to increase the chance of infection.[20,21] The fixation method presently being studied, however, combines the benefits of minimal soft tissue trauma, and adequate stabilization of the fracture so that mobilization may be begun soon after surgery and the patient well rehabilitated in the process. Hybrid fixators are also valuable when the articular fragment is small and unsuitable for internal fixation with plates and screws.

Many studies have shown hybrid fixators to be effective in treating these complex fractures. Gaudinez et al. treated 18 S-V and S-VI fractures using a hybrid frame, recommended this technique because of low incidence of soft tissue complications and ease of early joint motion.[22] Catagni et al also tretated S-V and S-VI fractures using this technique and obtained 50.85% excellent and 45.76% good results I their series. Our study had an overall 75% good or excellent result based on the 100 piint rating scale (modified Insall), which is comparable to other studies.

The number of open fractures in our group was 4 out of 20 patients. All four of them progressed to union albeit with a fair result. Gaudinez et al also reported fair results in their subset with open fractures.

The average range of motion was 113 degrees, with full extension in all patients. Kumar et al and David et al reported average ranges of knee joint motion of 103 and 107 degrees respectively in their patients treated with tensioned wire fixators.[24]

A frequent problem with this treatment method is pin site infection. Huston et al in meta-analysis of a total of 381 patients found a pin tract infection rate of 10%.[25] 3 out of 20 patients in our series had pin site infection (15%). The higher rate may be because we operated patients with pre-existing bad skin, and also had 4 open fractures in our group. Babis et al reported a pin track infection rate of 9.1%.[9] All pin track infections in our series were managed with local dressings and antibiotics and healed without need for pin change. We had deep infection in one patient (5%). No patient developed septic arthritis which is caused by inadvertent introduction of pin through joint capsule.

The average knee score in our series was 82.5, which compares favourably with various other such series (Mikulak et al: 80.2; Kumar et al: 73).[24,26] The limitation of the study, A small sample size which have rendered our statistics less than accurate and decreased the power of our study. A short follow up period, because of which the fate of the joint in terms of degeneration and long-term function could not be assessed.

CONCLUSION

High energy tibial plateau fractures pose management challenges because of the complexity of the bony and soft tissue injury. Internal fixation can lead to bad outcomes if done through unfavourable skin in S-V and S-VI and grade 3 open fractures. The hybrid external fixator is a very good treatment modality to tackle such fractures. It allows good reduction, adequate stabilization and early knee mobilization which are the goals of any operative fracture management modality. It is complicated by the need to meticulously care for the pins during the period of fixator wear, and relatively frequent pin site infections, but we think they are nothing compared to the risk of deep infection, skin necrosis and bad outcomes that are possible with open surgery. We recommend hybrid external fixators for such complex tibial plateau fractures.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Oestern HJ, Tscherne H. Pathophysiology and Classification of Soft Tissue Injuries Associated with Fractures. In Fractures with Soft Tissue Injuries, Springer-Verlag. Edited by: Tscherne H, Gotzen L. Berlin; 1984:1-9.
2. Schatzker J, McBroom R, Bruce D. The tibial plateau fracture: the Toronto experience 1968–1975. Clin Orthop.1979;138:94-104.
3. Coval DJ, Fowble CD, Foster TE, Whitelaw GP. Bicondylar tibial plateau fractures: Principles of treatment. Contemp Orthop. 1994;28:115-22.
4. Swiontkowski MF, Bucholz RWL. Knee and Leg Trauma: Bone Trauma. In: Orthopaedic Knowledge Update 4, American Academy of Orthopaedic Surgeons. Edited by: Frymoyer JW. Rosemont. 1993:579-92.
5. 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;18:649-57.
6. Waddell JP, Johnston DW, Neidre A. Fractures of the tibial plateau: a review of ninety-five patients and comparison of treatment methods. J Trauma. 1981;21:376-81.
7. Young MJ, Barrack RL. Complications of internal fixation of tibial plateau fractures. Orthop Review. 1994;23:149-54.
8. Ariffin HM, Mahdi NM, Rhani SA, Baharudin A, Shukur MH. Modified hybrid fixator for high-energy Schatzker V and VI tibial plateau fractures. Strategies Trauma Limb Reconstr. 2011;6(1):21-6.
9. 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 Jul 14;6:35
10. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res. 1989;(248):13-4.
11. Rommens PM, Broos PL. The significance of soft tissue trauma for fracture healing. A prospective study on 70 tibial shaft fractures following primary treatment with the Monofixateur. Unfallchirurg. 1992;95(3):133-41.
12. Marsh JL. Tibial plateau fractures. In: Bucholz RW, Court-Brown CM, Heckman, Tornetta P (eds) Rockwood and Green's Fractures in Adults. 7th edn. Lippincott Williams and Wilkins, Philadelphia; 1780-831.
13. Delamarter R, Hohl M. The cast brace and tibial plateau fractures. Clin Orthop Relat Res. 1989; 242:26-31.
14. Tscherne H, Obenhofferm P. Tibia1 plateau fractures. Management and expected results. Clin Orthop Relat Res. 1993;292:87-100.
15. Blokker CP, Rorabeck CH, Bourne RB. Tibial plateau fractures. An analysis of the results of treatment in 60 patients. Clin Orthop Relat Res. 1984;182:193-9.
16. Coval DJ, Fowble CD, Foster TE, Whitelaw GP. Bicondylar tibial plateau fractures: Principles of treatment. Contemp Orthop. 1994;28:115-22.
17. Weigel DP, Marsh JL. High-energy fractures of the tibial plateau. Knee function after longer follow-up. J Bone Joint Surg Am. 2002;84:1541-51.
18. Higgins TF, Klatt J, Bachus KN. Biomechanical Analysis of Bicondylar Tibial Plateau Fixation: How Does Lateral Locking Plate Fixation Compare to Dual Plate Fixation? J Orthop Trauma. 2007; 21:301-6.
19. Gosling T, Schandelmaier P, Muller M, Hankemeier S, Wagner M, Krettek C. Single lateral locked screw plating of bicondylar tibial plateau fractures. Clin Orthop Relat Res. 2005;439:207-14.
20. Laible C, Earl-Royal E, Davidovitch R, Walsh M, Egol KA. Infection after spanning external fixation for high-energy tibial plateau fractures: is pin site-plate overlap a problem? J Orthop Trauma. 2012;26(2):92-7.
21. Haller JM, Holt D, Rothberg DL, Kubiak EN, Higgins TF. Does Early versus Delayed Spanning External Fixation Impact Complication Rates for High-energy Tibial Plateau and Plafond Fractures?. Clinical Orthopaedics and Related Research®. 2016;474(6):1436-44.
22. Gaudinez RF, Mallik AR, Szporn M. Hybrid external fixation of comminuted tibial plateau fractures. Clin Orthop. 1996;328:203-10.
23. 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;63:1043-53.
24. Kumar A, Whittle AP. Treatment of complex (Schatzker Type VI) fractures of the tibial plateau

with circular wire external fixation: retrospective case review. J Orthop Trauma. 2000 Jun-Jul;14(5):339-44.
25. Hutson JJ, Zych GA. Infections in periarticular fractures of the lower extremity treated with tension wires hybrid fixators. J Orthop Trauma. 1998;12:214-8.
26. Mikulak SA, Gold SM, Zinar DM. Small wire external fixation of high energy tibial plateau fractures. Clin Orthop. 1998;50:230-8.

Cite this article as: Jahan A, Haseeb M, Wazir F. Treatment of high energy tibial plateau fractures with hybrid external fixator: intermediate term outcome. Int J Res Med Sci 2017;5:4582-7.