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Fracture Evaluation of Proximal Tibia Medial and Posteromedial Fracture Pattern and Its Surgical-Radiological Outcome

Dr Shlok V Shah[1], Dr Shaunak Chacha[2], Dr Karan Shah[3], Dr Karan Kotak[4], Dr Aneri Shah[5]

[1]Junior Resident Department of Orthopedics, GCS Medical College and Hospital and Research Center Ahmedabad, Gujarat University, Ahmedabad, Gujarat.
[2]Junior Resident Department of General Surgery, GCS Medical College and Hospital and Research Center Ahmedabad, Gujarat University, Ahmedabad, Gujarat
[3]Junior Resident Department of Orthopedics, GCS Medical College and Hospital and Research Center Ahmedabad, Gujarat University, Ahmedabad, Gujarat
[4]Junior Resident Department of General Surgery, GCS Medical College and Hospital and Research Center Ahmedabad, Gujarat University, Ahmedabad, Gujarat
[5]Junior Resident Department of Radiology, GCS Medical College and Hospital and Research Center Ahmedabad, Gujarat University, Ahmedabad, Gujarat

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Corresponding Author:

Dr Shlok V Shah
Junior Resident Department of Orthopedics, GCS Medical College and Hospital and Research Center Ahmedabad, Gujarat University, Ahmedabad, Gujarat.

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ABSTRACT

Background: Medial and posteromedial proximal tibial fractures are complex injuries often resulting from high-energy trauma and are frequently associated with soft tissue compromise. Accurate fracture evaluation and stable fixation are essential to restore joint congruity and achieve favourable outcomes.
Objective: To evaluate the fracture patterns involving the medial and posteromedial columns of the proximal tibia and to assess the surgical and radiological outcomes following operative management.
Materials and Methods: This prospective observational study was conducted from November 2022 to November 2025 at a tertiary care orthopaedic institute. Fifty patients with medial and/or posteromedial proximal tibial fractures treated operatively were included. Fractures were evaluated using radiographs and computed tomography and classified based on column involvement. Surgical fixation was performed using posteromedial buttress plating, with additional anterolateral or dual plating as required. Patients were followed up at regular intervals, and radiological outcomes were assessed using the Modified Rasmussen Radiological Score. Complications and the knee range of motion were documented.
Results: The mean age of patients was 41.72 ± 8.3 years, with male predominance (70%). Road traffic accidents were the most common mechanism of injury (80%). Combined medial and lateral column involvement was the most frequent fracture pattern (48%). Radiological evaluation showed articular depression <5 mm in 80% of cases, condylar widening <5 mm in 90%, and angular deformity <10° in 86% of patients. Postoperative complications were minimal, with 82% of patients experiencing no complications.
Conclusion: Operative management of medial and posteromedial proximal tibial fractures using a column-based fixation strategy provides satisfactory radiological outcomes with low complication rates. Accurate fracture assessment, stable posteromedial buttress fixation, and careful soft tissue management are key determinants of successful outcomes.

***Keywords**: Proximal tibia fracture, posteromedial fracture, medial column, buttress plating, radiological outcome.*

INTRODUCTION

Proximal tibial fractures represent a complex spectrum of injuries that involve the weight-bearing articular surface of the knee joint and pose significant challenges in terms of management and functional recovery. These fractures account for approximately 1–2% of all fractures and nearly 8% of fractures in the elderly population, with an increasing incidence due to high-energy trauma such as road traffic accidents and falls from height [1,2].

Among proximal tibial fractures, medial and posteromedial fracture patterns are of particular clinical importance. These fractures are often associated with axial loading combined with varus forces, resulting in coronal plane instability and disruption of the posterior column [3]. Posteromedial fragments are frequently overlooked on plain radiographs, leading to inadequate fixation and subsequent complications such as malunion, loss of reduction, post-traumatic osteoarthritis, and knee instability [4,5].

Traditional classification systems such as the Schatzker classification primarily emphasize lateral plateau injuries and may inadequately describe fractures involving the posterior and medial columns [6]. With advances in imaging, especially computed tomography (CT), a better understanding of fracture morphology has evolved. The three-column concept of proximal tibial fractures highlights the importance of identifying posterior column involvement to guide surgical planning and fixation strategy [7].

Surgical management of medial and posteromedial proximal tibial fractures typically requires buttress plating to counteract shear forces and restore joint congruity. Posteromedial plating through a dedicated approach has been shown to provide stable fixation, allow early mobilisation, and reduce the risk of secondary displacement [8,9]. In complex fracture patterns, dual or triple plating may be necessary to achieve optimal biomechanical stability [10].

Radiological outcome assessment plays a crucial role in evaluating fracture reduction and alignment. The Modified Rasmussen Radiological Score is a widely accepted tool for assessing parameters such as articular depression, condylar widening, and angular deformity, which correlate with functional outcomes [11].

Despite advances in surgical techniques and fixation methods, there remains limited prospective data specifically analysing medial and posteromedial proximal tibial fracture patterns, their surgical management, and radiological outcomes in the Indian population. Therefore, the present study was undertaken to evaluate the fracture patterns involving the medial and posteromedial columns of the proximal tibia and to analyse their surgical and radiological outcomes following operative management.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted at a tertiary care orthopaedic institute after obtaining approval from the Institutional Ethics Committee. The study period extended from November 2022 to November 2025.

Study Population

A total of fifty (50) patients with proximal tibial fractures involving the medial and/or posteromedial columns were enrolled. All patients were treated operatively. Written informed consent was obtained from each participant before inclusion in the study.

Inclusion Criteria

- Patients of all age groups and both genders with medial and/or posteromedial proximal tibial fractures.
- Patients with polytrauma having proximal tibial fractures associated with other skeletal injuries.
- Patients with medial and posteromedial proximal tibial fractures associated with fractures of other columns of the tibia.

Exclusion Criteria

- Patients unfit for anaesthesia due to medical comorbidities.
- Patients with proximal tibial fractures managed conservatively without surgical intervention.

Preoperative Management Protocol

On admission, patients underwent initial assessment and stabilization following Advanced Trauma Life Support (ATLS) principles, with particular attention to airway, breathing, circulation, and vital parameters. A detailed history and thorough general and systemic examination were performed to rule out associated head, thoracic, and abdominal injuries.
Local examination of the affected limb included assessment of fracture pattern, soft tissue condition, and distal neurovascular status (distal pulses and motor function). Standard anteroposterior and lateral radiographs of the knee and proximal tibia were obtained. Computed tomography (CT) scans were performed in selected cases to better delineate fracture morphology and column involvement.

Initial limb stabilisation was achieved using an above-knee posterior plaster slab, limb elevation, intravenous analgesics, and anti-oedema measures. Regular monitoring was carried out for signs of impending compartment syndrome. Limb elevation with pillows, calf pump exercises, and local monitoring for blister formation were routinely practised. In patients with significant swelling or fracture blisters, magnesium sulfate–glycerin dressings were applied, and definitive surgery was delayed until the local skin condition improved.

Fractures were classified based on radiographic and CT findings according to the column involvement, and surgical planning was done once the patient achieved medical fitness and satisfactory local soft tissue condition.

Preparation for Surgery
After completion of preoperative investigations and anaesthetic clearance, patients were prepared for surgery. The operative limb was shaved and scrubbed with an antiseptic solution. Prophylactic intravenous antibiotics were administered the night before surgery and one hour before incision. Urinary catheterisation was performed when required. Strict aseptic precautions were maintained throughout the procedure.

Surgical Technique
Most surgeries were performed in the floating supine position with the knee extended and supported by a pillow. In six cases, surgery was performed in the prone position, while in four cases, a prone position was initially used to address the posterior column, followed by repositioning to supine for fixation of the anterior or anterolateral column. A tourniquet was applied after limb exsanguination.

In the supine position, a sandbag or bolster was placed under the contralateral hip to externally rotate the affected limb, facilitating exposure of the posteromedial tibial surface. The posteromedial fragment was addressed first through a 6–8 cm posteromedial incision. Care was taken to identify and preserve the long saphenous vein and nerve.

Reduction of the posteromedial fragment was achieved using knee extension and abduction manoeuvres, followed by provisional fixation with Kirschner wires. Definitive fixation was done using anatomical posteromedial buttress plates.
When dual plating was required, an anterolateral approach was used to address the anterior column. Intra-articular depressed fragments were elevated under fluoroscopic guidance using a bone tamp or blunt instrument. Final fixation was completed using an anterolateral locking plate. Particular attention was paid to screw length and trajectory, especially in cases requiring dual or triple plating. Prophylactic fascial release incisions were made in selected cases to prevent postoperative compartment syndrome.

Wound closure was performed carefully to avoid undue tension on the skin. A suction drain was placed and removed after 48 hours.

Postoperative Protocol
Postoperatively, patients received parenteral antibiotics for a minimum of five days, followed by oral antibiotics for seven days. Anti-edema therapy and limb elevation were continued. The first wound inspection was done after 24 hours, and drains were removed. Subsequent dressings were done on the third postoperative day. Sutures were removed between 12 and 15 days postoperatively.

The above-knee slab was converted to a below-knee slab to facilitate knee mobilisation. Patients were typically discharged on the fifth postoperative day, provided the wound condition was satisfactory.

Physiotherapy and Rehabilitation
Physiotherapy was initiated on the first postoperative day, including static quadriceps, hamstring strengthening, and calf pump exercises. Active-assisted knee flexion and extension exercises, high sitting knee bending, and straight leg raising up to 30 degrees were started between the second and third postoperative day as tolerated.

Weight bearing was commenced after radiological evidence of union, generally at 6–8 weeks, beginning with protected weight bearing and gradually progressing to full, unassisted weight bearing.

Follow-up and Outcome Assessment
Patients were followed weekly until suture removal and subsequently at **1, 3, and 6 months** postoperatively. At each visit, a detailed **clinical and radiological assessment** was performed. Anteroposterior and lateral radiographs of the proximal tibia and knee were evaluated for fracture union, callus formation, joint line congruity, and implant position.
Clinical assessment included evaluation of the **knee range of motion**, pain, and the presence of any instability. Any complications, if present, were documented during follow-up.

RESULTS AND OBSERVATIONS

Table 1: Age Distribution of Patients with Proximal Tibia Medial and Posteromedial Fractures

Age Group	No. of Patients	Percentage	Statistical Analysis	
21-30	8	16%	Mean = 41.72, SD =8.3	**Chi-square**: p = 0.624
31-40	10	20%		

41-50	14	28%	
51-60	10	20%	
61-70	8	16%	
Total	50	100%	

This table categorises patients based on their age group. The sample is divided into five age groups ranging from 21-70 years. The largest group is 41-50 years, accounting for 28% of the patients, followed by the 31-40 and 51-60 age groups, each representing 20% of the sample. The distribution reflects a middle-aged population, typically affected by fractures due to moderate to high-energy trauma.

Table 2: Sex Distribution of Patients with Proximal Tibia Fractures

Sex	**No. of Patients**	**Percentage**	**Statistical Analysis**
Male	35	70%	
Female	15	30%	
Total	50	100%	**Chi-square**: p = 0.033

The table outlines the sex distribution of the study population. A majority of the patients are male (70%), which is consistent with the typical higher incidence of fractures in males, particularly from high-energy trauma such as road traffic accidents (RTAs). Females represent 30% of the study population, highlighting a notable but smaller proportion of fractures in women in this particular sample.

Table 3: Distribution of Patients According to Side of Injury and Mode of Injury (n = 50)

Variable	**Category**	**No. of Patients**	**Percentage (%)**	**Statistical Analysis**
Side of Injury	**Right**	**27**	**54**	
	Left	**23**	**46**	**χ^2 test, *p* = 0.456**
	Total	**50**	**100**	**Not significant**
Mode of Injury	**Road Traffic Accident**	**40**	**80**	
	Fall	**7**	**14**	
	Other causes	**3**	**6**	**χ^2 test, *p* = 0.245**
	Total	**50**	**100**	**Not significant**

Table 4: Distribution of Comorbidities and Preoperative Complications in Patients with Proximal Tibia Fractures (n = 50)

Variable	**Category**	**No. of Patients**	**Percentage (%)**	**Statistical Analysis**
Comorbidities	**Diabetes Mellitus**	**8**	**16**	
	Hypertension	**7**	**14**	
	Diabetes + Hypertension	**3**	**6**	**χ^2 test, *p* = 0.122**
	No comorbidities	**32**	**64**	**Not significant**
	Total	**50**	**100**	
Preoperative Complications	**Swelling alone**	**14**	**28**	
	Swelling + blisters	**12**	**24**	
	Swelling + blisters + skin necrosis	**6**	**12**	**χ^2 test, *p* = 0.756**
	None	**18**	**36**	**Not significant**
	Total	**50**	**100**	

Table 5: Column Involved and Fracture Patterns in Proximal Tibia Fractures

Column Involved/Fracture Pattern	**No. of Patients**	**Percentage**
Lateral + Posteromedial	**7**	**14%**
Medial	**13**	**26%**
Medial + Lateral	**24**	**48%**
Medial + Lateral + posteromedial	**6**	**12%**
Total	**50**	**100%**

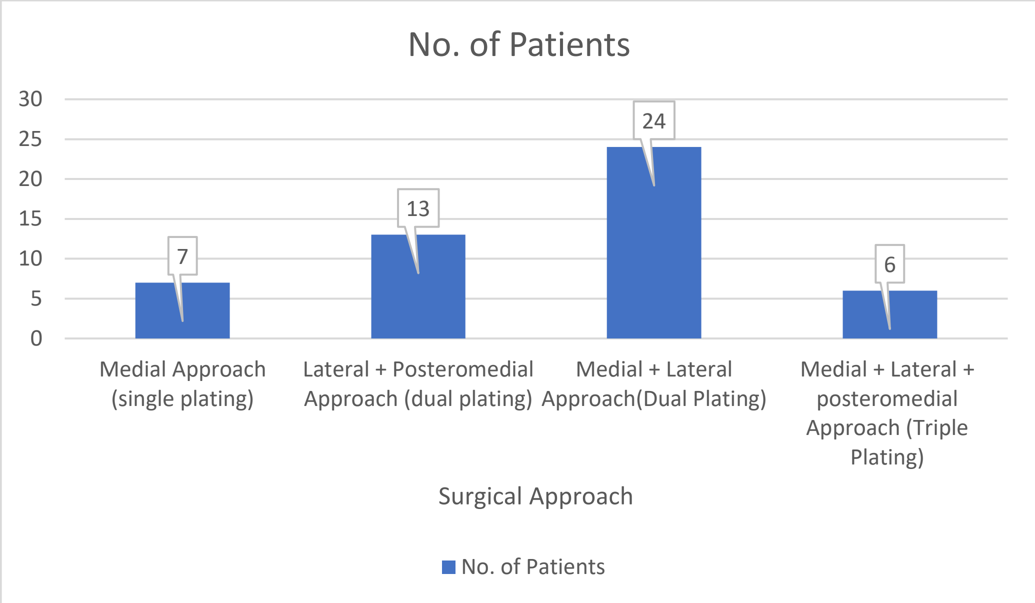

Figure 1: Bar chart for Surgical Approach and Fixation Techniques Used for Proximal Tibia Fractures

Table 6: Postoperative Complications in Patients with Proximal Tibia Fractures

Postoperative Complication	No. of Patients	Percentage	Statistical Analysis
Wound Dehiscence	3	6%	Chi-square: p = 0.452
Infection	2	4%	
Knee Stiffness	4	8%	
None	41	82%	
Total	50	100%	

Table 7: Radiological Outcomes of Proximal Tibia Fractures Using the Modified Rasmussen Score

Radiological Factor	Pts	No. of Patients	Percentage	Statistical Analysis
Articular Depression				
<5 mm	4	40	80%	Chi-square: p = 0.213
5-10 mm	2	8	16%	
>10 mm	0	2	4%	
Condylar Widening				
<5 mm	4	45	90%	
5-10 mm	2	5	10%	
>10 mm	0	0	0%	
Angulation (varus/valgus)				
<10°	4	43	86%	
10-20°	2	7	14%	
>20°	0	0	0%	
Total		50	100%	

DISCUSSION

Proximal tibial fractures involving the medial and posteromedial columns are complex injuries that demand meticulous evaluation and stable fixation to restore knee joint congruity and function. The present prospective observational study was conducted to analyse the fracture patterns, surgical management, and radiological outcomes of medial and posteromedial proximal tibial fractures treated operatively. The findings of this study are discussed in comparison with available literature.

The majority of patients in the present study belonged to the 41–50-year age group, with a mean age of 41.72 years. This observation is consistent with previous studies, which have reported a higher incidence of proximal tibial fractures in the middle-aged population due to high-energy mechanisms such as road traffic accidents [12,13]. The predominance of male patients (70%) in this study also correlates with existing literature, reflecting increased exposure of males to outdoor activities and vehicular trauma [14].

Road traffic accidents accounted for 80% of injuries in the present study, highlighting the role of high-energy trauma in the causation of medial and posteromedial fracture patterns. Similar findings have been reported by Barei et al. and Elsoe et al., who observed RTAs as the most common mechanism in complex tibial plateau fractures [4,15]. The slightly higher involvement of the right side (54%) in the present study was not statistically significant and has also been variably reported in earlier studies without consistent laterality trends [16].

In terms of fracture morphology, the most common pattern observed was combined medial and lateral column involvement (48%), followed by isolated medial column fractures (26%). Posteromedial involvement, either alone or in combination, was observed in a significant proportion of cases. These findings reinforce the importance of CT-based fracture assessment, as posteromedial fragments are often underestimated on plain radiographs [7,17]. Luo et al. emphasised that failure to identify posterior column fractures may result in inadequate fixation and poor outcomes [7].

Soft tissue condition plays a critical role in determining the timing and outcome of surgery. In the present study, 64% of patients exhibited preoperative soft tissue complications, including swelling, blisters, and skin necrosis. Similar rates of soft tissue compromise have been reported in high-energy proximal tibial fractures [18]. Delayed definitive fixation until improvement of local skin conditions, as practised in this study, has been shown to reduce postoperative wound complications [19].

The surgical strategy in this study prioritised posteromedial fragment fixation as the first step, using buttress plating through a dedicated posteromedial approach. This technique provides biomechanically stable fixation against shear forces and prevents secondary displacement of the fragment [8,20]. Dual plating was employed in fractures involving both medial and lateral columns, which is supported by biomechanical and clinical studies demonstrating superior stability compared to single lateral plating in complex fracture patterns [3,21].

Postoperative complications in the present study were relatively low, with 82% of patients experiencing no complications. Wound-related issues and knee stiffness were the most common complications encountered. Comparable complication rates have been reported by Barei et al., who emphasized the importance of meticulous soft tissue handling and staged protocols in minimizing adverse outcomes [4,22].

Radiological outcomes assessed using the Modified Rasmussen Score demonstrated satisfactory results in the majority of patients. Articular depression of less than 5 mm was achieved in 80% of cases, while condylar widening of less than 5 mm was noted in 90% of patients. Angular alignment within 10 degrees was maintained in 86% of cases, indicating effective restoration of joint anatomy. These findings are consistent with earlier studies that have reported good to excellent radiological outcomes following anatomical reduction and stable fixation of medial and posteromedial tibial plateau fractures [11,23].

Early initiation of physiotherapy and delayed weight bearing until radiological union contributed to favourable outcomes and reduced the incidence of knee stiffness. Restoration of joint congruity and alignment has been shown to correlate strongly with improved functional outcomes and reduced risk of post-traumatic osteoarthritis [24].

Despite the encouraging results, the present study has certain limitations, including a relatively small sample size, the absence of a control group, and limited follow-up duration. Functional outcome scores were not extensively analysed, which could have provided further insight into patient-reported outcomes. Larger multicentric studies with longer follow-up and correlation between radiological and functional outcomes are recommended for future research.

Overall, the present study highlights the importance of early CT-based fracture evaluation, addressing the posteromedial fragment, and stable anatomical fixation in achieving satisfactory radiological outcomes in medial and posteromedial proximal tibial fractures.

CONCLUSION

Medial and posteromedial proximal tibial fractures require accurate CT-based evaluation and stable anatomical fixation. Addressing the posteromedial fragment with buttress plating, along with column-specific fixation when indicated, results in satisfactory radiological outcomes and low complication rates. Careful soft tissue management and structured rehabilitation are essential for achieving optimal fracture union and knee function.

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