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HIGH ENERGY COMPLEX PROXIMAL TIBIAL FRACTURES MANAGED BY HYBRID EXTERNAL FIXATOR

Orthopaedics

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ABSTRACT

Introduction: The proximal tibial fractures are associated with high energy trauma and present with difficulty in treatment due to poor soft tissue condition. In our study, we have operated 20 patients with hybrid external fixator as definitive treatment of these fractures. This technique gives good reduction, adequate stability, early mobilization and less complications in patients with high energy proximal tibial fractures.

Aim: To assess the functional and radiological outcome of hybrid external fixator in proximal tibial fractures.

Material and Methods: The study was conducted in Institute of Orthopaedics and Traumatology, Madras Medical College between January 2016 to March 2018. Institutional ethical committee approval obtained. It is an analysis of 20 patients treated with hybrid external fixator for compound proximal tibial fractures with or without compartment syndrome. In our study Schatzker classification was used to classify the proximal tibia fracture pattern, the soft tissue injury was classified by Gustilo Anderson classification and functional outcome was analyzed using Rasmussens Scoring for knee and Karlson and Peterson Ankle Scoring.

Results: In our study, road traffic accident was the most common mode of injury. Males (86%) are most commonly affected than female (14%) in the ratio of 5:1.The mean age was 40 years. Mean time for fracture union was 20 weeks which ranges from 16 weeks to 32 weeks. Functional scoring of knee by Rasmussen's criteria shows that excellent in 8 patients (40%), good in 6 patients (30%), fair in 4 patients (20%) and poor in 2 patients (10%). Overall 70% patients had acceptable outcome. Most common complication encountered in our study was pin tract infection (grade 1 to 3 according to Checketts-Otterburns classification) followed by 2 patients had varus malunion and 1 patient went for delayed union.

Conclusion: Hybrid external fixator is a simple and effective way to treat compound proximal tibial fractures with a low complication rate and good clinical outcomes were internal fixation is contraindicated.

KEYWORDS

Proximal tibial fracture, High energy tibial plateau fracture, Complex proximal tibial fracture, Hybrid external fixator, Compound tibial fractures, Schatzker classification.

INTRODUCTION:

Proximal tibial periarticular fractures are usually caused by high energy trauma with severe soft tissue damage and poses challenge to operating surgeon. They usually result from axial loading combined with varus and valgus forces, leading to medial or lateral compartment fracture with comminution of articular surface.[1] Schatzker classification system[2], widely classifies them into six types, out of which the type V (bicondylar) and type VI (bicondylar with diaphyseal discontinuity) are the most severe injury patterns, almost always caused by high energy trauma and associated with high incidence of complications because of associated soft tissue damage. CT scan is useful in the evaluation of the size, comminution and orientation of articular fragments, allowing proper classification and preoperative planning.[3]

The goal of treatment of such fracture treatment is the anatomical restoration of the articular surface so that post traumatic arthritis is prevented, minimal handling of compromised soft tissue cover and stable fixation to allow early mobilization so that joint stiffness is prevented.

The choice of treatment depends upon age of the patient, medical condition, fracture pattern, degree of fracture displacement and condition of the overlying soft tissue cover, associated bony injuries and any neurovascular complications. Closed management of these injuries has proven ineffective and associated with many complication related to malreduction. Open reduction and internal fixation with plates and screws has been termed as the 'gold standard' treatment for these fractures which gives an accurate anatomic reduction of the joint surface which is stable enough to allow early mobilization. But these modalities of internal fixation, especially with a compromised soft tissue and high profile implants, have been associated with high rates of complications such as deep infection and wound dehiscence.[4]

To avoid these difficulties, Hybrid external fixator which act by ligamentotaxis principle has been evaluated in many studies of comminuted complex tibial plateau fractures and this gives quite encouraging results as it combines the benefit of least disruption of soft tissue and good fracture stability, allowing early mobilization.[5,6,7,8,9]

The purpose of this study is to assess the functional and radiological outcome of hybrid external fixator in complex proximal tibial fractures.

MATERIALS AND METHOD:

The study was conducted in Institute Of Orthopaedics and Traumatology, Madras Medical College, Rajiv Gandhi Government General Hospital Chennai. Study period was between January 2016 and March 2018. Patient in the age group of 18 to 65 years with proximal tibial periarticular fractures (Schatzker type IV,V,VI) with soft tissue problems like compound fractures and compartment syndromes are included in this study. Patients with neurovascular injury, pathological fractures, severe systemic illness and any other medical contraindication for surgery are excluded from this study.

Totally 20 patients with high energy proximal tibial fractures were included. Initially airway breathing and circulation are assessed. The injured limb was immobilized in Thomas splint. Management was directed after assessing the patient general condition and excluding other systemic injuries. Radiographs of the knee and ankle were obtained. CT scans of the proximal tibia were also obtained prior to surgery to better delineate fracture morphology and help in fracture reduction. The fractures were classified by using Schatzker classification and open fractures were classified by Gustilo Anderson classification. Condition of the soft tissue was evaluated and development of compartment syndrome was cautiously watched in clinically in high energy fractures. Open fractures up to grade II compound are given thorough wound wash, debrided and stabilized with above knee slab. In case of Grade IIIA & B compound fractures thorough wound wash and debridement has been done and stabilized with AO tubular external fixator with traction.

Broad spectrum intravenous antibiotics were administered in the emergency department and subsequently replaced according to the

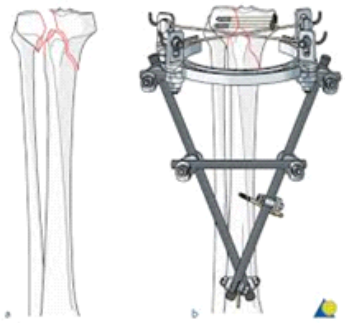
cultures results. Tetanus immunoglobulin was administered according to the protocol. If there was a clinical suspicion of compartment syndrome, individual compartment pressures were measured by whitesides technique and differential pressure calculated. If the differential pressure was below 30 mm of Hg and there was clinical evidence of comportment syndrome, then two incision fasciotomy has been done and all four compartments released. The fracture is stabilized with AO tubular external fixator.

Surgical technique:

Operation was carried out on a radiolucent table under general / spinal anesthesia in all our patients. Fractures were reduced by manual traction/manipulation, and then stabilized with the hybrid external frame. 6.5mm cancellous screws used percutaneously to compress the condyles together if possible. If no satisfactory closed reduction was achieved then a minimal open reduction was done and the fragment elevated/manipulated using a small blunt instruments, and fixed with K-wires. Extensile approach have never been performed.

Two 1.8mm olive wires were then introduced in the condyles of the tibia 14mm below the joint line, angled at least 60 degrees from each other, and passed through the safe zones at the level of the fibular head under C-arm guidance. If needed another one K wire was used to stabilize the condyles. They were secured to the 5/8th ring of appropriate size and then tensioned to compress the condyles against each other. Fracture reduction and articular surface elevation confirmed under C-arm guidance by taking anteroposterior, lateral, 15 degree caudal, and two oblique views. A 10–15 degree caudally tilted plateau view was used to assess articular step off because of the 10–15-degree posterior slope of the tibial articular surface.

After reconstituting the articular block, two or three 4.5mm cortical Schanz pins were placed into the diaphysis of the distal fragment anteromedially, and connected with a tubular rod. The metaphyseal fracture was then reduced accurately, and the metaphyseal and diaphyseal assemblies connected. If there is instability with single rod two more rods one on either side was connected as shown in **case 2 fig 6**. Reduction was confirmed under image. SSG with or without flap cover were done at the same setting by the plastic surgeon.



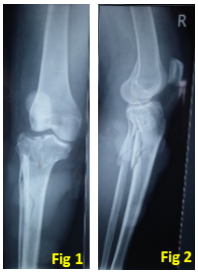
Ref: Hans Christoph Pape, Pol M Rommens; AO principle of fracture management AO Surgery Reference - AO Foundation

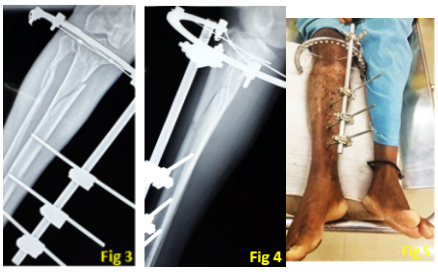
Post op care:

Intravenous antibiotics were continued for three days and oral antibiotics was given for 10 days and it is continued as needed according to culture reports. Patient taught about pin site care. Our Physiotherapy protocol - Quadriceps strengthening exercise started on day 1. Knee and ankle ROM exercise started on day 2. Mobilization with non weight bearing walking or tip toe weight bearing started depending upon fracture pattern, stability and if other associated injury permits. Early ROM should not be at the cost of producing proximal wire inflammation which will lead to pin site infection.

Follow up:

Patient was discharged in one or two weeks and reviewed every 4 weeks with x ray of knee joint to evaluated for secondary fracture displacement, loss of fixation, articular/metaphyseal union, mechanical axis deviation. Partial weight bearing advised when callus start to appear radiologically and full weight bearing after fracture got united. Functional assessment of knee and ankle was done with Modified Knee Society Score and Karlson and Peterson Ankle Scoring System respectively. Ankle functional outcome was evaluated separately because muscles for ankle movements originate from proximal tibia and distal femur and also in our study there are patients with associated ankle fractures, hence ankle functional assessment is used. With every follow up patient was encouraged to mobilize the knee and ankle joint. Wire tension and pin site infection was checked at follow-up visits. If tension is less manual wire tensioning is done as necessary. Absence of pain on springing or on walking indicates full clinical union on manipulation and radiological evidence of three cortical union is noted hybrid external fixator was dynamized by loosening the nut connected to the rod. Frame removal was commonly performed after two to three weeks of dynamization in outpatient clinic and supported with patella tendon bearing cast for another two weeks. Patients are followed up for 1 year.





CASE:1 Fig 1 & 2) was the pre op x ray shows Type VI tibial plateau fracture; **3 & 4)** Immediate post op x ray with hybrid external fixator with acceptable reduction; **5)** Clinical picture of hybrid external fixator; **6 & 7)** shows 20 weeks post op x ray with good fracture consolidation; **8 & 9)** was the 1 yr post op x ray; **10)** the excellent functional outcome at 1 year follow up.

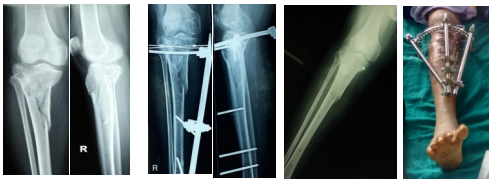
RESULTS:

Bony union, range of motion and associated complications of the treatment were assessed.

Patients in fourth decade (8 patients) are most commonly affected and mean age group of 40 years. Males (86%) are most commonly affected than female (14%) in the ratio of 5:1.

In our study Road traffic accident (93%) was the most common mode of injury and two patients had fracture due to fall of metal pipe and wall collapse.

11 of our patients sustained type VI tibial plateau fracture and 6 patients had type IV tibial plateau and 3 patients has type V tibial plateau fractures as per schatzker classification. Type VI fractures had worst outcome due to difficulty in reconstruction the articular surface. 16 patients (85%) sustained compound injuries and 4 patients (20%) had closed injuries. Of the compound injuries Grade I - 6, Grade II – 8, Grade III A - 1 and Grade IIIB – 14. All the wounds healed within 10 to 14 days with primary intention and one patient with Grade –IIIB had soft tissue defect which needed gastronemius based flap cover and in the same sitting conversion of external fixator to hybrid external fixator was done.



hybrid external fixator with good fracture consolidation;

CASE: 2 Fig 1 & 2) pre op x ray of type 4 tibial plateau fracture; 3 & 4) 20 weeks follow up x ray with hybrid external fixator with good fracture consolidation; 5) 9 months follow up; 6) clinical picture with hybrid external fixator

5 of our patients (25%) had compartment syndrome of which 1 patient had grade 1 compound injury and 4 patients had closed injury. All of them presented after 6 hours of development of comportment syndrome so fasciotomy was done along with knee spanning external fixator on the same day of admission. For 14 of our patients AO tubular knee spanning external fixator has been applied on the day of admission for wound management and converted to hybrid External fixator by 10 to 14 days. Minimal internal fixation with 6.5 mm cancellous screw has been done in three cases.

8 of our patients sustained associated injury of other parts of the body. 3 patients had clavicle fracture and 2 patients had ipsilateral medial malleolus fracture and 1 patient had ipsilateal shaft of femur fracture, 1 patient had both bone fracture of opposite leg and 1 patient had lisfranc injury. All associated fractures are treated simultaneously.

Mean time for fracture union was 20 weeks which ranges from 16 weeks to 32 weeks. Many of the cases took long time to unite because they are compound and comminuted fracture which resulted in loss of fracture hematoma and periosteal stripping. Secondary procedure was done in 6 patients, of which Split skin graft in 5 patients and 1 patient underwent bone grafting for delayed union which went on for union at 32 weeks.

Most common complication encountered in our study was pin tract infection (grade 1 to 3 according to Checketts-Otterburns classification) followed by 2 patients had varus malunion and 1 patient went for delayed union. Pin tract infection settled with adequate oral antibiotics after culture and sensitivity and proper care of pint tract with povidone iodine solution. For none of the cases pin or wire revision was needed. Loss of reduction was found in one case which went for unacceptable varus deformity since the patient was not compliant with the postoperative protocol and frequent follow-up as advised. Another patient had severe comminution of proximal tibia with articular involvement, hence articular and metaphyseal reconstruction could not be done leading to varus deformity. For these patients corrective osteotomy/ replacement is planned at later stage.

There were no cases of soft tissue breakdown or osteomyelitis. None of the patients developed vascular injury or common peroneal nerve injury related to inadvertent Kirschner wire penetration. Ligament reconstruction was not done in any patients as they have not complained any instability.

Mean knee range of movement attained was 100 degrees and there were 2 cases of 10 degrees extensor lag. Functional scoring of knee by Rasmussen's criteria shows that excellent in 8 patients (40%), good in 6 patients (30%), fair in 4 patients (20%) and poor in 2 patients (10%). Scoring of ankle by Karlson and Peterson scoring shows that 18 patients (87%) had acceptable functional outcome and 2 patients (13%) had unacceptable functional outcome. Unacceptable outcomes are in patients with associated ankle fractures and in type VI tibial plateau fracture patients.

DISCUSSION:

High energy tibial plateau fracture is defined based on the presence of large degree of articular depression, displaced multiple condylar fracture lines and metaphyseal comminution or extension in association with open injuries or extensive soft tissue injury. These injuries were also designed as severe or complex fractures.[8]

Open reduction and internal fixation with plates and screws has been termed as the "gold standard" treatment for these fractures so as to achieve a precise anatomic reduction of the joint surface which is solid enough to allow early mobilization; but these modalities of internal fixation, especially with a compromised soft tissue envelope and bulky metallic hardware, have been associated with complications.[4]

The importance of the soft-tissue envelope in the healing of plateau fractures has been analyzed in the literature and a correlation of poor results with severely damaged soft-tissues has already been established.[10] High energy trauma is considered as a major cause of poor results in the treatment of tibial plateau fractures. Different methods for treating these complex injuries have been proposed, including limited open reduction and stabilization with percutaneous screws, open reduction and internal fixation[11-14] and indirect reduction and application of a hybrid[15-17] or a circular external fixation device.[18,19]

The development of circular and hybrid frames, the capability of axial, lateral compression and dynamization, the development of olive wires have offered new possibilities to the external fixators for the treatment of complex fractures.[20] Gaudinez et al treated 18 type V and type VI fractures using a hybrid frame, recommended this technique because of low incidence of soft tissue complications and early knee range of motion. He recommended this technique for treatment of these difficult fractures.[21] Chin et al presented 38.9% good/excellent, and 61.1% fair/poor results in his type V and VI fracture series.[22] Catagni et al, in their series of high-energy Schatzker V and VI tibial plateau fractures treated with circular external fixator, reported excellent and good results in 30 (50.85%) and 27 (45.76%) patients respectively.[14] Our study had an overall 70% acceptable outcome which is comparable to other studies.

Mean time for fracture union was 20 weeks which ranges from 16 weeks to 32 weeks. This is comparable with the study by Babis et al, in their series mean radiological union was 27 months (range 24 to 36 months). The time taken for union depends on the type of fracture[23]. The average range of motion attained was 100 degrees, with full extension in 13 patients and 10 degree extension lag in 2 patients. Kumar et al [24] reported average ranges of knee joint motion of 103 and 107 degrees respectively in their patients treated with tensioned wire fixation which is comparable with our study.

A common problem with this method of treatment is in pin site infection. Hutson et al, in his study of 145 fractures, Nineteen (13 percent) were complicated by infection. Infections presented as pin tract inflammation requiring intravenous antibiotics (seven), deep infection requiring debridement and removal (five), septic arthritis (three), deep fracture infection (three), and necrotizing fasciitis (one).[25] 10 out of 15 patients in our series had pin site infection (66%). The higher rate may be because we operated patients with pre-existing bad skin, and also had 11 open fractures in our group and also poor socio-economic status of the patients. Babies et al reported a pin track infection rate 9.1%.[23] All pin track infections in our series were managed with local dressings and antibiotics and healed without need for pin change. No patient developed septic arthritis which is caused by inadvertent introduction of pin through joint capsule.

CONCLUSION:

Hybrid external fixator is an acceptable alternative method for definitive fixation of proximal tibial fractures. It has been shown to provide adequate stability to maintain fracture alignment without the need of massive soft tissue dissection, hence minimizing the potential soft tissue complications. It provides lower rate of infection, good range of motion and decreases the disability especially in high energy trauma where the skin condition is compromised. The main disadvantage of Hybrid external fixator is when there is sever articular comminution maintaining the articular fragments are difficult with or

without screw fixation leading to articular collapse. We believe it is appropriate for treatment of these complex tibial fractures, especially in patients with a poor soft-tissue envelope.

BIBLIOGRAPHY:

1. Eggi S, Hartel MJ, MD S, Haupt U, Exadaktylos AK, Roder C, Unstable Bicondylar Tibial Plateau Fractures: A Clinical Investigation.J Orthop Trauma 2008, 22:673-679.
2. Schatzker J,Mc Broom R, Bruce D: The tibial Plateau Fracture: The Toronto Experience (1968-1975). Clin Orthop Relat Res 1979, 138: 94-104.
3. Hackl W, Riedl J, Reichkendler M, Benedetto KP, Freund M, Bale R, Preoperative computerized tomography diagnosis of fractures of the tibial plateau. Unfallchiurg 2001, 104:519- 523.
4. Ruffolo MR, Gettys FK, Montijo HE, Seymour RB, Karunakar MA. Complications of high-energy bicondylar tibial plateau fractures treated with dual plating through 2 incisions. J Orthop Trauma. 2015;29:85–90.
5. Gaudinez RF, Mallik AR, Szporn M. Hybrid external fixation of comminuted tibial plateau fractures. Clin Orthop. 1996;328:203-10.
6. Harpreet Singh, RakeshKumarMisra, Manjinder Kaur, Management of Proximal Tibia Fractures Using Wire Based Circular External Fixator, Journal of Clinical and Diagnostic Research. 2015 Sep, Vol-9(9): RC01-RC04
7. Piper KJ, Won HY, Ellis AM. Hybrid external fixation in complex tibial plateau fractures and plafond fractures: An Australian audit of outcomes. Injury. 2005:36:178-84.
8. Watson JT, Ripple S, Hoshaw SJ, Fhyrie D. Hybrid external fixation for tibial plateau fractures: Clinical and biomechanical correlation. Orthop Clin North Am. 2002;33:199–209.
9. Aseri MK, Ankur Gupta, Dr. Uukhtiyar Khilji. Role of hybrid external fixator in proximal tibial fractures: A prospective analysis, International Journal of Orthopaedics Sciences 2017; 3(1): 810- 13.
10. Delamarter RB, Hohl M, Hopp E. Ligament injuries associated with tibial plateau fractures. Clin Orthop Relat Res. 1990;250:226–233.
11. Blokker CP, Rorabeck CH, Bourne RB. Tibial plateau fractures. An analysis of the results of treatment in 60 patients. Clin Orthop Relat Res. 1984;182:193–199.
12. Reichard AK, Seligson D, Alt V. External fixation of tibial plateau fractures: a retrospective evaluation and case report. Osteo Trauma Care. 2004;12:33–36.
13. 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;21:376–381. doi: 10.1097/00005373-198105000-00007.
14. 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;63:1043–1053. doi: 10.1097/TA.0b013e3181238d88.
15. Katsenis D, Athanasiou V, Megas P, Tillianakis M, Lambiris E. Minimal internal fixation augmented by small wire transfixion frames for high-energy tibial plateau fractures. J Orthop Trauma. 2005;19:241–248. doi: 10.1097/01.bot.0000155309.27757.4c.
16. Weiner LS, Kelley M, Yang E, Steuer J, Watnick N, Evans M, Bergman M. The use of combination internal fixation and hybrid external fixation in severe proximal tibial fractures.JOrthop Trauma.1995;9:244–250. doi:10.1097/00005131-199506000-00011
17. Weigel DP, Marsh JL. High-energy fractures of the tibial plateau. Knee function after longer follow-up. J Bone Joint Surg Am. 2002;84:1541–1551.
18. Watson JT, Coufal C. Treatment of complex lateral plateau fractures using Ilizarov techniques. Clin Orthop Relat Res. 1998;353:97–106.
19. Dendrinos GK, Kontos S, Katsenis D, Dalas A. Treatment of high energy tibial plateau fractures by the Ilizarov circular fixator.J Bone Joint Surg Br. 1996;78:710–17
20. Schwartsman V, Martin SN, Ronquist RA, Schwartsman R. Tibial fractures. Clin Orthop Relat Res. 1992;278:207–216.
21. Gaudinez RF, Mallik AR, Szporn M. Hybrid external fixation of comminuted tibial plateau fractures. Clin Orthop Relat Res. 1996;328:203–10
22. Chin TYP, Bardana D, Bailey M, Williamson OD, Miller R, Edwards ER, Esser MP. Functional outcome of tibial plateau fractures treated with the fine-wire fixator. Injury. 2005;36:1467–1475. doi: 10.1016/j.injury.2005.05.008.
23. 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.
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;14:339–44.
25. Hutson JJ, Zych GA. Infections in periarticular fractures of the lower extremity treated with tensioned wire hybrid fixators. J Orthop Trauma. 1998;12:214–8. doi: 10.1097/00005131-199803000-00014.