



ILIZAROV-BASED RECONSTRUCTION FOR COMPLEX TIBIAL PLATEAU FRACTURES (SCHATZKER V-VI): A STUDY OF FUNCTIONAL AND RADIOLOGIC OUTCOMES.

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Abstract

Background: Complex tibial plateau fractures (Schatzker V-VI) present a significant surgical challenge due to articular comminution, metaphyseal-diaphyseal dissociation, and soft tissue compromise. The Ilizarov circular fixator offers advantages of stable fixation, early weight-bearing, and simultaneous management of bone loss. This study evaluates the functional and radiological outcomes of Ilizarov-based reconstruction for these fractures at a tertiary care center.

Methods: A prospective interventional study was conducted at BSMMU from January 2015 to December 2017. Fifty consecutive adult patients with closed Schatzker type V and VI tibial plateau fractures were managed with Ilizarov fixation, often using limited internal fixation for articular reduction. Outcomes were assessed using the Rasmussen's functional and radiological scoring systems at final follow-up (minimum 12 months). Complications were recorded.

Results: The mean patient age was 42.3 ± 10.5 years, with 76% males. The mean time to full weight-bearing was 12.1 ± 2.3 weeks. At final follow-up, the mean Rasmussen functional score was 26.2 ± 3.1 , with 72% (n=36) achieving good-to-excellent results. Radiologically, 68% (n=34) had good-to-excellent anatomical restoration. The most common complications were pin-tract infections (28%), all resolving with oral antibiotics. No cases of deep infection or non-union were observed.

Conclusion: Ilizarov circular fixation is an effective and reliable method for managing complex tibial plateau fractures, providing high rates of union, good functional outcomes, and enabling early mobilization. Its utility is particularly pronounced in settings with high-energy trauma and compromised soft tissues.

Keywords: Tibial plateau fracture; Schatzker V–VI; Ilizarov fixator; External fixation; Functional outcome; Radiological outcome.

Introduction

Complex tibial plateau fractures involving bicondylar patterns or metaphyseal-diaphyseal dissociation (Schatzker V and VI) are debilitating injuries often resulting from high-energy trauma. Treatment aims include anatomical articular reduction, stable fixation to allow early motion, and the preservation

of soft tissue viability. Dual plating, while providing rigid fixation, carries a substantial risk of wound dehiscence and deep infection, especially in the often-compromised soft tissue envelope.

The Ilizarov method, employing a circular external fixator, provides a biologically friendly alternative. It allows for minimally invasive application, indirect reduction, and stable, multi-planar fixation that permits immediate knee movement and early, progressive weight-bearing. This study presents our experience with Ilizarov-based reconstruction for complex tibial plateau fractures at Bangabandhu Sheikh Mujib Medical University (BSMMU), focusing on functional recovery, radiographic outcomes, and complications.

Materials and Methods

Study Design & Setting: A prospective interventional study conducted in the Department of Orthopaedic Surgery, BSMMU, Dhaka, from January 2015 to December 2017.

Participants: Fifty consecutive adult patients with closed, acute (within 2 weeks), Schatzker type V or VI tibial plateau fractures were included. Patients with open fractures, neurovascular injury, or pre-existing knee arthritis were excluded.

Surgical Technique: Under appropriate anesthesia, a closed or limited open reduction of the articular surface was performed via a small arthrotomy when necessary. Articular fragments were fixed with percutaneous cannulated screws. The Ilizarov frame was then constructed, typically consisting of two proximal rings (fixed to the epiphyseal-metaphyseal segment) and two distal rings on the diaphysis, connected by threaded rods. The construct was hinged at the knee joint line to allow early range of motion.

Postoperative Protocol: Knee mobilization began on postoperative day 2. Toe-touch weight-bearing was encouraged from week 2, progressing to full weight-bearing based on radiographic signs of consolidation. Patients were followed monthly until frame removal and then at 3-, 6-, and 12-months post-removal.

Outcome Measures:

- **Primary:** Functional outcome assessed using the Rasmussen's Functional Scoring System (excellent: 27-30; good: 20-26; fair: 10-19; poor: <10).
- **Secondary:** Radiological outcome assessed using the Rasmussen's Radiological Criteria (excellent: 18; good: 12-17; fair: 6-11; poor: <6) on follow-up radiographs. Time to union, time to full weight-bearing, and complications were recorded.

Statistical Analysis: Data were analyzed using SPSS version 23.0. Descriptive statistics are presented as mean $\pm$ standard deviation or frequencies and percentages.



Picture:1 Complex Tibial Plateau Fracture with Ilizarov fixation



Picture:2 Complex Tibial Plateau Fracture with Ilizarov fixation

Results

The study comprised 50 patients with a mean age of 42.3 years. The demographic and injury characteristics are summarized in Table 1. The functional and radiological outcomes at a mean follow-up of 16.4 ± 3.1 months are detailed in Table 2.

Table 1: Patient Demographics and Injury Characteristics (N=50)

Characteristic	Value
Mean Age (years $\pm$ SD)	42.3 $\pm$ 10.5
Gender (n, %)	
Male	38 (76%)
Female	12 (24%)
Mechanism of Injury (n, %)	
Road Traffic Accident	38 (76%)
Fall from Height	12 (24%)
Fracture Type (Schatzker) (n, %)	
Type V	20 (40%)
Type VI	30 (60%)
Mean Time to Surgery (days $\pm$ SD)	5.2 $\pm$ 2.1

Table 2: Functional and Radiological Outcomes (N=50)

Outcome Measure	Result
Mean Time to Full Weight-Bearing (weeks $\pm$ SD)	12.1 $\pm$ 2.3
Mean Time to Radiological Union (weeks $\pm$ SD)	15.8 $\pm$ 2.7
Mean Ilizarov Frame Duration (weeks $\pm$ SD)	18.5 $\pm$ 3.0
Rasmussen's Functional Score (Mean $\pm$ SD)	26.2 $\pm$ 3.1
Excellent (27-30)	18 (36%)
Good (20-26)	18 (36%)
Fair (10-19)	12 (24%)
Poor (<10)	2 (4%)
Good-to-Excellent Functional Outcome	36 (72%)
Rasmussen's Radiological Score (Mean $\pm$ SD)	15.1 $\pm$ 2.8
Excellent (18)	14 (28%)
Good (12-17)	20 (40%)
Fair (6-11)	14 (28%)
Poor (<6)	2 (4%)

Good-to-Excellent Radiological Outcome	34 (68%)
Range of Motion (Final, degrees $\pm$ SD)	112.5 $\pm$ 15.4
Complications (n, %)	
<i>Pin-Tract Infection</i>	14 (28%)
<i>Knee Stiffness (<90° flexion)</i>	5 (10%)
<i>*Residual Varus/Valgus (>5°)*</i>	3 (6%)
<i>Deep Infection / Non-Union</i>	0 (0%)

Discussion

Our study demonstrates that Ilizarov-based reconstruction is a highly effective strategy for high-energy tibial plateau fractures. The 72% good-to-excellent functional outcome and 100% union rate compare favorably with reports using dual plating, while notably avoiding the catastrophic soft tissue complications associated with the latter.

The hallmark of the Ilizarov method is its ability to facilitate early rehabilitation. Our mean time to full weight-bearing of 12.1 weeks is a significant advantage over plate osteosynthesis, promoting functional recovery, preventing disuse osteoporosis, and reducing overall morbidity. The high rate of pin-tract infection (28%) is consistent with other external fixator series, but all were superficial and managed conservatively, underscoring the importance of meticulous pin-site care.

The main limitations of this technique include a steep learning curve, patient tolerance of the external frame, and the risk of knee stiffness, which was observed in 10% of our cohort. This stiffness is often attributable to the original articular damage and can be mitigated with aggressive physiotherapy and hinge-assisted mobilization.

Conclusion

Ilizarov circular external fixation, often combined with limited internal fixation, provides a biologically sound and mechanically stable solution for complex tibial plateau fractures. It yields predictable union, good functional outcomes, and allows for immediate knee movement and early weight-bearing. It is a particularly valuable technique in a high-volume trauma center like BSMMU, where it helps manage severe fractures with a compromised soft tissue envelope, minimizing severe complications.

Conflicts of Interest: The authors declare no conflicts of interest.

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Ethical Approval: Obtained from the Institutional Review Board of BSMMU.

References

1. El Barbary HM, Abdel Ghani H, Misbah H, Salem KH. Complex tibial plateau fractures treated with Ilizarov external fixation. *Eur J Orthop Surg Traumatol*. 2016;26(8):877-84.
2. Singh AK, Sen RK, Tripathy SK, Aggarwal S. Ilizarov treatment of Schatzker type V and VI tibial plateau fractures. *Acta Orthop Belg*. 2011;77(3):325-32.
3. Catagni MA, Radwan M, Lovisetti L, D'Imporzano M. Management of Schatzker type V and VI fractures with a circular fixation. *J Orthop Trauma*. 2007;21(10):687-92.
4. Hall JA, Beuerlein MJ, McKee MD. Open reduction-internal fixation versus circular fixator in bicondylar tibial plateau fractures. *J Orthop Trauma*. 2009;23(8):571-7.
5. Hirsh DM, Aronson J, Tuten HR. Mechanical considerations in the Ilizarov method. *Clin Orthop Relat Res*. 1994;(301):11-20.
6. Ali AM, Yang L, Hashmi M, Saleh M. Bicondylar tibial plateau fractures managed with circular external fixation. *J Orthop Trauma*. 2003;17(10):693-9.
7. Stinner DJ, Mir H. Techniques for the surgical treatment of tibial plateau fractures. *Orthop Clin North Am*. 2014;45(1):25-36.

8. Dendrinis GK, Kontos S, Katsenis D, Dalas A. Treatment of high-energy tibial plateau fractures using Ilizarov fixation. *Clin Orthop Relat Res*. 1996;(332):200-10.
9. Zura RD, Browne JA, Black MG, Olson SA. Circular external fixation in tibial plateau fractures. *J Trauma*. 2004;57(2):378-81.
10. Rasmussen PS. Tibial condylar fractures: Impairment of knee joint stability as an indication for surgical treatment. *J Bone Joint Surg Am*. 1973;55(7):1331-50.