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Functional and radiological outcomes of posterior column tibial plateau fractures treated with column-specific fixation: a prospective study

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ABSTRACT

Background: Posterior column tibial plateau fractures are complex intra-articular injuries. This study aims to evaluate the functional and radiological outcomes of such fractures managed through column-specific open reduction and internal fixation based on CT classification.
Methods: A prospective interventional study on 30 patients with posterior column tibial plateau fractures treated surgically between 2020 and 2022 at Deen Dayal Upadhyay Hospital, New Delhi. Fractures were classified based on CT imaging and approaches selected according to column involvement. Functional and radiological outcomes assessed at 6 months using Rasmussen's grading systems. Data were analyzed using SPSS v21, with significance set at $p<0.05$.
Results: Mean age of patients was 40.3±8.94 years, with a male predominance (86.67%). RTA accounted for 90% of injuries. Most common fracture pattern was PM/AM (33.33%), and the posteromedial approach was used in 60% of cases. The mean time to radiological union was 17.13±1.22 weeks. Functional outcomes were excellent in 33.33%, good in 60%, and fair in 6.67% of patients. Radiological outcomes showed excellent results in articular depression (63.33%), condylar widening (80%), and angulation (76.67%). A significant correlation was found between radiological and functional outcomes ($p=0.030$), but not between fracture classification and outcome ($p=0.426$). Minimal complications (4 superficial and 1 case of deep infection).
Conclusion: CT-based classification and column-specific fixation of posterior tibial plateau fractures provides favorable functional and radiological outcomes with minimal complications. Accurate reduction and stable fixation tailored to fracture morphology are key to optimal recovery.

Keywords: Tibial plateau fracture, Posterior column, Column-specific fixation, Rasmussen score

INTRODUCTION

Tibial plateau fractures are among the most frequently encountered intra-articular fractures, accounting for approximately 1% of all fractures. These injuries typically result from high-energy trauma and often involve complex mechanisms including valgus or varus stress, rotational forces, and axial compression, particularly when the knee is in a flexed position. The lateral tibial condyle is most commonly affected, with isolated injuries comprising 55–70% of cases, whereas isolated medial condyle fractures account for 10–25% and bicondylar fractures represent 10–30% of cases.[1] Posterior tibial plateau fractures, however, are relatively uncommon, reported in about 28.8% of tibial plateau fracture cases.[2] These posterior fractures often extend along the coronal plane and may involve the medial or lateral condyle, posing significant diagnostic and therapeutic challenges due to their complex anatomy and relatively hidden presentation on standard anteroposterior radiographs.[3] Despite advancements in surgical management, postoperative complications such as articular step-off and angular deformities continue to be

observed in 19–26% of cases.[4] Conventional classification systems, such as the AO/OTA (types 41-B2.2 and B3.2) and Schatzker (types IV, V, and VI), provide limited descriptions of posterior column fractures and often fail to distinguish between fractures where the medial fragment is primarily posterior and potentially associated with subluxation or dislocation of the knee joint.[5] In response to these limitations, revised classification systems such as the Duparc modification have been developed to better describe posterior elements, categorizing Schatzker type IV fractures as spinocondylar (74%), unicondylar (19%), or bicondylar (2%) based on key morphological features.[5] Computed tomography (CT) has emerged as a crucial tool in the assessment of posterior tibial plateau fractures, offering superior visualization of coronal plane fractures that are often missed on plain radiographs. Several contemporary classification systems based on CT imaging have enhanced the understanding of these fractures. For instance, Luo et al. proposed a three-column concept dividing the tibial plateau into anterior, medial, and posterior columns, allowing for a more precise description and tailored management strategies.[6] Similarly, Chang et al. introduced a four-quadrant classification system, segmenting the plateau into isolated or combined quadrant injuries, which aids in selecting the appropriate surgical approach.[7]

Traditional surgical techniques involving open reduction and internal fixation (ORIF) through anterolateral or anteromedial approaches have shown limitations in accessing and stabilizing the posterior fragments, particularly the posteromedial and posterolateral components. Inadequate fixation from these conventional approaches has been associated with suboptimal outcomes, including malalignment, instability, and delayed rehabilitation. These challenges have prompted a shift toward column-specific surgical approaches that aim for minimal soft tissue dissection, anatomical joint reconstruction, rigid fixation, and early mobilization. Due to the coronal orientation and location of these fractures, a single lateral-based plate often provides insufficient stability, necessitating additional fixation to prevent varus or valgus malalignment, even with locking plate technology.[8]

Despite the evolving understanding of posterior tibial plateau fractures and the development of new classification systems and surgical approaches, there remains a paucity of clinical studies assessing the functional and radiological outcomes of these injuries using a column-specific fixation strategy. Previous research has largely focused on descriptive analyses or small cohorts without standardized outcome measurements. Therefore, a clear gap exists in evaluating the effectiveness of tailored, column-based surgical management in terms of both functional recovery and radiological restoration. The aim of this study is to evaluate the functional and radiological outcomes of posterior column tibial plateau fractures managed by open reduction and internal fixation using a column-specific surgical approach. This evaluation is conducted using the Rasmussen functional and radiological scoring systems in a cohort of 30 patients, thereby contributing to evidence-based decision-making in the management of these complex fractures.

METHODS

This prospective interventional study was conducted in the Department of Orthopaedics, Deen Dayal Upadhyay Hospital, Hari Nagar, New Delhi, during the period from 2020 to 2022. A total of 30 patients with tibial plateau fractures involving the posterior column were included, all of whom were treated with open reduction and internal fixation using a column-specific surgical approach.

Inclusion criteria

Patients were selected based on the fractures of the tibial plateau involving the posterior column with displacement >2 mm affecting articular congruity, age above 18 years, presentation within two weeks of injury.

Exclusion criteria

Associated fractures in the ipsilateral or contralateral lower limb, compound or open fractures, neurovascular compromise, pathological fractures, patients unfit for surgery.

Ethical clearance

Ethical approval for this study was obtained from the institutional ethical committee at Deen Dayal Upadhyay Hospital, Hari Nagar, New Delhi.

Initial assessment and preoperative evaluation

Upon arrival at the emergency department, patients were evaluated following the ATLS protocol. Detailed clinical examination focused on identifying associated injuries, neurovascular status, soft tissue condition, and overall limb alignment. Primary imaging included standard radiographs of the chest, pelvis, and affected limb.

Fracture assessment involved evaluating swelling, joint effusion, and skin condition. In cases of significant swelling or presence of blebs, elevation with a Bohler-Braun splint and traction were applied until the edema subsided and the wrinkle sign appeared, indicating readiness for definitive surgery. Laboratory investigations included a complete hemogram, blood grouping, random blood sugar, renal and liver function tests, serum electrolytes, viral markers, ECG, and chest radiograph. Radiological imaging included standard anteroposterior, lateral, and oblique X-rays of the affected knee joint. CT scan with 3D reconstruction was performed to classify the fracture pattern accurately, using the Chang et al. CT-based classification system which categorizes injuries into single, two, three, or four-quadrant involvement.

Surgical procedure

All patients underwent pre-anesthetic evaluation and were operated on under regional anesthesia. The aim of surgical treatment was to restore the articular surface, correct limb alignment, and provide stable fixation to allow early knee mobilization and weight-bearing. The surgical approach was tailored to the specific fracture configuration:

Posteromedial approach

Used in prone position, an inverted L-shaped incision was made. After careful dissection and retraction of neurovascular structures, the posteromedial corner was exposed. The fragment was elevated, reduced, and fixed with a 3.5 mm T or L buttress locking plate or a distal radius locking plate (Figure 1A-C).

Anterolateral approach

Performed in the supine position with a curvilinear incision over Gerdy's tubercle. After exposing the lateral condyle and elevating the depressed fragments, the defect was filled with autogenous iliac crest bone graft and stabilized with a lateral locking plate.

Posterolateral approach

Executed in the prone position, with a straight incision medial to the fibular head. The common peroneal nerve was identified and protected. After incising the posterior capsule and elevating the menisci, the posterolateral fragment was exposed, reduced, and fixed with a similar locking plate (Figure 1D). Depending on the column involvement, combined approaches were adopted sequentially in prone and supine positions to ensure complete fracture stabilization.

Postoperative management

Postoperatively, limbs were kept elevated and monitored for vitals, swelling, drain output, and signs of complications such as deep vein thrombosis (DVT). Intravenous antibiotics (Ceftriaxone 1 g BD and Amikacin 500 mg BD) were administered for five days. High-risk patients received Enoxaparin 40 mg subcutaneously for 2–3 days. Radiographs were taken to assess fixation, and drains were removed after 24 hours. Dressings were done on day 3 and day 7, with suture removal on day 14. Patients were initiated on non-weight-bearing mobilization with physiotherapy guidance before discharge.

Rehabilitation protocol

Phase 1 (0–6 weeks)

Knee immobilization with a hinged brace in extension, patellar mobilization, assisted ROM up to 90°, and non-weight-bearing walking with quadriceps strengthening.

Phase 2 (6–12 weeks)

Progressive ROM, gradual transition to weight-bearing from the 8th week, and stationary cycling.

Phase 3 (12–24 weeks)

Full ROM and gait training without support, progressive strengthening of lower limb muscles, and return to functional activities including jogging and gym exercises.

Follow-up and outcome evaluation

Patients were followed up at 4, 6, 12, and 24 weeks postoperatively. At each visit, clinical and radiological assessments were performed using Rasmussen's functional and radiological grading systems. Evaluation included pain, range of motion, walking ability, stair climbing, knee stability, and return to daily activities. Radiographs were reviewed for articular step-off, condylar widening, and tibial plateau angle to assess anatomical restoration.

Articular step-off was measured as the maximal depression of the joint surface (Figure 2A). Condylar widening was determined by comparing tibial and femoral condylar widths. (Figure 2B). Tibial plateau angle was assessed in AP view for varus or valgus malalignment (Figure 2C.)

Complications monitored

Immediate

Bleeding, neurovascular injury.

Early

Compartment syndrome, superficial infections.

Late

Deep infections, fixation failure (screw loosening, plate migration/breakage), need for reoperation, nonunion, or malunion. Figure 3 (A-K) and Figure 4 (A-K) show illustrations of cases from preoperative stage to follow up stage.

Statistical analysis

All statistical analyses were conducted using SPSS version 21.0. Continuous variables were expressed as mean±standard deviation. Categorical variables were analyzed using frequencies and percentages. Paired t-tests or Wilcoxon tests were applied for continuous variables across follow-ups, while Chi-square or Fisher's exact tests were used for categorical data. A p value<0.05 was considered statistically significant, and<0.001 as highly significant.

RESULTS

The demographic profile of the 30 patients included in the study shows that the majority of patients (40%) were in the 31–40 years' age group, followed by 30% in the 41–50 years' group, indicating a predominance of middle-aged individuals. Younger patients under 30 years constituted 16.67%, while only 13.33% were in the 51–60 years range. A clear male predominance was observed, with 86.67% of the patients being male and only 13.33% female. This demographic pattern is consistent with the literature, where high-energy trauma-related tibial plateau fractures are more common in active, middle-aged men. Fractures were slightly more common on the right side (53.33%) compared to the left (46.67%), suggesting no strong lateral predominance.

Regarding the mode of injury, the majority of fractures (90%) resulted from road traffic accidents (RTA), reflecting the high-energy trauma typically associated with posterior tibial plateau fractures. Only 10% of the cases were due to falls, further supporting the finding that such fractures commonly occur in younger, more active individuals involved in high-impact incidents. Classification of fractures based on CT imaging and the corresponding surgical approaches used in the 30 patients included in the study showed that the most common fracture pattern was involvement of the posteromedial and anteromedial (PM/AM) columns, seen in 33.33% of patients, followed by isolated posteromedial (PM) fractures in 26.67% and posterolateral/anterolateral (PL/AL) in 20%. Less common patterns included isolated posterolateral (PL) fractures (13.33%) and complex three-column fractures (PL/AL/AM) in 6.67% of cases (Table 1).

In terms of surgical management, the posteromedial approach was most frequently employed (60%), especially in cases involving the PM and PM/AM regions. Combined posterolateral and anterolateral approaches were used in 26.67% of patients, reflecting the need for dual access in complex lateral-column fractures. Isolated posterolateral approaches were used in 13.33% of cases (Table 1). The majority (40%) underwent surgery between 6 to 8 days' post-injury, indicating a cautious approach to allow soft tissue recovery. About 30% of the patients were operated on within 5 days, reflecting early surgical readiness in cases with favorable soft tissue conditions.

Surgeries performed between 9–10 days and 11–12 days accounted for 16.7% and 13.3% of the cases, respectively. This distribution suggests that timing of surgery was tailored to each patient's tissue status, balancing the need for early fixation with the importance of minimizing soft tissue complications. The most common injury was to the anterior cruciate ligament (ACL), observed in 3 patients (10%). Posterior cruciate ligament (PCL) and medial collateral ligament (MCL) injuries were each present in 2 patients (6.67%). Similarly, medial and lateral meniscal tears were noted in 2 patients each. Notably, there were no recorded cases of nerve injury, compartment syndrome, or lateral collateral ligament (LCL) injury. These findings highlight the frequent involvement of intra-articular structures in such fractures and underscore the importance of careful intraoperative evaluation for associated ligament and meniscal damage.

The distribution of knee range of motion (ROM) among patients at the end of 6 months following surgical management of tibial plateau fractures showed that the majority of patients (60%) achieved a knee ROM of at least 120º, while 33.33% regained full functional flexion of 140º or more. A smaller proportion (6.67%) attained a ROM of at least 90º. No patients had restricted motion below 90º, indicating overall effective rehabilitation and joint recovery. The mean knee range of motion was 124.67º±10.58, suggesting good postoperative joint mobility following column-specific surgical intervention and structured physiotherapy protocols (Figure 5).

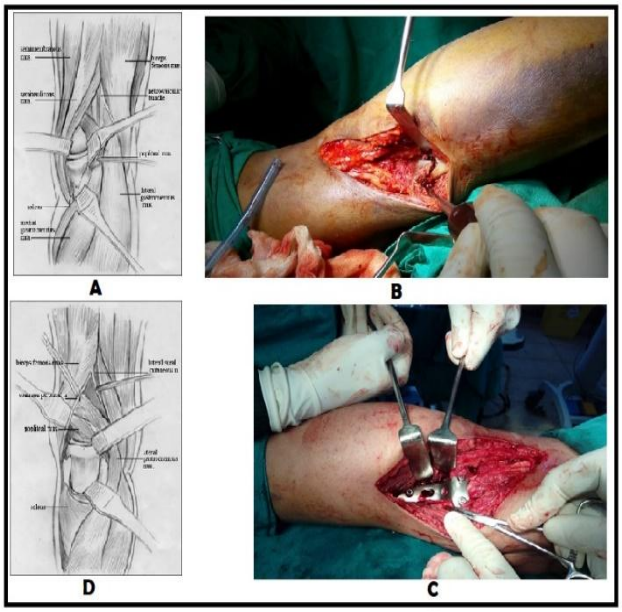


Figure 1: (A) Posteromedial approach. (B) Exposure of the posteromedial fractures site. (C) Posterolateral approach. (D) Plate placement on posteromedial fragment.

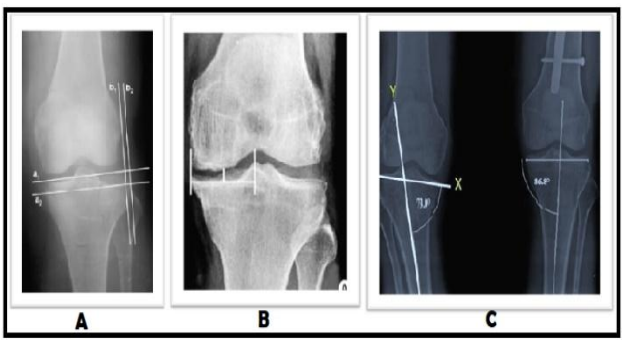


Figure 2: (A) Articular step off measurement. (B) Condylar width measurement. (C) Tibial plateau angle measurement.

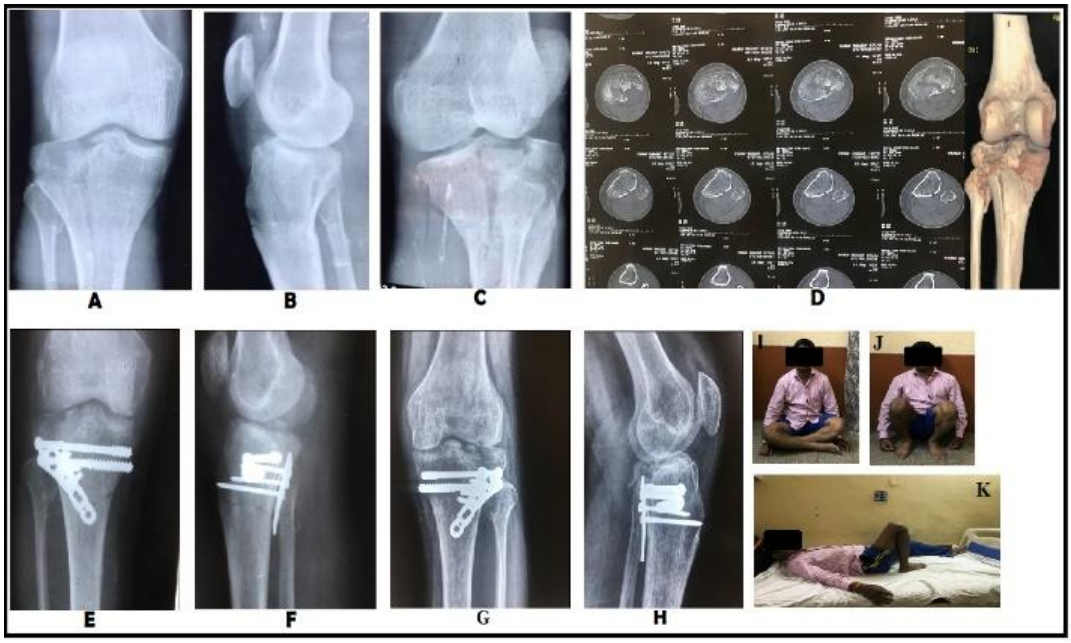


Figure 3: (A-C) Preoperative X-ray images showing 2 column fracture (anterolateral and posterolateral), confirmed by CT images. (D) Pre operative CT images. (E, F) Immediate post-operative X-ray image: fracture was addressed through posteolateral approach and fixation was done using 3.5 mm buttress plate and through anterolateral approach CC screw fixation was done. (G, H) 6th month follow-up X-ray image shows complete union of fracture. (I) Patient sitting in squatting position. (J) Patient sitting in cross legged position. (K) Complete knee flexion.



Figure 4: (A, B) Preoperative X-ray images showing 2 column fracture (Anterolateral and Posteromedial) confirmed by CT-images. (C)- Pre operative CT images. (D, E) Immediate Post-Operative X-ray image. Fracture was addressed through posteromedial approach and fixation was done using 3.5 mm buttress plate and CC screw from posteromedial to anterolateral direction. Anterolateral fracture fixation was done using 4.5mm proximal tibia locking plate using anterolateral approach. (F, G) 6th month follow-up x-ray image showing fracture union in progress with varus angulation of proximal tibia. (H) Complete knee extension. (I) Complate knee flexion J-patient sitting in squatting position. (K) Patient sitting in cross legged position; Patient having good knee range of motion with Rasmussen's functional score-28, Rasmussen's radiological score-16.

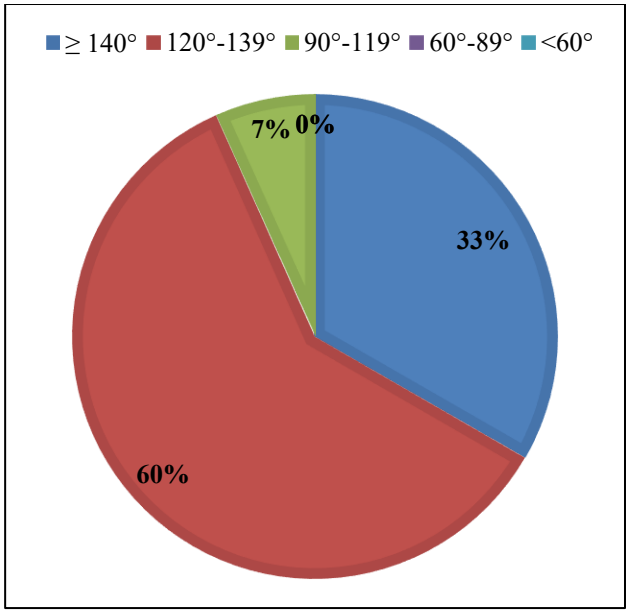


Figure 5: Knee range of motion at 6 months follow up.

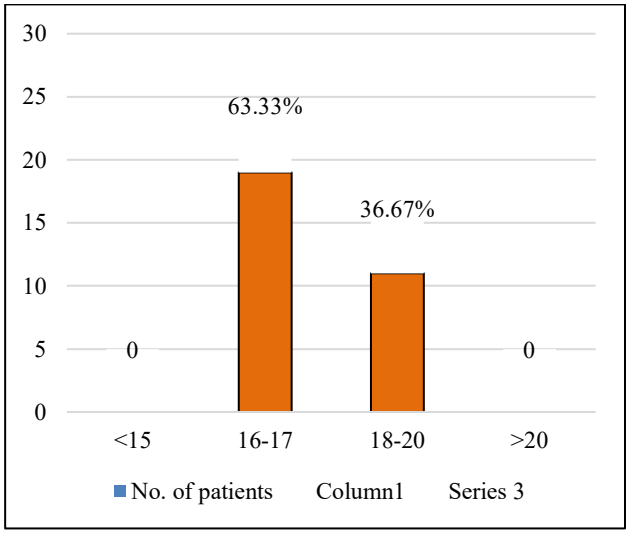


Figure 6: Time taken for radiological union in weeks.

The time taken for radiological union in patients with tibial plateau fractures treated using a column-specific fixation approach showed that the majority of patients (63.33%) achieved union between 16 and 17 weeks, while the remaining 36.67% showed union between 18 and 20 weeks. There were no cases of delayed union beyond 20 weeks or early union before 15 weeks. The mean time to union was 17.13±1.22 weeks, indicating that most fractures healed within a predictable timeframe (Figure 6).

A majority of patients (60%) achieved a good functional outcome, while 33.3% had excellent results. Only 6.7% of the patients had a fair outcome, and none experienced a poor result. These findings suggest that the column-specific surgical approach provided favorable clinical recovery, with most patients regaining significant functional mobility within six months. Radiological outcomes at 6 months demonstrated favorable results across all evaluated parameters articular depression, condylar widening, and angulation. Excellent results were observed in 63.33% of cases for articular depression, 80% for condylar widening, and 76.67% for angulation, indicating effective restoration of joint congruity and alignment. The remaining cases were graded as good, with no fair or poor outcomes recorded. These findings suggest that the column-specific fixation approach provided reliable anatomical reconstruction and maintained mechanical alignment, contributing to successful radiological recovery in the majority of patients (Table 2). The relationship between the CT-based fracture classification and functional outcome (assessed using Rasmussen's grading) at the 6-month follow-up showed that the most favorable outcomes (excellent) were noted in patients with PM (50%) and PM/AM (40%) type fractures.

Good functional results were consistently observed across all fracture types, especially in PL/AL and PL/AL/AM fractures, where 83.33% and 100% of patients, respectively, achieved good outcomes. Two patients with PM/AM fractures had fair results, representing the only less-than-good outcomes in the study. Importantly, no poor functional results were reported in any group (Table 3). The statistical analysis showed no significant correlation between fracture classification and functional outcome ($p=0.426$), indicating that with appropriate column-specific surgical management, favorable functional recovery can be achieved regardless of the specific fracture pattern.

The correlation between functional and radiological outcomes at the 6-month follow-up, assessed using Rasmussen's grading systems showed that among patients with excellent radiological outcomes (n=19), 47.37% also had excellent functional outcomes, while 52.63% had good functional outcomes. Among those with good radiological outcomes (n=11), the majority (72.73%) had good functional outcomes, and 18.18% had fair functional results. Notably, no patients in either group had poor outcomes (Table 4). The association between radiological and functional results was found to be statistically significant ($p=0.030$), indicating a meaningful relationship between the quality of anatomical restoration and clinical recovery.

In essence, patients who had better radiological alignment and joint surface reconstruction were more likely to regain superior functional outcomes, supporting the importance of achieving precise surgical reduction in tibial plateau fractures. Postoperative complications in this study were minimal, indicating a favorable safety profile for the column-specific surgical approach. No immediate complications were observed in any of the 30 patients. Early complications were limited to four cases of superficial surgical site infections, all of which responded well to conservative management without the need for surgical intervention.

Only one patient developed a delayed complication in the form of a deep infection. Importantly, there were no instances of implant failure, hardware prominence, malunion, or nonunion throughout the follow-up period. These findings reflect careful surgical planning, appropriate timing of intervention based on soft tissue condition, and strict adherence to postoperative care protocols.

Table 1: CT-based fracture classification and type of surgical approach.

Parameter	Category	Frequency	Percentage
CT-based fracture classification	PL	4	13.33
	PL/AL	6	20.00
	PL/AL/AM	2	6.67
	PM	8	26.67
	PM/AM	10	33.33
Type of surgical approach	PL	4	13.33
	PL/AL	8	26.67
	PM	18	60.00
Total	—	30	100.00

Table 2: Radiological outcome based on articular depression, condylar widening, and angulation.

Radiological outcome	Articular depression (%)	Condylar widening (%)	Angulation (%)
Excellent	19 (63.33)	24 (80.00)	23 (76.67)
Good	11 (36.67)	6 (20.00)	7 (23.33)
Fair	0 (0.00)	0 (0.00)	0 (0.00)
Poor	0 (0.00)	0 (0.00)	0 (0.00)
Total	30 (100.00)	30 (100.00)	30 (100.00)

Table 3: Correlation between CT-based fracture classification and functional outcome at 6 months.

Grading (Rasmussen's Functional Grading System at 6 months)	PL (%) (n=4)	PL/AL (%) (n=6)	PL/AL/AM (%) (n=2)	PM (%) (n=8)	PM/AM (%) (n=10)	Total (%) (n=30)
Excellent	1 (25.00)	1 (16.67)	0 (0.00)	4 (50.00)	4 (40.00)	10 (33.33)
Good	3 (75.00)	5 (83.33)	2 (100.00)	4 (50.00)	4 (40.00)	18 (60.00)
Fair	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (20.00)	2 (6.67)
Poor	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Total	4 (100.00)	6 (100.00)	2 (100.00)	8 (100.00)	10 (100.00)	30 (100.00)
P value						0.426

Table 4: Correlation between functional and radiological outcomes at 6 months.

Grading (Rasmussen's Functional Grading System at 6 months)	Excellent (%) (n=19)	Good (%) (n=11)	Fair (%) (n=0)	Poor (%) (n=0)	Total (%) (n=30)
Excellent	9 (47.37)	1 (9.09)	0 (0.00)	0 (0.00)	10 (33.33)
Good	10 (52.63)	8 (72.73)	0 (0.00)	0 (0.00)	18 (60.00)
Fair	0 (0.00)	2 (18.18)	0 (0.00)	0 (0.00)	2 (6.67)
Poor	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Total	19 (100.00)	11 (100.00)	0 (0.00)	0 (0.00)	30 (100.00)
P value					0.030

DISCUSSION

Tibial plateau fractures involving the posterior column are increasingly recognized for their complexity, particularly due to their coronal fracture plane, challenging surgical access, and association with soft tissue and ligamentous injuries. In our prospective study involving 30 patients, we assessed the functional and radiological outcomes following open reduction and internal fixation using a column-specific approach, and evaluated the pattern of injury, management strategy, and complications encountered. The mean age in our study was 40.3 years, with a male predominance (86.67%), consistent with trauma-related epidemiology reported by Barei et al who

also found high-energy trauma in young to middle-aged men to be a common mechanism.[9] Road traffic accidents were the most frequent mode of injury (90%), in line with multiple studies emphasizing the high-energy nature of such fractures.[10]

Based on CT evaluation, most patients had two-column fractures (53.33%), followed by single-column (40%) and three-column fractures (6.67%). This is comparable to the findings by Luo et al who introduced the three-column concept and highlighted the importance of posterior involvement, which often requires separate surgical strategies.[11] The Zhang et al classification we used further allowed better surgical planning by categorizing fracture patterns into quadrant-based involvement, supporting individualized treatment (Table 1).[12]

Posteromedial approach was the most frequently used (60%), followed by combined posterolateral and anterolateral approaches (26.67%). Posterolateral approach alone was used in 13.33% of cases. This is consistent with approaches recommended by Bowles et al, who emphasized the need for dual or triple surgical windows in complex bicondylar or posterior fractures to achieve anatomic reduction and biomechanical stability (Table 1).[13]

The study recorded ligamentous injuries in a small subset: ACL in 10%, PCL in 6.67%, and MCL in 6.67%, while meniscal injuries were observed in 13.34% of cases. These findings reflect similar associations reported by Gardner et al, who found a significant incidence of soft tissue injury associated with posterior tibial plateau fractures, often diagnosed on MRI or intraoperatively.[14] At the 6-month follow-up, 33.33% of patients achieved an excellent functional outcome and 60% had good results based on Rasmussen's scoring. Radiological outcomes were similarly favorable, with 63.33% rated excellent and 36.67% good.

These results compare well with the outcomes reported by Sameer et al who used dual plating and achieved over 85% satisfactory radiological alignment and functional mobility in patients with complex tibial plateau fractures (Table 3).[15] The mean range of motion achieved was 124.67°, and the mean time to radiological union was 17.13 weeks (Figure 5 and 6) suggest that the column-specific fixation approach allowed early rehabilitation and joint mobilization, supporting the findings of Frost et al who advocate for stable fixation and early motion to reduce stiffness and improve outcomes.[16]

Only minor complications were encountered: four cases of superficial infection and one case of deep infection. No instances of implant failure, malunion, or nonunion were noted. This low complication rate can be attributed to careful patient selection, appropriate timing of surgery based on soft tissue condition, and meticulous surgical technique principles emphasized in recent literature.[8] Statistical correlations between fracture type and functional (p=0.426) or radiological (p=0.850) outcomes was not significant. This suggests that, irrespective of the fracture complexity, favorable outcomes can be achieved with proper column-specific surgical approaches.[17] However, the significant correlation (p=0.030) between functional and radiological grading reinforces the importance of achieving good anatomical reduction for better clinical results.

Limitations

The following are the limitations with regards to this study. The sample size was small and therefore did not allow for multivariate regression analysis, in order to identify for predictors of our key clinical outcome. The follow ups were also limited. The study also involved complex fracture patterns with some cases requiring dual plating and suitable surgical approaches including posterolateral and anterolateral approaches rather than the standard posteromedial approach.

CONCLUSION

Tibial plateau fractures involving the posterior column pose significant diagnostic and therapeutic challenges. A CT-based column-specific classification system provides valuable guidance in surgical planning. Our study demonstrates that open reduction and internal fixation using a column-specific approach results in favorable functional and radiological outcomes, with minimal complications. The absence of statistically significant correlation between fracture complexity and outcomes indicates that tailored surgical management can neutralize the impact of anatomical severity. Thus, individualized surgical strategies based on fracture morphology, timely intervention respecting soft tissue status, and early mobilization play a key role in optimizing outcomes in posterior tibial plateau fractures.

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REFERENCES

1. Malik S, Herron T, Mabrouk A, Rosenberg N. Tibial plateau fractures. InStatPearls; 2023.
2. Yang G, Zhai Q, Zhu Y, Sun H, Putnis S, Luo C. The incidence of posterior tibial plateau fracture: an investigation of 525 fractures by using a CT-based classification system. Arch Orthop Trauma Surg. 2013;133:929-34.
3. Kennedy JC, Bailey WH. Experimental tibial-plateau fractures: studies of the mechanism and a classification. JBJS. 1968;50(8):1522-34.
4. Cole PA, Zlowodzki M, Kregor PJ. Treatment of proximal tibia fractures using the less invasive stabilization system: surgical experience and early

clinical results in 77 fractures. J Orthop Trauma. 2004;18(8):528-35.
5. Schatzker J, Mcbroom R, Bruce D. The Tibial Plateau Fracture: The Toronto Experience 1968-1975. Clin Orthopaed Rel Res. 1979;138:94-104.
6. Luo CF, Sun H, Zhang B, Zeng BF. Three-column fixation for complex tibial plateau fractures. J Orthop Trauma. 2010;24(11):683-92.
7. Chang SM, Zheng HP, Li HF, Jia YW, Huang YG, Wang X, et al. Treatment of isolated posterior coronal fracture of the lateral tibial plateau through posterolateral approach for direct exposure and buttress plate fixation. Arch Orthop Trau Surg. 2009;129:955-62.
8. Eggli S, Hartel MJ, Kohl S, Haupt U, Exadaktylos AK, Röder C. Unstable bicondylar tibial plateau fractures: a clinical investigation. J Orthop Traum. 2008;22(10):673-9.
9. Barei DP, Nork SE, Mills WJ, Coles CP, Henley MB, Benirschke SK. Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incisions and medial and lateral plates. JBJS. 2006;88(8):1713-21.
10. Bhattacharyya T, McCarty III LP, Harris MB, Morrison SM, Wixted JJ, Vrahas MS. The posterior shearing tibial plateau fracture: treatment and results via a posterior approach. J Orthop Trauma. 2005;19(5):305-10.
11. Luo CF, Sun H, Zhang B, Zeng BF. Three-column fixation for complex tibial plateau fractures. J Orthop Trauma. 2010;24(11):683-92.
12. Zhang X, Lv B, Yao X. Response to "Comments on: Classification of tibial plateau fracture according to the four-column and nine-segment". Injury. 2020;51(2):577-8.
13. Bowles RJ, Chadayammuri V, Baldini T, Brecevich A, Mauffrey C. Split-Depressed Lateral Tibial Plateau Fractures: A Comparison of Augmented Percutaneous Screws Versus Augmented Plate and Screw Construct in a Cadaveric Model. J Orthop Trauma. 2018;32(7):270-5.
14. Gardner MJ, Yacoubian S, Geller D, Suk M, Mintz D, Potter H, et al. The incidence of soft tissue injury in operative tibial plateau fractures: a magnetic resonance imaging analysis of 103 patients. J Orthop Trauma. 2005;19(2):79-84.
15. Sameer MM, Bassetty KC, Singaravadivelu V. Functional outcome analysis of fixation of tibial plateau fractures using the three-column concept. J Orthop Case Rep. 2022;12(5):6-10.
16. Frost HM. The biology of fracture healing. An overview for clinicians. Part II. Clin Orthop Relat Res. 1989;(248):294-309.
17. Kandemir U, Maclean J. Surgical approaches for tibial plateau fractures. J Knee Surg. 2014;27(1):21-9.

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