

Original Research Article

Functional outcomes of posteromedial plating in proximal tibial plateau fractures: a prospective clinical study

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ABSTRACT

Background: Proximal tibial plateau fractures involving the posteromedial fragment represent a complex injury pattern associated with instability, late collapse, and poor functional outcomes if inadequately addressed. Conventional fixation strategies focusing only on the anterolateral column may fail to counteract posterior shear forces acting on the medial tibial plateau.

Methods: This prospective clinical study included 30 patients with proximal tibial plateau fractures involving the posteromedial fragment treated with posteromedial buttress plating, with or without additional lateral fixation, at a tertiary care center. Fractures were classified using the Schatzker system. Functional outcomes were assessed using the Rasmussen functional scoring system at final follow-up. Radiological outcomes and post-operative complications were also evaluated.

Results: The mean age of the 30 patients was 42.0±8.92 years, and 25 (83.33%) were male. Motor vehicle accidents were the most common mechanism of injury (13 (43.33%)). Schatzker type IV, V, and VI fractures were observed in 18 (60.00%), 9 (30.00%), and 3 (10.00%) patients, respectively. Single posteromedial plating was performed in 21 (70.00%) patients and double plating in 9 (30.00%). Rasmussen functional outcomes were excellent in 21 (70.00%), good in 6 (20.00%), and fair in 3 (10.00%) patients, with no poor outcomes. Knee stiffness occurred in 2 (6.67%) patients and wound dehiscence in 1 (3.33%); no hardware failure was reported.

Conclusion: Posteromedial plating provides biomechanically stable fixation for proximal tibial plateau fractures involving the posteromedial fragment, resulting in favourable functional outcomes and a low complication rate. Direct fixation of the posteromedial fragment should be considered an integral component in the management of complex proximal tibial plateau fractures.

Keywords: Proximal tibial plateau fracture, Posteromedial plating, Rasmussen functional score, Schatzker classification, Functional outcome

INTRODUCTION

Proximal tibial plateau fractures account for approximately 1% of all fractures and represent a spectrum of injuries ranging from low-energy unicondylar fractures to high-energy bicondylar and comminuted patterns.^{1,2} These fractures commonly affect young, economically active individuals following road traffic accidents or falls from height, leading to significant functional impairment if not managed appropriately.^{3,4}

Among these injuries, fractures involving the posteromedial tibial plateau constitute a distinct and clinically important subgroup. The posteromedial fragment is subjected to significant shear forces during axial loading and knee flexion, predisposing it to secondary displacement and varus collapse when inadequately stabilized.^{5,6} Conventional fixation strategies relying solely on anterolateral plating may fail to address these biomechanical forces, resulting in loss of reduction and suboptimal functional outcomes.^{7,8}

Accurate fracture classification and preoperative assessment are essential for appropriate surgical planning. The Schatzker classification remains one of the most widely used systems for categorizing tibial plateau fractures; however, it may underestimate posterior column involvement. Recent modifications and column-based concepts have emphasized the importance of identifying and stabilizing posteromedial fragments to restore joint congruity and stability.^{9,10} Biomechanical and cadaveric studies have demonstrated that posteromedial buttress plating effectively neutralizes posterior shear forces and provides superior stability compared to lateral plating alone.¹¹⁻¹³

Clinical studies have similarly reported improved radiological alignment and functional outcomes with direct fixation of the posteromedial fragment.^{14,15} Despite this growing evidence, posteromedial plating is not uniformly employed, and data from prospective clinical studies remain limited, particularly in the Indian population.

The present prospective study was undertaken to evaluate the functional outcomes, radiological results, and complication profile of posteromedial plating in proximal tibial plateau fractures involving the posteromedial fragment, thereby contributing evidence to support its role in contemporary fracture management.

METHODS

Study design and setting

This was a prospective clinical study conducted at a tertiary care teaching hospital. The study period extended from May 2023 to October 2025. The study was approved by the Institutional Ethics Committee, and written

informed consent was obtained from all patients prior to inclusion in the study.

Study population

A total of 30 consecutive patients with proximal tibial plateau fractures involving the posteromedial fragment who met the eligibility criteria were included in the study.

Inclusion criteria

Patients aged ≥ 18 years, closed proximal tibial plateau fractures involving the posteromedial fragment, fractures amenable to surgical fixation, patients willing to provide informed consent and comply with follow-up.

Exclusion criteria

Open fractures, pathological fractures, associated vascular injury requiring repair, polytrauma patients with life-threatening injuries, patients unfit for surgery or lost to follow-up.

Preoperative evaluation

All patients underwent a detailed clinical evaluation, including assessment of soft-tissue condition, neurovascular status, and associated injuries. Standard anteroposterior and lateral radiographs of the knee were obtained in all cases. Computed tomography (CT) scans with three-dimensional reconstruction were performed to accurately delineate fracture morphology and to identify posteromedial fragment involvement.

Fractures were classified according to the Schatzker classification system. Surgical planning was based on fracture pattern, degree of displacement, articular involvement, and stability of the medial and lateral columns.

Surgical technique

All patients were operated under regional or general anaesthesia with the patient positioned supine. A posteromedial approach to the proximal tibia was utilized to directly visualize and reduce the posteromedial fragment.

The fracture was anatomically reduced and stabilized using a posteromedial buttress plate, ensuring restoration of articular congruity and prevention of posterior shear displacement. In cases with bicondylar involvement or lateral column instability, additional lateral plating was performed through a standard anterolateral approach.

Care was taken to minimize soft-tissue dissection and preserve periosteal blood supply. Intra-operative fluoroscopy was used to confirm fracture reduction and implant positioning.

Postoperative management

Postoperatively, the limb was immobilized in a knee brace as required. Early knee range-of-motion exercises were initiated once pain and soft-tissue conditions permitted.

Non-weight-bearing ambulation was advised initially, followed by graduated weight bearing based on radiological evidence of fracture healing and clinical assessment.

Patients were followed up at regular intervals, and radiographs were obtained to assess fracture union and maintenance of reduction.

Outcome assessment

Functional outcomes were assessed using the Rasmussen functional scoring system at final follow-up. The score evaluates pain, walking capacity, range of motion, and stability of the knee joint. Outcomes were categorized as excellent, good, fair, or poor based on the total score.

Radiological outcomes were assessed for fracture union, alignment, and implant integrity. Postoperative complications such as infection, knee stiffness, implant failure, and non-union were recorded.

Statistical analysis

Data were entered into a spreadsheet and analysed using descriptive statistics. Categorical variables were expressed as frequencies and percentages.

Continuous variables were summarized using appropriate descriptive measures. No comparative statistical analysis was performed due to the absence of a control group.

RESULTS

Demographic profile

A total of 30 patients with proximal tibial plateau fractures involving the posteromedial fragment were included in the study. Baseline demographic and injury-related characteristics are summarized in Table 1.

The mean age of the study population was 42.0 ± 8.92 years (range, 18–60 years). Of the 30 patients, 25 (83.33%) were male and 5 (16.67%) were female. Motor vehicle accidents were the most common mode of injury, occurring in 13 (43.33%) patients, followed by accidental falls in 8 (26.67%), falls from height in 6 (20.00%), and sports injuries in 3 (10.00%). Right-sided fractures were observed in 18 (60.00%) patients and left-sided fractures in 12 (40.00%) patients (Table 1).

Table 1: Baseline demographic and injury characteristics of the study population (n=30).

Variables	Numerical finding
Age, years, mean$\pm$SD	42.0 $\pm$ 8.92
Age range, (in years)	18–60
Sex	
Male	25 (83.33)
Female	5 (16.67)
Mode of injury	
Motor vehicle accident	13 (43.33)
Accidental fall	8 (26.67)
Fall from height	6 (20.00)
Sports injury	3 (10.00)
Side involved	
Right	18 (60.00)
Left	12 (40.00)

Table 2: Distribution of fracture types and fixation methods (n=30).

Parameters	N (%)
Schatzker fracture type	
Type IV	18 (60.00)
Type V	9 (30.00)
Type VI	3 (10.00)
Fixation method	
Single posteromedial plating	21 (70.00)
Double plating (anterolateral+ posteromedial)	9 (30.00)

Table 3: Functional outcome according to the Rasmussen functional score at final follow-up (n=30).

Outcome categories	N (%)
Excellent	21 (70.00)
Good	6 (20.00)
Fair	3 (10.00)
Poor	0 (0.00)
Total	30 (100.0)

Table 4: Post-operative complications observed during follow-up (n=30).

Complications	(N %)
Knee stiffness	2 (6.67)
Wound dehiscence	1 (3.33)
Implant/hardware failure	0 (0.00)

Fracture pattern and fixation

The fracture patterns were classified according to the Schatzker classification, with a predominance of complex fracture patterns involving medial and posterior components. Schatzker type IV fractures were observed in 18 (60.00%) patients, type V fractures in 9 (30.00%), and type VI fractures in 3 (10.00%). Single posteromedial plating was performed in 21 (70.00%) patients, whereas double plating using both posteromedial and anterolateral plates was performed in 9 (30.00%) patients (Table 2).

Dual plating was performed in cases with bicondylar involvement or significant instability, whereas single posteromedial plating was sufficient in selected fractures with isolated posteromedial fragments and stable lateral columns.

Functional outcome

At final follow-up, Rasmussen functional outcomes were excellent in 21 (70.00%) patients, good in 6 (20.00%), and fair in 3 (10.00%); no patient had a poor outcome. Overall, 27 (90.00%) patients achieved an excellent or good functional outcome (Table 3).

A majority of patients achieved excellent to good functional outcomes, indicating satisfactory restoration of knee function following posteromedial plating. Only a small proportion of patients had fair outcomes, and no poor functional results were observed.

Complications

Post-operative complications included knee stiffness in 2 (6.67%) patients and wound dehiscence in 1 (3.33%) patient. Knee stiffness was managed with physiotherapy, while wound dehiscence was managed conservatively with regular dressings and limb elevation, followed by secondary suturing (Table 4). No implant/hardware failure was reported.



Figure 1 (a-d): Representative pre-operative and post-operative radiographs demonstrating fracture reduction and fixation. Preoperative X-rays (ap and lateral), Post operative X-rays (ap and lateral).

DISCUSSION

Proximal tibial plateau fractures involving the posteromedial fragment represent a distinct injury pattern that poses significant challenges in achieving stable fixation and satisfactory functional outcomes. These fractures are frequently associated with high-energy trauma and are prone to late collapse if the posteromedial fragment is inadequately addressed. In the present prospective study, posteromedial plating resulted in favourable functional outcomes with a low complication rate, supporting its role as an effective fixation strategy in

such injuries. The demographic profile observed in this study, characterized by a predominance of young to middle-aged males and road traffic accidents as the most common mechanism of injury, is consistent with previously published literature from both Indian and international cohorts.^{1,2} This pattern reflects increased exposure to high-energy trauma among the economically active population. Similar age and gender distributions have been reported by Barei et al and Lee et al who noted that complex tibial plateau fractures commonly occur in younger males involved in vehicular accidents.^{3,4}

Functional outcomes in the present study were assessed using the Rasmussen functional scoring system, which remains a widely accepted method for evaluating knee function following tibial plateau fractures.⁵ The majority of patients achieved excellent to good functional outcomes at final follow-up, comparable to results reported in studies emphasizing direct fixation of the posteromedial fragment.^{6,7} In contrast, reports relying solely on anterolateral plating for fractures with posterior shear components have demonstrated higher rates of secondary displacement and inferior functional outcomes.⁸ These findings highlight the importance of addressing posterior fracture components to achieve durable stability and satisfactory knee function.

Fracture patterns in this study were classified using the Schatzker system, one of the most commonly employed classification methods for tibial plateau fractures.⁹ However, traditional classifications may underestimate posterior column involvement, potentially leading to incomplete fixation strategies. More recent concepts and revisions have emphasized column-based assessment, underscoring the clinical relevance of posteromedial fragments in determining fracture stability and outcome.¹⁰ The predominance of complex Schatzker type IV–VI fractures in the present series reinforces the need for careful evaluation and stabilization of posterior fracture components.

The biomechanical rationale for posteromedial plating has been well established in the literature. The posteromedial fragment is subjected to significant shear forces during axial loading and knee flexion, which are not sufficiently neutralized by lateral plates alone.^{11,12} Biomechanical and cadaveric studies have demonstrated that posteromedial buttress plating effectively counteracts these forces, thereby preventing posterior displacement and varus collapse.¹³ The favourable radiological alignment and functional recovery observed in this study are consistent with these biomechanical principles.

The complication profile observed in the present series was acceptable and comparable to that reported in similar studies. Superficial wound infections and transient knee stiffness were the most commonly encountered complications and resolved with conservative management. Importantly, there were no cases of implant failure, non-union, or deep infection. Previous reports have

similarly demonstrated low complication rates with posteromedial plating when meticulous surgical technique and careful soft-tissue handling are employed.^{14,15} These findings suggest that the addition of a posteromedial approach does not necessarily increase morbidity when appropriate surgical principles are followed.

From a clinical perspective, the findings of this study emphasize the importance of thorough preoperative evaluation, particularly with computed tomography, to identify posteromedial fracture components. Failure to recognize and stabilize these fragments may compromise fracture stability and long-term functional outcomes.¹⁶ Posteromedial plating should therefore be regarded as an essential component of surgical planning in complex proximal tibial plateau fractures, especially those with posterior shear or medial column involvement.

In summary, the present study adds to the growing body of evidence advocating direct fixation of the posteromedial fragment in proximal tibial plateau fractures. The favourable functional outcomes, low complication rates, and sound biomechanical rationale collectively support the inclusion of posteromedial buttress plating as a standard technique in the management of these complex injuries.

Limitations

This study has certain limitations that should be acknowledged. The sample size was relatively small, which may limit the statistical power and generalizability of the findings. As a single-center study, the results may reflect institutional practices and surgeon experience, potentially limiting external validity. Additionally, the absence of a comparative control group treated with alternative fixation methods precludes direct comparison of outcomes. Long-term functional and radiological outcomes beyond the follow-up period were not evaluated, and therefore late complications such as post-traumatic osteoarthritis could not be assessed.

CONCLUSION

Posteromedial plating provides biomechanically stable fixation for proximal tibial plateau fractures involving the posteromedial fragment and is associated with excellent functional outcomes and a low complication rate.

Direct fixation of the posteromedial fragment facilitates anatomical reduction, maintains fracture stability, and supports early rehabilitation. Based on the findings of this study, posteromedial buttress plating should be considered an integral component of the surgical management of complex proximal tibial plateau fractures.

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