Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2016/487

Original Article

Outcome of High-energy Tibial Plateau Schatzker Type VI Fractures with Compromised Soft Tissue Treated by Ilizarov Fixator

Kanailal Jana[1], Atanu Chatterjee[2], Prasanta Kumar Pujari[3], Dipak Kumar Jha[4]

[1]Assistant Professor, Department of Orthopaedics, Ramakrishna Mission Seva Pratisthan, Vivekananda Institute of Medical Sciences, Kolkata, West Bengal, India, [2]Senior Resident, Department of Orthopaedics, Ramakrishna Mission Seva Pratisthan, Vivekananda Institute of Medical Sciences. Kolkata, West Bengal, India, [3]Associate Professor, Department of Orthopaedics, Ramakrishna Mission Seva Pratisthan, Vivekananda Institute of Medical Sciences. Kolkata, West Bengal, India, [4]Professor, Department of Orthopaedics, Ramakrishna Mission Seva Pratisthan, Vivekananda Institute of Medical Sciences, Kolkata, West Bengal, India

Abstract

Background: High-energy fractures of tibial plateau are associated with severe articular depression, separation of both condyles, diaphyseal comminution and dissociation and loss of integrity of the soft-tissue envelope. Complications of plating are well known since last 50 years in these difficult fractures. An alternative method was proposed by Ilizarov (Catagni, 1991; Ilizarov, 1992), and we have adopted his techniques for the treatment of these complex injuries.

Aim of Study: This prospective study used this method, i.e., Illizarov fixator for the management of high-energy fractures of the tibial plateau.

Material and Methods: A total of 13 patients (mean age of 44 years) with high-energy fractures of the tibial plateau (Schatzker VI) by the Ilizarov fixator and transfixion wires. 7 fractures were open, and 6 patients had complex injuries. All were treated by ligamentotaxis and percutaneous fixation. All were followed for a mean of 24 months.

Results: All the fractures united with an average time to healing of 15 weeks. Eight patients achieved full extension and 5 patients more than 110° of flexion. All knees were stable with one patient uniting in mild varus deformity. 12 patients walked normally and one patient with only a slight limp. All but one knee had an articular step-off of <4 mm and all had normal axial alignment except one. Using the knee society clinical rating system, six knees were rated as excellent, four as good, one as fair, and one as poor. There were no cases of post-operative skin infection, osteomyelitis, or septic arthritis. There was a direct correlation between the presence of associated injuries and the final outcome.

Conclusion: The technique is well suited to the management of complex fractures of the tibial plateau when extensive dissection and internal fixation are contraindicated due to the comminution at the fracture site and compromise of the soft tissue.

Key words: Ilizarov, Ligamentotaxis, Metaphyseal fractures, Schatzker

INTRODUCTION

Complex tibial plateau fractures are one of the most challenging problems in fracture surgery.[1-3] In 1979, Schatzker *et al.* described six types of tibial plateau fractures based on anteroposterior (AP) radiographs.[4] Schatzker Type VI tibial plateau fractures are caused by severe high-energy trauma. A transverse or oblique fracture of proximal tibia is present in addition to a fracture of one or both condyles of the tibia and articular surfaces. The high energy causes severe bony comminution and soft tissue injury. These high energy injuries cause significant articular depression, condylar displacement, metadiaphyseal fracture extension with open wounds or extensive closed degloving injuries of the proximal tibia.[5] Complications include severe soft tissue coverage problems, lower limb compartment syndrome, peroneal nerve injury, vascular injury, and eventual knee arthrosis.[6]

Access this article online

www.ijss-sn.com

Month of Submission : 07-2016
Month of Peer Review : 08-2016
Month of Acceptance : 09-2016
Month of Publishing : 09-2016

Corresponding Author: Dr. Kanai Lal Jana, 388 Hostel. 99, A.J.C. Bose Road, Ramakrishna Mission Seva Pratisthan, Vivekananda Institute of Medical Sciences, Kolkata, West Bengal, India. Phone: +91-9163515650. E-mail: atanuchatterjee1987@gmail.com

These associated complications directly impact surgical decision-making and prognosis.

The principles of the treatment are anatomical reconstruction of the articular surface, restoration of the anatomical axis, fixation spanning the metaphyseal comminution, and further minimization of secondary insult to an already traumatized soft tissue envelope.[7] These objectives can be achieved with internal fixation or external fixation with or without limited open procedures and bone grafting or a combination of these methods. With extensive contusion or soft-tissue injury, a joint-bridging external fixator is recommended to provide a sufficient stability for the recovery of the soft tissues. The concept of "spanning" the knee joint was introduced in the 1990s.[5] This concept evolved as proponents of indirect fracture reduction and biological fixation reported increased rates success.[8] With this method, the fractures are indirectly reduced with traction, and then maintained with either internal or external fixation before a knee-spanning external fixator is finally applied. With the knee-spanning external fixator, reduction of the intra-articular fragments is maintained.

Many problems encountered in the management of such fractures has panacea in Ilizarov technique. It provides a method for closed reduction and fixation that does not necessitate excessive soft-tissue stripping.[1-3,9-11] Combining this Ilizarov external fixation with minimal internal fixation provides better radiological and functional results.[11,12] The aim of this study was to assess the clinical outcomes of Type VI tibial plateau fractures with severe soft tissue injuries treated with Ilizarov spanning fixator across the knee joint.

MATERIALS AND METHODS

A total of 15 patients were included in this prospective study conducted between 2011 and 2014. The average was 36 years (range 18-65 years). There were 13 male and 2 female patients. The mode of injury was road traffic accident in all cases. There were open fractures in 9 cases and closed fractures with large blisters in 6 cases. The open fractures were Gustilo-Anderson Type I in 2 cases, Type II in 5 cases, and Type III in 2 cases.[10] Six closed fractures had extensive closed soft tissue injuries (mostly Type I and II Tscherne and Gotzen).[13] All patients with the presence of high-energy tibial plateau fractures (Schatzker VI) either closed or open in skeletally mature patients were included. AP view X-ray was used to determine medial and lateral plateau involvement with a degree of articular comminution and lateral view X-rays were used to determine the extent of posterior displacement of condyles and joint depression. Soft tissue condition had a crucial importance on our planning for the time of the operation. All patients were reviewed at a minimum of 12 months.

The patients with open fractures (n = 9) patients were operated within 6 days after primary wound irrigation, debridement, and intravenous antibiotics; while 6 closed fractures were treated with an average of 4 days delay (range 3-6 days) to allow soft tissue edema to subside. In cases of extremely complex and unstable fractures (n = 13), the frame was extended onto the distal femur which kept the knee joint in distraction.

Operation Technique

The operation was done under spinal anesthesia in radiolucent operating table. The fragments were aligned by simple manual traction by an assistant or by fracture table. The fracture reduction was visualized on both planes by the image intensifier. Fragments were held with patella holding forceps. Depressed articular fragments often necessitate elevation (2 cases). The failure to reduce the articular fragments often necessitates an open reduction. A small window was made over tibial cortex through a small incision on the anterior-medial aspect of the tibial metaphysis. A bone elevator was introduced through the hole and fragments were elevated under image intensifier. Meniscal or ligament injuries were not addressed at this stage. After reduction of the condyles, counteropposed olive wires through the fragments were used to achieve interfragmentary compression. Three wires with a divergence of at least 60° were usually required for stabilization of the condylar and metaphyseal fragments. The wires were placed at least 15 mm away from the joint surface to prevent synovial contact and to avoid septic arthritis in the case of pin tract infection. The first 1.8 mm olive wire was inserted using image intensifier in a lateral to medial direction just anterior to the head of the fibula at the tibial plateau subchondral region to provide interfragmentary compression. All wires were passed through safe zones. The first ring was fixed to the first wire with two fixation bolts and tensioned to create compression in between the articular fragments. Another olive wire was applied from medial to lateral on the distal side of the ring, and then a drop wire is inserted. This ring is then connected to one ring distally with four interconnecting rods. Care was taken to restore the mechanical axis in relationship to the condyles. The frame was extended as distractor onto the distal femur. The frame was fixed by two half pins between quadriceps and hamstring. The tibial and femoral rings were connected with connecting rods. The pin sites were dressed with povidone-iodine solution soaked gauzes.

Post-operative Rehabilitation

For open fractures, either daily dressing or delayed primary closure or skin grafting was done depending on the size

of the wound. Post-operative care consisted of daily pin tract dressing. Check radiographs were done on the next day and adjustments of the fixator were done by the 3rd day. Parenteral antibiotics were given up to the 3rd day for closed fractures and up to the eradication of infection or wound healing for open and infected fractures. Active and passive dorsiflexion exercises of the ankle were started on the second post-operative day. To prevent an equinus deformity of the ankle, the foot was kept in a neutral position by splinting. Isometric quadriceps exercises and hip raising exercises were permitted. All patients were allowed partial weight bearing as pain tolerated by the end of 1 week. Patients with open fractures were checked weekly in the outpatient department until wound healing. Thereafter, they were checked every 4 weeks (as patients with closed fractures) with check radiographs. The femoral frame was removed on an average 4.4 weeks after the operation and knee range of motion (ROM) exercises were allowed. All patients were encouraged to fully weight-bear. After radiographic healing, frame dynamization was performed to decrease pin bone stresses and to transmit weight-bearing forces to the bone. Incomplete fracture healing was assumed when pain or subtle radiographic changes were present after frame dynamization. The frame was retightened to allow further consolidation. The external fixator was removed once radiographic evidence of union was established, and the fracture was clinically united. Clinically, healing was defined as the ability to bear full weight with a varus and valgus stress to the injured tibia without causing pain. All the fixators were removed as an outpatient procedure without anesthesia. Walking cast was applied for 3-4 weeks. Physiotherapy was continued after removal of the cast to improve the range of knee motion. Radiographs were taken without cast and were allowed full weight bearing with follow-up at 6 weeks, 3, 6 and 12 months.

Assessment

All patients had record of the clinical and subjective assessment, the level of function and radiological assessment according to the criteria established by Honkonen and Järvinen (1992).[14] All patients were asked to record their symptoms electrical submersible pumps frequency and importance. The symptoms were pain during activities, swelling, stiffness, weakness, limping, giving way, and crepitus. The severity was assessed by multiplying the frequency of symptoms by the grade of importance to the patient. All patients were clinically assessed with extension lag (in degrees), flexion range (in degrees), and thigh atrophy (in cm). These parameters are graded from excellent to poor. The final score was the lowest grade found in any of the four tests. Functional assessment was done by assessing the walk, stair climbing, squatting, jumping and duck-walking. The final score was the lowest found on these five tests and graded as excellent to poor. Radiological grading was done by assessing the plateau tilt, varus/valgus tilt, articular step-off, condylar widening, and degeneration (relative narrowing of the joint). The radiographs were assessed in both AP and lateral planes. Tilting of the plateau was measured in the frontal plane by drawing a line between the deepest points of the weight-bearing area of the two condyles. The angle between that line and the long axis of the tibia was recorded. Local step-off was measured whenever there was an intact part of the articular surface. The normal alignment of the plateau was measured on the radiograph of the uninjured knee. Condylar widening was estimated in comparison with the width of the ipsilateral femoral condyles. Posttraumatic arthritis was recorded as narrowing of the joint space compared with the uninjured knee.

RESULTS

The mean interval between the injury and application of the Ilizarov ring external fixator was 5.6 days (range 3.5-10 days) in our hospital. The external fixator was tolerated for the entire treatment period in all cases. Average partial weight bearing walking was 5.5 days (range 4-7 days), and average full weight bearing was 17.4 weeks (15-25 weeks). The mean hospital stay was 5.4 weeks (range 2-18 weeks). All fractures healed with an average time of treatment with the frame for 14.6 weeks (range 10.5-45 weeks). All but two fractures were united within 4 months. 11 patients required additional casting and four patients did not require any other form of supports. In one patient, fracture took longer than 6 months to heal. Two patients had pin track infection. All pin track infections healed by regular dressing without requiring wire removal. One patient had united in varus (10°) but was asymptomatic. One patient required muscle flap procedure for soft tissue coverage, and two patients required split-thickness skin grafting.

A total of 14 patients regained functional use of the knee joint, without pain or instability and improved quality of daily living. Mean flexion of 110° (range 70-130°) was achieved in 15 patients at a mean follow-up of 19.4 months. In fractures treated with knee distractor (n = 13), the average knee flexion achieved was 108° (range 70-130°). 2/15 patients were able to flex the knee 130° and 6/15 patients up to 120°. Three patients had 5° lack of extension (range 0-8°). Thigh atrophy of more than 1 cm was noted in only one patient.

Normal walking was observed in nine patients and four had a mild limp. None of the patients used any walking aid. Squatting was normal in 10 patients. Limitation of squatting

was observed in three patients. 8/15 patients could climb stairs normally. Overall, there were seven excellent, seven good and one fair result.

On AP radiographs, the varus tilt of 10° was noted in one patient. On lateral radiographs, the plateau tilt of <6° was noted in two patients. Only one patient had a step of <4 mm on the articular surface. On comparing with the uninjured knee, the tibial varus tilt was observed in two patients. Condylar widening was noted in 7 patients and none were more than 6 mm. No patients had post-traumatic degeneration. Radiologically, 6 were excellent, 4 were good, and 4 were fair (Tables 1-3) (Figures 1-4).

DISCUSSION

Decision-making in the management of tibial plateau Schatzker Type VI fractures with extensive soft tissue injuries relates to the long-term outcome.[15] Surgery is indicated in such fractures with metaphysio-diaphyseal dissociation.[16] In this series, 60% patients had open fractures and 40% had significant closed injuries to the soft tissue. Joint spanning circular fixation (Illizarov frame) provides adequate healing of soft tissue injuries especially ligament injuries. In the present series, despite the severe articular comminution, spanning of fixator across the joint allowed adequate rest to the tissues and a satisfactory functional outcome was achieved. It has been reported that the healing of the articular surface is adequate when the articular congruity is maintained. Intra-operative

Table 1: Number of patients with grades of fractures with time to union

Grade	Number of patients	Time to union (weeks)
I[a]	2	12
II[a]	5	14.6
III[a]	2	20
I[b]	2	13
II[b]	4	14

[a]Open fractures (Gustillo/Anderson), [b]Closed fractures (Tscherne/Goetzen)

Figure 1: Pre-operative X-ray

Figure 2: Fracture fixed with Ilizarov ring

Table 2: Details and outcome in 15 patients with Schatzker VI fractures

Age	Sex	Side	Sost tissue status	Fixator (weeks)		Full weight bearing (week)	Follow-up (months)	Time to union (week)	Range of motion (·)	Results	Complication
				Femoral	Tibial						
36	Male	Left	Blister	No	12	15	24	14	120	Excellent	No
39	Male	Right	Open	4	13	16	18	15	120	Excellent	No
53	Male	Left	Open	6	16	25	30	25	70	Fair	Stiffness
63	Male	Left	Blister	4	13	17	18	15	100	Good	Pin tract infection
48	Female	Right	Open	4	14	17	18	15	120	Excellent	Pin tract infection
44	Male	Left	Blister	4	13	16	24	13	130	Excellent	No
37	Male	Right	Open	4	14	17	16	14	100	Good	Varus deformity
27	Male	Left	Open	6	18	20	16	16	100	Good	No
50	Male	Left	Blister	6	12	15	15	13	120	Excellent	No
25	Male	Right	Open	4	16	17	20	14	120	Excellent	No
60	Male	Left	Blister	4	13	17	18	13	100	Good	No
45	Female	Right	Open	4	14	17	18	15	120	Good	No
42	Male	Left	Blister	4	13	16	24	13	130	Excellent	No
33	Male	Right	Open	4	14	17	16	12	100	Good	No
31	Male	Left	Open	No	18	19	16	12	100	Good	No

Figure 3: Post-operative radiological outcome

Figure 4: Post-operative functional range of motion

Table 3: Outcome analysis of individual aliments

Subjective outcome	Clinical outcome	Functional outcome	Radiological outcome
Good	Excellent	Excellent	Excellent
Good	Excellent	Excellent	Excellent
Poor	Fair	Fair	Poor
Fair	Good	Good	Fair
Good	Excellent	Good	Excellent
Excellent	Excellent	Excellent	Excellent
Fair	Good	Good	Fair
Fair	Good	Good	Fair
Good	Excellent	Excellent	Excellent
Good	Excellent	Excellent	Excellent
Fair	Fair	Good	Good
Good	Good	Good	Good
Excellent	Excellent	Excellent	Good
Fair	Good	Fair	Fair
Fair	Good	Good	Good

imaging helps in providing congruous reduction although it is difficult to achieve an anatomical reduction by closed methods. Instability of the knee after these fractures is a major cause of a poor result.[15,17-19] Whether it is due to ligamentous laxity or bone deformity is debatable.[18,20] There is no general agreement as to whether the repair of associated ligament injuries at the time of the fixation of the fracture is necessary, but many believe that operative repair should be undertaken.[19,20] In this series, the ligament injuries were not primarily assessed. Ilizarov circular fixation allowed both early movement and early weight-bearing, and none of the patients had signs of instability.

Open reduction and internal fixation are not indicated in the presence of fracture blisters or extensive subcutaneous hemorrhage and bruising. Literature review suggests increased rates of infection in 23-80% patients with complex proximal tibial fracture.[21-24] Morandi *et al.* showed decreased the rate of complications with external fixation in such fractures.[25] The percutaneous wires could be used to avoid additional devitalization of the bone since the periosteal and endosteal blood supply do not undergo a secondary insult. Olive wires act as lag screws and compress the fragments against condyle. Small tension wire helps to hold the small fragments.[26] Mechanical axis of lower limb can be maintained and monitored by adjustment of the frame. Two patients required open reduction with an elevation of the tibial plateau. Early ROM in such fractures has been well established,[16] but early loading of such fractures has generally been avoided because the reduction may be lost, resulting in depression of the joint surface or a progressive deformity. However, early weight bearing could stimulate bone healing and muscular strength could be regained early for a better functional outcome.[25] The Ilizarov tibiofemoral frame allows initial weight bearing. In this series, it has been observed that minimum of 6 weeks was required for soft callous formation. The early sign of healing due to early weight bearing confirms the already established theory.[27]

Our study emphasises, the low morbidity associated with the Ilizarov method. No patient developed osteomyelitis or septic arthritis. This absence of infection and septic nonunion compares favorably with other published studies on these complex injuries.[28,29] The functional outcome of tibial plateau fractures managed with Ilizarov fixator was reported as excellent to good in 76-89%.[30-32] In this series, excellent to good function was achieved in 96.7% patients. Kumar and Whittle in a study of treatment of complex fractures of the tibial plateau with circular wire external fixation had reported an average of 173 days, i.e., 24.71 weeks (range 50-415 days) for fracture union, i.e., 7.14-59.28 weeks.[33] Behrens and Searls in their study of external fixation of the tibia showed average union time of 186 days, i.e., 26.57 weeks.[34]

In our study, knee flexion in knee distractor group was 108.4° compared with average 83° in El Barbary *et al.*[29]

CONCLUSION

The technique is well suited to the management of complex fractures of the tibial plateau when extensive dissection and internal fixation are contraindicated due to the comminution at the fracture site and compromise of the soft tissue.

REFERENCES

1. Buckle R, Blake R, Watson JT, Morandi M, Browner BD. Treatment of complex tibial plateau fractures with the Ilizarov external fixator. J Orthop Trauma 1993;7:167.
2. Hefny HM. Treatment of complex tibial plafond injuries using Ilizarov methodology. Pan Arab J Orthop Trauma 2000;4:37-42.
3. Watson JT, Coufal C. Treatment of complex lateral plateau fractures using Ilizarov techniques. Clin Orthop Relat Res 1998:97-106.
4. Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968--1975. Clin Orthop Relat Res 1979:94-104.
5. Watson JT. High-energy fractures of the tibial plateau. Orthop Clin North Am 1994;25:723-52.
6. Honkonen SE. Degenerative arthritis after tibial plateau fractures. J Orthop Trauma 1995;9:273-7.
7. Mills WJ, Nork SE. Open reduction and internal fixation of high-energy tibial plateau fractures. Orthop Clin North Am 2002;33:177-98, ix.
8. Leunig M, Hertel R, Siebenrock KA, Ballmer FT, Mast JW, Ganz R. The evolution of indirect reduction techniques for the treatment of fractures. Clin Orthop Relat Res 2000:7-14.
9. 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;78:710-7.
10. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: A new classification of type III open fractures. J Trauma 1984;24:742-6.
11. Marsh JL, Smith ST, Do TT. External fixation and limited internal fixation for complex fractures of the tibial plateau. J Bone Joint Surg Am 1995;77:661-73.
12. 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;9:244-50.
13. Tscherne H, Gotzen L. Fractures with Soft Tissue Injuries. Berlin: Springer; 1984.
14. Honkonen SE, Järvinen MJ. Classification of fractures of the tibial condyles. J Bone Joint Surg Br 1992;74:840-7.
15. 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.
16. Gausewitz S, Hohl M. The significance of early motion in the treatment of tibial plateau fractures. Clin Orthop Relat Res 1986:135-8.
17. Reibel DB, Wade PA. Fractures of the tibial plateau. J Trauma 1962;2:337-52.
18. Hohl M, Hopp E Jr. Ligament injuries in tibial condylar fractures. J Bone Joint Surg Am 1976;58A:279.
19. Schulak DJ, Gunn DR. Fractures of tibial plateaus. A review of the literature. Clin Orthop Relat Res 1975:166-77.
20. Delamarter RB, Hohl M, Hopp E Jr. Ligament injuries associated with tibial plateau fractures. Clin Orthop Relat Res 1990:226-33.
21. Moore TM, Patzakis MJ, Harvey JP. Tibial plateau fractures: Definition, demographics, treatment rationale, and long-term results of closed traction management or operative reduction. J Orthop Trauma 1987;1:97-119.
22. Mallik AR, Covall DJ, Whitelaw GP. Internal versus external fixation of bicondylar tibial plateau fractures. Orthop Rev 1992;21:1433-6.
23. Young MJ, Barrack RL. Complications of internal fixation of tibial plateau fractures. Orthop Rev 1994;23:149-54.
24. Yang EC, Weiner L, Strauss E, Sedlin E, Kelley M, Raphael J. Metaphyseal dissociation fractures of the proximal tibia. An analysis of treatment and complications. Am J Orthop (Belle Mead NJ) 1995;24:695-704.
25. Morandi M, Watson JT, Blake R, Morandi M, Browner BD. Treatment of complex tibial plateau fractures with circular external fixators. Orthop Trans 1993-1994;17:1056.
26. Segal D, Mallik AR, Wetzler MJ, Franchi AV, Whitelaw GP. Early weight bearing of lateral tibial plateau fractures. Clin Orthop Relat Res 1993:232-7.
27. Ranatunga IR, Thirumal M. Treament of tibial plateau Schatzker Type VI fractures with the Ilizarov technique using ring external fixators across the knee: A retrospective review. Malays Orthop J 2010;4:1-6.
28. Benirschke SK, Agnew SG, Mayo KA, Santoro VM, Henley MB. Immediate internal fixation of open, complex tibial plateau fractures: Treatment by a standard protocol. J Orthop Trauma 1992;6:78-86.
29. Stamer DT, Schenk R, Staggers B, Aurori K, Aurori B, Behrens FF. Bicondylar tibial plateau fractures treated with a hybrid ring external fixator: A preliminary study. J Orthop Trauma 1994;8:455-61.
30. El-Gafary K, El-adly W, Farouk O, Khaled M, Abdelaziz MM. Management of high-energy tibial plateau fractures by Ilizarov external fixator. Eur Orthop Traumatol 2013;4:1.
31. 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.
32. El Barbary H, Abdel Ghani H, Misbah H, Salem K. Complex tibial plateau fractures treated with Ilizarov external fixator with or without minimal internal fixation. Int Orthop 2005;29:182-5.
33. 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.
34. Behrens F, Searls K. External fixation of the tibia. Basic concepts and prospective evaluation. J Bone Joint Surg Br 1986;68:246-54.

How to cite this article: Jana K, Chatterjee A, Pujari PK, Jha DK. Outcome of High-energy Tibial Plateau Schatzker Type VI Fractures with Compromised Soft Tissue Treated by Ilizarov Fixator. Int J Sci Stud 2016;4(6):66-71.

Source of Support: Nil, **Conflict of Interest:** None declared.