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Original Research Article

Functional Outcome of Management of Bicondylar Tibial Plateau Fractures with External Ring Fixator

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Abstract:

Background: Bicondylar tibial plateau fractures are complex intra-articular injuries commonly associated with high-energy trauma. These fractures pose challenges in achieving anatomical reduction and stable fixation while preserving soft tissues. Open reduction and internal fixation (ORIF) carry risks of wound complications, infection, and delayed rehabilitation. External ring fixators offer stable fixation with minimal soft tissue compromise.

Methods: A prospective study was conducted on 15 patients (age 18–65 years) with Schatzker type V and VI bicondylar tibial plateau fractures, managed with external ring fixator at Jhalawar Medical College (June 2023–June 2025). Functional outcomes were evaluated using Neer's Rating System and radiological outcomes using Modified Rasmussen's Score. Patients were followed up for 6 months.

Results: Mean age was 41.5 years; 66.7% were male. Road traffic accidents were the cause in 73.3% of cases. Schatzker type V constituted 53.3% and type VI 46.7%. Mean time to union was 16.9 weeks. Functional outcome was Excellent in 40%, Good in 46.7%, Fair in 13.3%. Radiological outcome was Excellent in 46.7%, Good in 40%, Fair in 13.3%. Complications included pin-tract infection (13.3%) and joint stiffness (6.7%).

Conclusion: External ring fixation provides reliable stability, early mobilization, satisfactory union and good functional outcomes in bicondylar tibial plateau fractures, especially in high-energy injuries with soft tissue compromise.

Keywords: Bicondylar Tibial Plateau Fracture; External Ring Fixator; Ilizarov; Functional Outcome; Rasmussen Score; Neerra.

Introduction

Bicondylar tibial plateau fractures are complex intra-articular injuries that pose major challenges in orthopedic trauma care. Typically resulting from high-energy trauma such as motor vehicle accidents or falls from height [1], these injuries are often associated with soft tissue damage, joint instability, and long-term functional impairment [2]. Successful management requires achieving stable fixation, anatomical reduction, and early mobilization while minimizing complications [3].

The tibial plateau is critical for weight transmission, alignment, and knee stability [4]. Fractures involving both condyles (Schatzker V and VI) often disrupt the articular surface and metaphyseal integrity, demanding meticulous surgical planning [5]. Although open reduction and internal fixation (ORIF) is widely practiced, concerns regarding wound complications, infection, and delayed rehabilitation have prompted interest in minimally invasive alternatives such as external ring fixation [6].

Circular external fixators, particularly Ilizarov and hybrid constructs, provide stable fixation while preserving soft tissues [7]. They reduce risks of wound dehiscence and deep infection [8], distribute forces evenly to support biological healing [9], and permit early mobilization in selected cases. Their adaptability makes them especially suitable for high-energy fractures with significant soft tissue compromise [10]. Modular designs enable deformity correction and alignment control [11] while preserving periosteal blood supply and fracture biology, thereby lowering risks of nonunion or malunion [12].

With increasing high-energy trauma in young, active populations, evaluating functional outcomes of external ring fixation has direct clinical significance [13]. Effective strategies must balance stability, biological preservation, and rehabilitation to

optimize recovery [14]. Recent evidence suggests external fixation may provide comparable or superior outcomes to ORIF in selected bicondylar plateau fractures [15], especially in cases with compromised soft tissues [16].

This study aims to assess the functional results of bicondylar tibial plateau fractures treated with external ring fixators, highlighting their benefits and limitations. Findings are expected to guide surgical decision-making and contribute to evolving strategies in complex peri-articular fracture management [17].

Materials and Methods

Study Design & Setting: Prospective observational study conducted at Department of Orthopedics, Jhalawar Medical College, from June 2023 – June 2025. Institutional ethics approval was obtained.

Sample Size: 15 patients aged 18–65 years.

Inclusion Criteria: Schatzker type V & VI fractures, closed or open Gustilo–Anderson type I–IIIA, treated within 2 weeks of injury.

Exclusion Criteria: Age <18 or >65, associated femoral shaft fracture, open type IIIB/IIIC, pathological fractures, neuromuscular disorders, medically unfit, or unwilling patients.

Preoperative Evaluation: All patients were assessed per ATLS protocol, stabilized, given antibiotics/tetanus prophylaxis, and underwent radiographs with CT scans.

Operative Procedure: The operations will be performed under spinal or general anesthesia on an OT traction table under C-arm guidance. Initially, fracture fragments will be aligned using straight manual traction, and reduction confirmed under C-arm. The fragments will be held with patella-holding forceps or temporary K-wires. In some cases, depressed articular fragments will require elevation through a window. Reduction of the condylar fragment will then be achieved, and counter-opposed olive wires inserted through the fragments to provide interfragmentary compression. Additional olive wires may be applied when necessary for intraarticular stabilization. These wires increase stability of the construct, allow gradual distraction when needed, and assist in correcting translation of fragments. Typically, three olive wires will be used in a divergent 60° configuration: one transverse olive wire placed 1–1.5 cm below the lateral joint line, a second from posterolateral to anteromedial, and a third from posteromedial to anterolateral, ensuring compression and firm fixation of the fragments.

Subsequently, two olive wires will be inserted 5 cm distal to the fracture site (one transverse and one oblique from posteromedial to anterolateral), and two more wires will be placed 2–5 cm proximal to the tibiotalar joint. The preassembled Ilizarov frame will then be disconnected at the ring-connecting bolt to open the frame and positioned around the limb: the proximal ring parallel to the knee joint, the middle ring just distal to the fracture, and the distal ring parallel to the ankle. The frame will be fixed along the olive wires with adequate soft tissue clearance (1.5 cm anteriorly and 3–4 cm posteriorly), and wires will be tensioned appropriately. The frame will first be tightened on one side of the fracture, followed by the other after ensuring reduction under C-arm guidance. Once satisfactory reduction is achieved, the construct will be locked, pin sites cleaned with betadine, and pin tract dressing applied.

- Postoperative Care:
- Early knee ROM from POD-2, progressive weight bearing as tolerated, regular pin-tract care, follow-up at 4–24 weeks.
- Assessment Tools:
- Functional: Neer's Rating System.
- Radiological: Modified Rasmussen's Score.

Observations and Results

Table 1: Distribution of Age of Patients

Age	Frequency	Percentage
19-35 Years	7	46.7
36-45 Years	3	20.0
46-55 Years	1	6.7
56-65 Years	4	26.7
Total	15	100.0

Table 2: Distribution of Gender of Patients

Gender	Frequency	Percentage
Female	5	33.33
Male	10	66.67
Total	15	100.0

Table 3: Distribution of Side of injury of patients

R/L	Frequency	Percentage
Left	8	53.3
Right	7	46.7
Total	15	100.0

Table 4: Distribution of Mode of injury of patients

Mode of injury	Frequency	Percentage
FALL	4	26.7
RTA	11	73.3
Total	15	100.0

Table 5: Distribution of associated injuries of patients

Associated injuries	Frequency	Percentage
Distal radius #	1	6.7
Distal shaft ulna #	1	6.7
Nil	13	86.7
Total	15	100.0

Table 6: Time of fracture union in present study

Time of fracture union	Frequency	Percentage
10-12 weeks	4	26.67
12-15 weeks	9	60
15-18 weeks	1	6.67
>18 weeks	1	6.67
Total	15	100

Table 7: Distribution of Range of motion of patients

ROM	Frequency	Percentage
$>100^0$	9	60.0
50^0-100^0	5	33.3
$<50^0$	1	6.7
Total	15	100.0

Table 8: Distribution of Post-op Pain of patients

Pain	Frequency	Percentage
Mild	4	26.7
Moderate	1	6.7
None	10	66.7
Total	15	100.0

Table 9: Distribution of Stability of elbow of Patients

Stability of elbow	Frequency	Percentage
Stable	14	93.3
Moderately Unstable	1	6.7
Unstable	0	0.0
Total	15	100.0

Table 10: Distribution of complications of patients

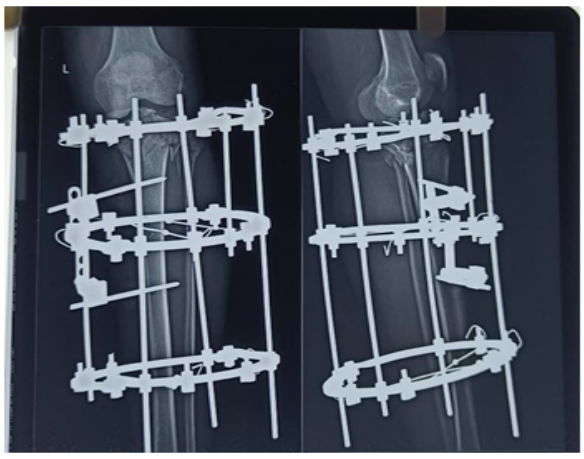
Complications	Frequency	Percentage
Nil	12	80
Delayed union	1	6.7
Superficial infection settled after debridement	1	6.7
Nonunion	1	6.7
Total	15	100.0

PRE-OP **POST-OP**

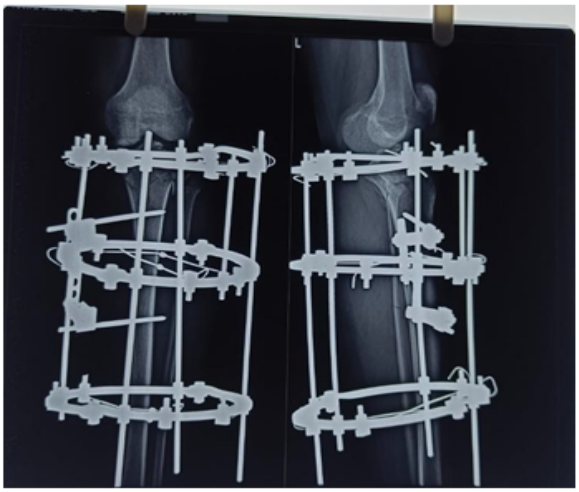
INTRA – OP IMAGES

POST-OP CLINICAL

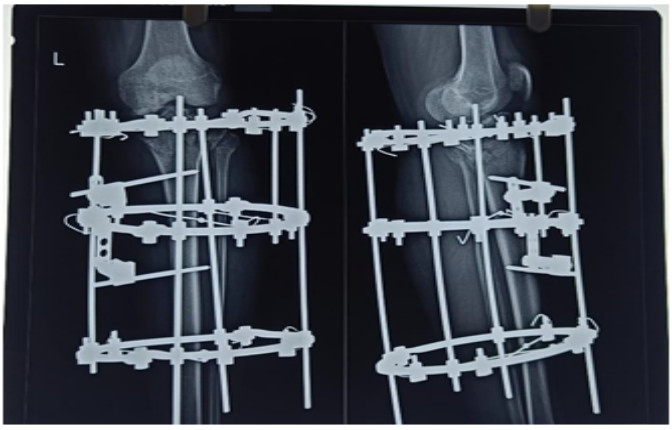
PATIENT WALKING ON POD-2 WITH SUPPORT



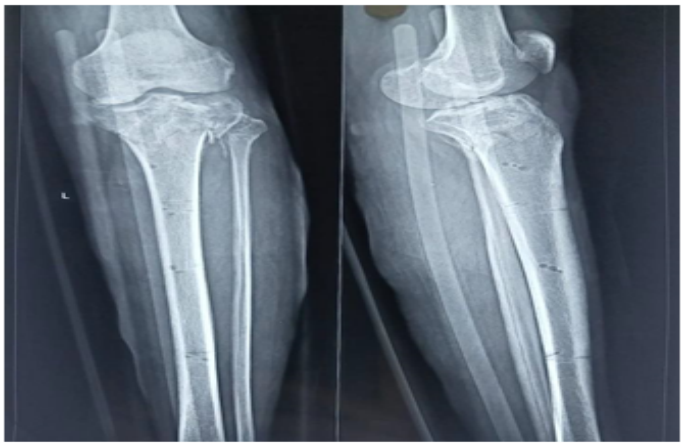
Follow up at 3 weeks



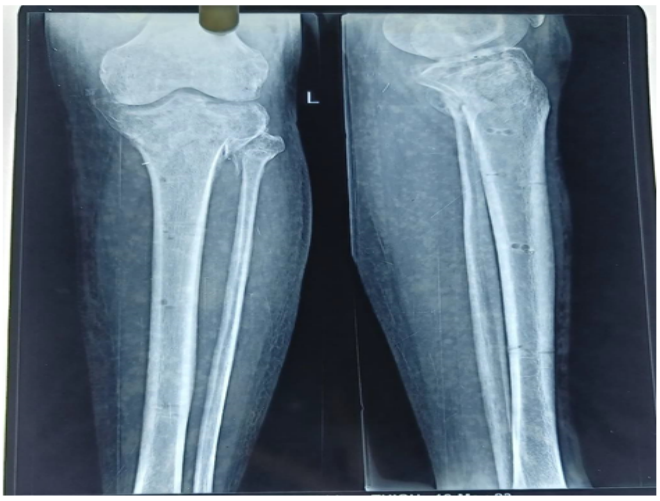
Follow up at 5 weeks



Follow up at 7 weeks



Removal at 7 weeks



Follow up at 11 weeks
(1 month after removal)

FOLLOW-UP CLINICAL PHOTOS

Cross leg sitting ROM -Flexion ROM - Extension

ROM -Flexion Squatting

Discussion

Bicondylar tibial plateau fractures often result from high-energy trauma and pose a challenge in orthopedic management due to soft tissue compromise and articular comminution. External ring fixators have emerged as a promising option, especially in complex fracture scenarios.

Age Distribution: In our study, the mean age was 41.5 years, which aligns with previous studies on high-energy tibial plateau injuries.

Study	Age
Our study	41.5
Wang et.al. (1998)	38.4
Ali et.al (2010)	39.2
El-Gafary et.al (2017)	42

Sex Distribution: A male predominance was observed, similar to past literature, reflecting increased exposure to trauma in males.

Study	Male	Female
Our study	10(66.67%)	5(33.33%)
Court-Brown et al (1999)	21(70%)	9(30%)
Ali et al (2010)	(68%)	(32%)

Fracture type: (Schatzker Classification) Our cohort showed a near-equal distribution of Schatzker type V and VI fractures.

Study	Schatzker Type-V	Schatzker Type - VI
Our study	8(53.3%)	7(46.7%)
Wang et al	(50%)	(50%)
Tornetta et al	(52%)	(48%)

Time to Union: All fractures united radiologically. The mean union time in our study was 16.9 weeks, comparable to established literature.

Study	Mean time of union
Our study	16.9 weeks
Gafary et -al	16.5 weeks
Patel et- al	17.2 weeks

Functional Outcomes (Neer's Score): Functional outcomes were assessed using Neer's rating system and showed good to excellent recovery in most cases.

Study	Excellent	Good	Fair	Poor
Our study	40%	46.7%	13.3%	0
Ali et al	42%	44%	14%	0
Mills et al	38%	50%	12%	0

Radiological Outcomes (Modified Rasmussen's Score): Radiological outcomes were assessed using Modified Rasmussen's Score and showed good to excellent recovery in most cases.

Study	Excellent	Good	Fair	Poor
Our study	46.67%	40%	13.33%	0
Sharma V et al (2017)	45%	40%	15%	0
Rana R et al (2019)	48%	32%	16%	0
Kumar A et al (2021)	43.3%	36.7%	20%	0

Complications

In the present study, 13.33% (2 patients) experienced pin tract infections, which were successfully managed with local wound care and antibiotics. One patient (6.67%) developed joint stiffness, which was managed by structured physiotherapy. The majority (80%) had no complications. Our complication rates align with published literature

Study	Pin tract infection	Joint stiffness	Nil
Our study	13.33%	6.67%	80%
El Gafary et -al	15%	10%	75%
Catagni et- al	18%	9%	73%

Conclusion

The use of external ring fixators in the management of bicondylar tibial plateau fractures resulted in excellent union rates, satisfactory functional outcomes, and low complication rates. This method is particularly advantageous in high-energy fractures with significant soft tissue injury where traditional open plating may not be ideal. External fixation, therefore, represents a reliable, minimally invasive alternative for achieving good results in these challenging injuries.

Bibliography

1. Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experiences. 1968–1975. Clin Orthop Relat Res. 1979;(138):94–104.
2. Barei DP, Nork SE, Mills WJ, Henley MB, Benirschke SK. Complications associated with internal fixation of high-energy bicondylar tibial plateau fractures. J Orthop Trauma. 2004;18(10):649–657.
3. Kfuri M, Schatzker J. Revisiting the Schatzker classification of tibial plateau fractures. Injury. 2018;49(12):2252–2263.
4. Dendrinos GK, Kontos S, Lyritsis E. Use of the Ilizarov technique for treatment of tibial plateau fractures. Clin Orthop Relat Res. 1996;(332):103–111.
5. 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(5):661– 673.
6. Watson JT, Wiss DA. Fractures of the proximal tibia and fibula. In: Bucholz RW, Heckman JD, Court-Brown CM, eds. Rockwood and Green's Fractures in Adults. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2006:2029–2078.
7. Court-Brown CM, McBirnie J. The epidemiology of tibial fractures. J Bone Joint Surg Br. 1995;77(3):417–421.
8. Catagni MA, Ottaviani G, Camagni M. Treatment strategies for complex fractures of the tibial plateau with external circular fixation and limited internal fixation. J Orthop Trauma. 2007;21(5):349–354.
9. Kugan R, Harwood P, Darrah C, et al. The role of circular fixator in bicondylar tibial plateau fractures. Eur J Orthop Surg Traumatol. 2013;23(5):599-606.
10. El Barbari M, Fekhaoui M, Daoudi A, et al. Management of open tibial plateau fractures with soft tissue compromise: Role of external fixation. Pan Afr Med J. 2016;25:121.

11. Watson JT, Sanders R. Management of tibial plateau fractures. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, eds. Skeletal Trauma: Basic Science, Management, and Reconstruction. 3rd ed. Philadelphia: Saunders; 2003:2225–2281.
12. Raza H, Hashmi P, Abbas K. Minimally invasive treatment of high-energy tibial plateau fractures using the Ilizarov external fixator. J Trauma. 2007;62(2):435–439.
13. 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(5):301–306.
14. Hall JA, Beuerlein MJ, McKee MD. 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.
15. Kumar A, Whittle AP. Treatment of complex (Schatzker Type VI) fractures of the tibial plateau with circular external fixation: Retrospective case review. J Orthop Trauma. 2000;14(5):339–344.
16. Gill SP, Smith GA, Kazemi N. Soft tissue considerations in tibial plateau fractures. Orthop Clin North Am. 2021;52(2):201–213.
17. Chhabra HS, Singh R, Gaba S, et al. Modified hybrid external fixation in high-energy tibial plateau fractures: Clinical and functional results. J Orthop Trauma. 2007;21(6):370–376.