Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Orthopaedics Surgery

Journal homepage: https://ijos.co.in/

Original Research Article

Evaluation of clinical and radiological outcomes of schatzker type v and vi tibial plateau fractures managed by dual plating: A prospective analytical study

Aman Bhardwaj[1]*, Vishnu Pratap Singh[2], Banshilal Bishnoi[2], AK Mehra[2], Ajeet Kumar Aloriya[2]

[1]Dept. of Orthopedics, SJP Medical College, Bharatpur, Rajasthan, India
[2]Dept. of Orthopedics, RNT Medical College, Udaipur, Rajasthan, India

Abstract

Introduction: Schatzker type V and VI tibial plateau fractures are complex injuries resulting from high-energy trauma, often associated with soft tissue damage. These fractures present significant challenges in restoring joint congruity and function. Dual plating techniques, utilizing both lateral locking plates and medial buttress plates, have become the gold standard for managing these fractures, offering enhanced stability and facilitating early mobilization.

Aims and Objective: This study aims to evaluate the functional outcomes of closed Schatzker type V and VI tibial plateau fractures managed by fracture-specific dual plating, assessed using the Hospital for Special Surgery (HSS) knee scoring system. It seeks to analyze the complications associated with this treatment method and assess its advantages and disadvantages as a fixation technique for managing such fractures.

Materials and Methods: A prospective analytical study was conducted at the Department of Orthopaedics, RNT Medical College, Udaipur, Rajasthan, from July 2023 to June 2024, involving 22 patients aged 18–60 years with closed Schatzker type V and VI tibial plateau fractures. All patients underwent dual plating surgery. Functional outcomes were assessed using the Knee Society Score, while radiological parameters such as medial proximal tibial angle (MPTA) and articular step-off were analyzed.

Results: The study demonstrated excellent to good functional outcomes in 95.4% of patients, with average Knee Society Scores of 81.53 for lateral locking plates and 84.44 for raft plates. Radiologically, 86% of patients had an articular step-off of ≤2 mm, and MPTA remained within the normal range. Complications were minimal, with a 4.54% rate of superficial infection and 22.72% of knee stiffness.

Conclusion: Dual plating is an effective treatment for Schatzker type V and VI tibial plateau fractures, offering superior functional and radiological outcomes with minimal complications, especially when combined with minimally invasive techniques.

Keywords: Schatzker type V, Schatzker type VI, Tibial plateau fractures, Dual plating, functional outcomes, Radiological outcomes, Knee Society Score, Complications, Minimally invasive surgery

Received: 16-12-2024; **Accepted:** 24-09-2025; **Available Online:** 20-11-2025

1. Introduction

Tibial plateau fractures represent a complex group of injuries ranging from simple, non-displaced fractures to highly comminuted patterns involving both articular and metaphyseal components. Among these, Schatzker type V and VI fractures are particularly challenging due to their instability, articular depression, and frequent association with extensive soft tissue injury.[1] Such fractures are predominantly seen following high-energy trauma such as road traffic accidents or falls from height, often leading to significant morbidity. Management of these injuries requires a fine balance between anatomical restoration, stability, and preservation of soft tissue integrity to ensure functional outcomes.[2]

Historically, conservative methods such as casting or traction were utilized for managing these injuries, particularly in low-energy fracture patterns or elderly osteoporotic patients. These techniques often resulted in complications such as joint stiffness, malunion, and poor functional outcomes.[3] The shift toward surgical management has been driven by the need for anatomical reduction, particularly in high-energy injuries

*Corresponding author: Aman Bhardwaj
Email: aman7sk@gmail.com

https://doi.org/10.18231/j.ijos.9438.1760522534

where displacement and comminution are significant.[4] Surgical techniques have evolved significantly, with internal fixation becoming the cornerstone of treatment. Dual plating techniques, using lateral locking plates and medial buttress plates, have emerged as a preferred approach for bicondylar tibial plateau fractures. This method allows for precise reduction of the articular surface and provides superior biomechanical stability. It enables early mobilization, which is critical for preserving joint function. Studies comparing single lateral plating and dual plating have demonstrated the superiority of dual plating in preventing varus collapse and maintaining anatomical alignment.[5]

Despite its advantages, dual plating is not without challenges. Extensive soft tissue dissection required for the medial and lateral incisions increases the risk of complications such as wound infection and dehiscence. Advancements in surgical techniques, such as the minimally invasive plate osteosynthesis (MIPO) method, have minimized these complications while preserving the benefits of dual plating (Eggli et al.).[6] The use of advanced imaging modalities like computed tomography (CT) and magnetic resonance imaging (MRI) has further refined pre-operative planning. These tools provide detailed information about fracture morphology and associated soft tissue injuries, enabling tailored surgical approaches. For example, fractures involving the posteromedial fragment can be effectively managed with specific approaches, such as the Lobenhoffer incision, ensuring accurate reduction and fixation while protecting neurovascular structures (Weil et al.).[7]

Present study investigates the clinical and radiological outcomes of Schatzker type V and VI tibial plateau fractures treated with dual plating. Using a prospective approach, we aim to assess functional recovery, post-operative complications, and long-term knee function. By employing validated scoring systems such as the Knee Society Score and analyzing radiological parameters, this study seeks to contribute to the evidence base for managing complex tibial plateau fractures effectively.

2. Materials and Methods

2.1. Study design and setting

This was a prospective analytical study conducted at the Department of Orthopaedics, RNT Medical College and MB Government Hospital, Udaipur, Rajasthan, from July 2023 to June 2024. The study focused on Schatzker type V and VI tibial plateau fractures managed with dual plating.

2.2. Study population

Twenty-two patients aged 18–60 years with closed Schatzker type V and VI tibial plateau fractures were included. Participants were selected based on the following inclusion and exclusion criteria:

2.3. Inclusion criteria

1. Adult patients aged 18–60 years.
2. Closed Schatzker type V and VI tibia plateau fractures.
3. Patients willing to give consent to this study and follow up

2.4. Exclusion criteria

1. Open fractures.
2. Old fractures (>4 weeks).
3. Fractures with neurovascular injury.
4. Patients unfit for surgery or unwilling to consent.

2.5. Preoperative management

Patients received analgesics and limb immobilization in a Genu Tibial slab (above-knee slab for temporary immobilization) upon admission. Radiographs and CT scans were used to assess fracture geometry. Skeletal traction was applied to stabilize the limb until soft tissue swelling subsided, indicated by wrinkle signs.

Computed tomography with axial, coronal and sagittal reconstructions is an extremely helpful, almost essential form of imaging for complex fractures. It allows us to formulate a three-dimensional Column concept of the fracture which is useful in delineating the extent and location of condylar fracture lines as well as the location and depth of articular impaction, comminution and Displacement. It facilitates preop planning: the size and location of placement of window for reduction can be determined. It helps to plan for type, size, location of plates and screws.

3. Images of Case (Figure 1A), (Figure 1B), (Figure 1C), (Figure 1D), (Figure 1E), (Figure 1F(a)), (Figure 1F(b)), (Figure 1G)

Figure 1A: Anterolateral incision with locking plate and mini- incision distal screws

Figure 1B: Posterio- medial incision with buttress plate

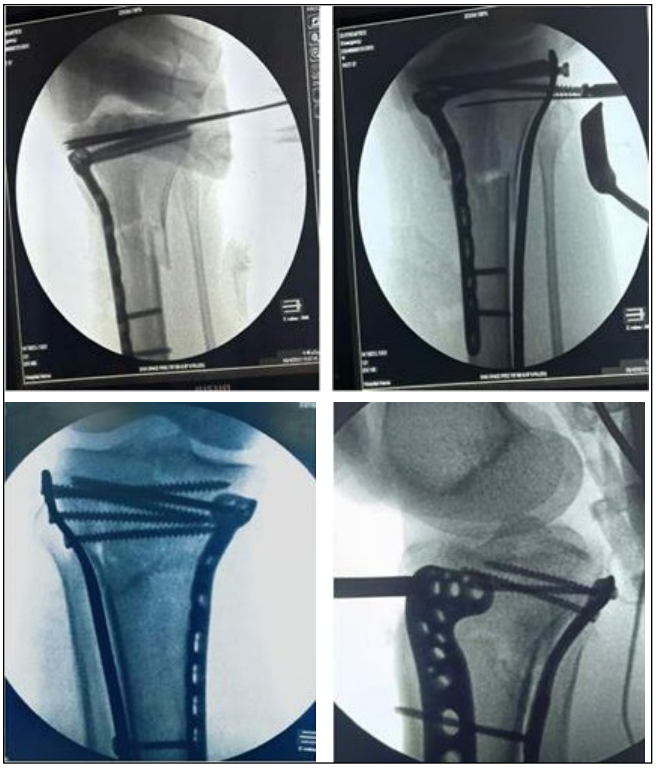

Figure 1C: Intraoperative fluoroscopic images of dual plating fixation

Figure 1D: Direct Posterior inverted L shape incision with buttress plate in tibial plateau fractures.

Figure 1E: Pre Operative Xray and 3D CT scan

Figure 1F(a): Immediate Post op-

Figure 1F(b): Range of motion after 10 months

Figure 1G: Follow up; at 1 month at 10 months

4. Surgical Technique

The procedure involved a dual plating approach for Schatzker Type V and VI tibial plateau fractures. For the medial condyle, a 2 cm posterior incision was made, and the gastrocnemius fascia was retracted to expose the fracture. The fracture was reduced by flexing and externally rotating the tibia, and a 3.5 mm dynamic compression plate was applied. For the lateral condyle, a lazy S incision was made over the Gerdy tubercle, and the fracture was mobilized using a chisel. The articular surface depression was elevated and fracture reduced. The resulting subchondral or metaphyseal defect was then grafted with autologous cancellous graft, and a lateral compression plate or raft plate was used to stabilize the fracture, ensuring screw orientation for biomechanical stability.

5. Postoperative Protocol

Postoperatively, patients were maintained in well-padded dressings, with no plaster/slabs for immobilization. Early knee mobilization was encouraged, with 90 degrees of active flexion achieved within 10 days. Initially non-weight-bearing, patients progressed to partial weight-bearing at 12 weeks and full weight-bearing at 16 weeks.

6. Data Collection and Analysis

Data on clinical and radiological outcomes were recorded on structured proformas. Functional outcomes were measured using the Knee Society Score, while radiological parameters, such as medial proximal tibial angle (MPTA) and articular step-off, were evaluated. Statistical analysis was conducted using SPSS Version 22.

7. Result

Table 1 show that majority of patients were male, reflecting the higher incidence of high-energy trauma among this group. Road traffic accidents emerged as the predominant mechanism of injury, accounting for over 95% of cases. The right and left sides were equally affected. The age distribution revealed a predominance of patients in the 31–40 years age group. Associated injuries such as clavicle fractures, forearm fractures, and distal radius fractures were also observed among the study population.

Table 2 showing bone grafting was utilized in a minority of cases, primarily in fractures with significant metaphyseal voids. Postoperative complications included knee stiffness in approximately 22.72% of patients and a low rate of superficial infection (4.54%), both of which were managed conservatively. Occasional postoperative pain was reported by a small proportion of patients.

Table 3 shows that overall, the majority of patients achieved excellent to good results, with higher scores observed in younger patients and those treated with raft plates. The analysis across different age groups and implant categories demonstrated favorable recovery patterns, highlighting the effectiveness of dual plating in achieving good functional outcomes.

Table 1: Demographics, injury characteristics, and associated injuries of patients with schatzker type v and vi tibial plateau fractures

Parameter	Categories	Frequency	Percentage
Sex distribution	Male	17	77.27%
	Female	5	22.72%
Mode of injury	Road traffic accident	21	95.45%
	Assault	1	4.54%
Side of injury	Right	11	50.00%
	Left	11	50.00%
Age distribution	18–30	6	27.27%
	31–40	9	40.90%
	41–50	4	18.18%
	51–60	3	13.63%
Fracture type	Schatzker type v	5	22.72%
	Schatzker type vi	17	77.27%
Associated injuries	Left clavicle fracture	2	9.09%
	Distal radius fracture	1	4.54%
	Both bone forearm fracture	1	4.54%

Table 2: Bone grafting usage and postoperative complications in schatzker type v and vi tibial plateau fractures

Parameter	Categories	Frequency	Percentage
Bone grafting usage	Bone graft used	4	18.18%
	Bone graft not used	18	81.82%
Complications	Knee stiffness	5	22.72%
	Superficial infection	1	4.54%
	Occasional pain	3	13.63%

Table 3: Functional outcomes based on knee society score in different implant groups

Outcome Parameter	Group/Category	Measure	Excellent	Good	Fair	Poor
Functional outcomes	Lateral column implant - LCP	Average knee society score: 81.53	6	6	1	0
	Lateral column implant - Raft plate	Average knee society score: 84.44	6	3	0	0
	Age group: 18–30	Average knee society score: 85.00	4	2	0	0
	Age group: 31–40	Average knee society score: 83.66	6	3	0	0
	Age group: 41–50	Average knee society score: 80.00	1	3	0	0
	Age group: 51–60	Average knee society score: 76.00	0	1	1	0
Overall functional outcomes	All patients	Combined average knee society score	12	9	1	0
Radiological analysis	MPTA	Normal range: 83–88 degrees	Maintained	–	–	–
	Articular step-off	≤2 mm (acceptable limit)	19 Patients ≤ 2 mm	0 Patients > 2 mm	–	–

8. Discussion

Schatzker type V and VI tibial plateau fractures represent some of the most complex and challenging injuries in orthopedic trauma due to their high-energy mechanism, bicondylar involvement, and associated soft tissue compromise. These injuries often necessitate surgical intervention to restore joint congruity, mechanical alignment, and functional outcomes. In our study, dual plating emerged as an effective surgical approach, with superior clinical and radiological outcomes that align closely with findings in the existing literature.

9. Demographics and Injury Mechanism

The male predominance observed in our study (3.3:1) reflects the higher exposure of men to high-energy trauma, such as road traffic accidents (95.45%), which was also the predominant mechanism of injury. These findings are consistent with previous studies, including Neil Rohra et al. (2016), who reported a similar gender distribution (male-to-female ratio of 5.8:1) and attributed it to the occupational and recreational activities more commonly undertaken by men on more study conducted by Kumar et al. further corroborated the predominance of road traffic accidents as a causative factor in these fractures.[8,9]

10. Functional Outcomes

Functional recovery was excellent to good in 95.4% of patients, with average Knee Society Scores of 81.53 for lateral locking plates and 84.44 for raft plates. These outcomes align with Cho et al., who achieved a mean Knee Society Score of 85 using dual plating and emphasized its role in enabling early mobilization and stability . Similarly, Khatri et al. reported excellent outcomes in 82% of cases, highlighting the importance of anatomical reduction and rigid fixation provided by dual plating.[10,11]

The age-based analysis in our study revealed that younger patients (18–30 years) achieved the highest scores (mean: 85.00), while older patients (51–60 years) had slightly lower scores (mean: 76.00). This trend is likely due to differences in bone quality and healing potential, consistent with findings by Vasiliadis et al., who observed that age significantly influences recovery timelines and overall functional outcomes.[12]

11. Radiological Outcomes

Radiological evaluation demonstrated that medial proximal tibial angles (MPTA) were consistently maintained within the normal range (83°–88°), and articular step-off ≤2 mm was achieved in 86% of cases. These results surpass those reported by Prasad et al. who achieved similar alignment in 75%–80% of cases using dual plating. The stability provided by dual plating minimizes the risk of late varus collapse, a common complication with single-plate fixation, as noted by Higgins et al.[5,13]

12. Surgical Technique and Bone Grafting

The dual plating approach employed in this study utilized a posteromedial buttress plate for the medial column and a locking compression or raft plate for the lateral column. Dindivanam et al. also reported comparable outcomes using locking compression plates.[14]

This configuration provides robust fixation, as corroborated by Khatri et al. and Patil et al., who emphasized the role of medial column buttressing in preventing malalignment and maintaining joint congruity.[15,16]

Bone grafting was performed in 18.18% of cases to address metaphyseal voids. This selective use of grafting aligns with the findings of Manjunath et al. , who reported grafting in 42.9% of patients with similar fracture patterns. Although grafting provided structural support, it did not significantly accelerate union times, which averaged 12–16 weeks, consistent with observations by Mandal et al.[17,18]

13. Complications

Complications were minimal in this study, with one case of superficial infection (4.54%) and five cases of knee stiffness (22.72%), all managed conservatively. These results are consistent with those of Vasiliadis et al., who reported minimal soft tissue complications when dual plating was combined with minimally invasive approaches. The MIPO technique used in our study minimized soft tissue disruption, contributing to the low complication rate.[12] This study compared lateral locking plates and raft plates for lateral column fixation, finding no significant differences in functional or radiological outcomes. These findings are consistent with Mandal et al., who noted that both implants provide comparable biomechanical stability when used as part of a dual plating approach.[18]

14. Conclusion

The findings of this study support the use of dual plating for managing Schatzker type V and VI tibial plateau fractures. This approach ensures anatomical reduction, biomechanical stability, and early mobilization, leading to excellent functional and radiological outcomes. The low complication rates observed highlight the importance of minimally invasive techniques in optimizing patient outcomes while minimizing soft tissue morbidity.

15. Source of Funding

None.

16. Conflict of Interest

None.

17. Ethical No.

RNT/ACAD/IEC/2023/812

References

1. Zeltser DW, Leopold SS. Classifications in Brief: Schatzker Classification of Tibial Plateau Fractures. *Clin Orthop Relat Res*. 2013;471(2):371–4. https://doi.org/10.1007/s11999-012-2451-z
2. Mills WJ, Nork SE. Open reduction and internal fixation of high-energy tibial plateau fractures. *Orthop Clin North Am*. 2002;33(1):177–98. https://doi.org/10.1016/s0030-5898(03)00079-8
3. Hoffmeyer P, Miozzari H, Holzer N. Non–hip/non-vertebral fractures – How to treat best? *Best Pract Res Clin Rheumatol*. 2019;33(2):236–63. https://doi.org/10.1016/j.berh.2019.03.019
4. Lansinger O, Bergman B, Körner L, Andersson GB. Tibial condylar fractures. A twenty-year follow-up. *J Bone Joint Surg Am*. 1986;68(1):13–9.
5. 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):301–6. https://doi.org/10.1097/BOT.0b013e3180500359.
6. Eggli S, Hartel MJ, Kohl S, Haupt U, Exadaktylos AK, Roder C. Unstable bicondylar tibial plateau fractures: A clinical investigation. *J Orthop Trauma*. 2008;22(10):673–9. https://doi.org/10.1097/BOT.0b013e31818b1452
7. Weil YA, Gardner MJ, Boraiah S, Helfet DL, Lorich DG. Posteromedial supine approach for reduction and fixation of medial and bicondylar tibial plateau fractures. *J Orthop Trauma*. 2008;22(5):357–62.
8. Rohra N, Suri HS, Gangrade K. Functional and radiological outcome of schatzker type v and vi tibial plateau fracture treatment with dual plates with minimum 3 years follow-up: a prospective study. *J Clin Diagn Res*. 2016;10(5):RC05–10. https://doi.org/10.7860/JCDR/2016/18732.7855
9. Kumar V, Singhroha M, Arora K, Sahu A, Beniwal R, Kundu A. A clinico-radiological study of bicondylar tibial plateau fractures managed with dual locking plates. *J Clin Orthop Trauma*. 2021;21:101563. https://doi.org/10.1016/j.jcot.2021.101563
10. Cho KY, Oh HS, Yoo JH, Kim DH, Cho YJ, Kim KI. Treatment of schatzker type v and vi tibial plateau fractures using a midline longitudinal incision and dual plating. *Knee Surg Relat Res*. 2013;25(2):77–83. https://doi.org/10.5792/ksrr.2013.25.2.77
11. Khatri SS, Rathore KS, Goyal V, Yadav J. Evaluation of Functional and Radiological Outcome of Tibial Plateau Fractures Schatzker Type V and VI Treated with Dual Plating. *Int J Orthop Sci*. 2017;3(2):150–6. http://dx.doi.org/10.22271/ortho.2017.v3.i2c.23
12. Vasiliadis AV, Poutoglidou F, Metaxiotis D, Mpeletsiotis A. Mid-term radiological and functional outcomes of bicondylar tibial plateau fractures managed with open reduction and internal fixation using dual plates. *Sultan Qaboos Univ Med J*. 2022;22(1):51–7. https://doi.org/10.18295/squmj.4.2021.059
13. Prasad GT, Kumar TS, Kumar RK, Murthy GK, Sundaram N. Functional outcome of schatzker type v and vi tibial plateau fractures treated with dual plates. *Indian J Orthop*. 2013;47(2):188–94. https://doi.org/10.4103/0019-5413.108915
14. Dindivanam MK, Prakashappa TH, Avinash P, Vamsinath P. Functional outcome of surgical management in schatzker type v, vi tibial plateau fractures with locking compression plate. *Int J Orthop Sci*. 2019;5(2):556–59. https://doi.org/10.22271/ortho.2019.v5.i2h.53
15. Patil SN, Srinivas P, Bhandary D. Prospective study of management of schatzker's type v & vi tibial plateau fractures by different types of plate osteosynthesis. *Int J Res Orthop*. 2017;3(5):1070–7. https://doi.org/10.18203/issn.2455-4510.IntJResOrthop20173944
16. Raj M, Gill SPS, Rajput A, Singh KS, Verma KS. Outcome analysis of dual plating in management of unstable bicondylar tibial plateau fracture - a prospective study. *Malays Orthop J*. 2021;15(3):29–35. https://doi.org/10.5704/MOJ.2111.005
17. Manjunath J, BC A, Shashidhara H, Rao V. A prospective study of surgical management of bicondylar schatzker type v & vi tibial plateau fracture by dual plating and dual incision. *Int J Orthop Sci*. 2019;5(3):46–54. https://doi.org/10.22271/ortho.2019.v5.i3b.1506
18. Mandal A, Dutta P, Sarkar PS, Bandyopadhyay U, Santra S. Single long midline incision versus two small incision techniques in treatment of schatzker type v and vi tibial plateau fractures—A Comparative study. *J Indian Med Assoc*. 2013;111(12):804–5.

Cite this article: Bhardwaj A, Singh VP, Bishnoi B, Mehra AK, Aloriya AK. Evaluation of clinical and radiological outcomes of schatzker type v and vi tibial plateau fractures managed by dual plating: A prospective analytical study. *Indian J Orthop Surg.* 2025;11(3):174–179.