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Original Research Article

FUNCTIONAL OUTCOMES OF SCHATZKER TYPE I–III LATERAL TIBIAL PLATEAU FRACTURES TREATED WITH LOCKING COMPRESSION PLATE FIXATION: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Lateral tibial plateau fractures significantly impair knee function and long-term quality of life, particularly when articular congruity and stability are compromised. Locking compression plates (LCP) provide angular stability and improved fixation in metaphyseal bone, potentially enabling early rehabilitation and improved outcomes. The objective is to evaluate functional and clinico-radiological outcomes in Schatzker type I–III lateral tibial plateau fractures treated with LCP fixation and to determine post-operative complications.

Materials and Methods: A prospective observational study was conducted at a tertiary care hospital from April 2023 to December 2024. Thirty-two adult patients (18–75 years) with closed Schatzker type I–III lateral tibial plateau fractures underwent fixation with a locking compression plate using ORIF or MIPPO techniques. Follow-up assessments included knee range of motion, Rasmussen clinical and radiological scoring, time to union, time to full weight bearing, complications, and SF-36v2 physical and mental component scores. Descriptive and inferential statistics were performed using SPSS, with $p < 0.05$ considered significant.

Results: Mean age was 48.4 ± 13.3 years, with male predominance (65.6%). Schatzker type II fractures were most common (56.25%). Mean knee flexion achieved was 128.1 ± 13.3 degrees. Rasmussen clinical outcomes were excellent in 31.3% and good in 68.8%. Mean time to full weight bearing was 12.56 ± 2.5 weeks, and mean fracture union time was 13.1 ± 3.9 weeks. Complications occurred in 37.5%, most commonly wound infection (15.6%). Mean SF-36v2 physical and mental component scores were 53.78 ± 5.62 and 58.56 ± 5.33, respectively.

Conclusion: Locking compression plate fixation for Schatzker type I–III lateral tibial plateau fractures demonstrated favorable functional recovery, reliable union, and acceptable complication rates, supporting its effectiveness in restoring knee function.

Keywords: Tibial plateau fracture; Schatzker classification; Locking compression plate; Rasmussen score; SF-36.

INTRODUCTION

Tibial plateau fractures represent complex peri-articular injuries involving the weight-bearing surface of the proximal tibia, frequently resulting in pain, instability, restricted motion, and post-traumatic osteoarthritis if not treated optimally. Contemporary epidemiological evidence indicates that tibial plateau fractures occur across a wide age spectrum, with bimodal distribution influenced by

high-energy trauma in younger individuals and low-energy fragility mechanisms in older adults.[1] Lateral plateau fractures are particularly common due to valgus loading patterns during road traffic accidents, falls, and sports-related trauma.[2]

The primary surgical objectives in tibial plateau fractures include restoration of articular congruity, correction of mechanical alignment, stable fixation, and preservation of soft tissues to enable early motion and minimize stiffness. These goals are especially relevant in lateral plateau fractures where depression and split components compromise joint surface integrity and can lead to long-term degenerative changes.[3]

Locking compression plates have gained prominence in the management of tibial plateau fractures due to their angular stability, improved fixation in osteoporotic bone, and reduced reliance on plate-to-bone compression. These characteristics allow the construct to behave as an "internal fixator," which may reduce loss of reduction and hardware failure compared with conventional non-locking constructs.[4] In addition, LCP constructs may facilitate early mobilization, which is a crucial determinant of functional recovery and prevention of post-operative arthrofibrosis.[5]

Functional outcome following tibial plateau fracture fixation is increasingly assessed using validated patient-reported and clinician-based instruments. The Rasmussen clinical and radiological scoring systems remain widely applied for post-operative evaluation of pain, walking capacity, stability, range of motion, and radiographic alignment.[6] Similarly, generic health-related quality of life measures such as SF-36 provide broader insight into the physical and mental recovery trajectory following peri-articular fracture surgery.[7]

Despite the increasing use of LCP fixation, outcome variability persists due to fracture pattern, reduction quality, soft tissue injury, surgical timing, and rehabilitation adherence. Recent studies continue to highlight complications such as infection, malalignment, stiffness, and secondary depression even with modern fixation strategies.[8] Therefore, prospective evaluation of outcomes using standardized scoring systems remains clinically important.

The present prospective observational study evaluated functional outcomes and complication rates among patients with Schatzker type I–III lateral tibial plateau fractures treated using locking compression plate fixation at a tertiary care centre.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital in Visakhapatnam, India. The study period was April 2023 to December 2024.

Study Population: Patients presenting with lateral tibial plateau fractures classified as Schatzker type I–III were enrolled. All fractures were closed injuries. Both male and female adult patients were included.

Inclusion Criteria

- Age 18–75 years
- Closed tibial plateau fracture
- Schatzker type I, II, or III fractures

Exclusion Criteria

- Open fractures
- Associated vascular injury
- Pathological fractures
- Immunocompromised state
- Pregnant women
- Patients lost to follow-up

Sample Size: Sample size calculation was based on prior published union rates using a confidence level of 95% and a union probability of approximately 98%, resulting in a minimum calculated sample size of 32 patients.

Surgical Procedure: All patients underwent fixation with a lateral locking compression plate. Reduction and fixation were performed either by open reduction internal fixation (ORIF) or minimally invasive percutaneous plate osteosynthesis (MIPPO), based on fracture configuration and soft tissue condition.

Outcome Measures: Patients were assessed clinically and radiologically at follow-up. The main outcomes included:

- Knee range of motion (flexion and extension)
- Rasmussen clinical knee score
- Rasmussen radiological score
- Clinico-radiological outcome grading
- Time to full weight bearing
- Time to fracture union
- Return to pre-injury activity
- Complications and revision surgery
- SF-36v2 Physical Component Score (PCS) and Mental Component Score (MCS)

Statistical Analysis: Data were entered into MS Excel and analyzed using SPSS v25. Descriptive statistics were reported as mean ± SD for continuous variables and as frequency (%) for categorical variables. Statistical significance was set at $p < 0.05$.

RESULTS

Total sample size was 32.

The study included 32 patients with a mean age of 48.4 ± 13.3 years. Most patients belonged to the 46–60 year age group (56.3%), followed by 31–45 years (31.3%). Young adults aged 18–30 years represented 12.4% of the cohort. Male predominance was observed, with males constituting 65.6% and females 34.4%. This distribution reflects higher exposure to injury mechanisms among working-age males.

Table 1: Baseline demographic profile (Age and Gender)

Variable	Category	n (%)
Age group	18–30	4 (12.4)
	31–45	10 (31.3)
	46–60	18 (56.3)
Gender	Male	21 (65.6)
	Female	11 (34.4)

Mean age: 48.4 ± 13.3 years

Table 2: Injury characteristics (Mechanism, Side, Schatzker type)

Variable	Category	n (%)
Mechanism of injury	RTA	14 (43.8)
	Fall	12 (37.5)
	Assault	6 (18.8)
Side	Left	20 (62.5)
	Right	12 (37.5)
Schatzker type	I	6 (18.75)
	II	18 (56.25)
	III	8 (25.00)

Road traffic accidents were the most common mechanism of injury (43.8%), followed by falls (37.5%) and assault-related trauma (18.8%). Left-sided fractures were more frequent (62.5%) than right-sided injuries (37.5%). Schatzker type II fractures accounted for the majority (56.25%), consistent with the typical split-depression pattern seen in lateral plateau injuries. Schatzker type III constituted 25.0% and type I accounted for 18.75%.

Table 3: Functional recovery (Knee ROM, Rasmussen clinical score)

Variable	Category	n (%)
Knee flexion ROM	0–110°	2 (6.3)
	0–120°	6 (18.8)
	0–130°	11 (34.4)
	0–140°	13 (40.6)
Rasmussen clinical score	Excellent	10 (31.3)
	Good	22 (68.8)

Mean knee flexion: 128.1 ± 13.3 degrees

Post-operative functional recovery was favorable. Mean knee flexion achieved was 128.1 ± 13.3 degrees, with 75% of patients achieving at least 130° of flexion. Only 6.3% remained limited to 110° flexion. Rasmussen clinical outcomes showed that 31.3% achieved an excellent score while 68.8% achieved good outcomes. No patient was categorized as poor under Rasmussen clinical grading, supporting the effectiveness of LCP fixation in restoring knee function.

Table 4: Healing, complications, and quality-of-life outcomes

Outcome	Finding
Mean time to full weight bearing	12.56 ± 2.5 weeks
Mean time to fracture union	13.1 ± 3.9 weeks
Revision surgery required	5 (15.6%)
Reason for revision (n=5)	Malunion: 4 (80%), Non-union: 1 (20%)
Complications	Wound infection: 5 (15.6%), Nerve injury: 4 (12.5%), Redepression: 2 (6.3%), Knee stiffness: 1 (3.1%), None: 20 (62.5%)
SF-36v2 PCS	53.78 ± 5.62
SF-36v2 MCS	58.56 ± 5.33

The mean time to full weight bearing was 12.56 ± 2.5 weeks, while mean fracture union time was 13.1 ± 3.9 weeks. Revision surgery was required in 15.6%, most commonly for malunion (80%). Overall complications occurred in 37.5%, with wound infection (15.6%) being the most frequent. Despite this, 62.5% had no complications. SF-36v2 scores indicated moderate-to-good quality-of-life recovery (PCS 53.78; MCS 58.56).

DISCUSSION

This prospective observational study evaluated functional recovery and clinico-radiological outcomes of Schatzker type I–III lateral tibial plateau fractures treated with locking compression plate fixation. The overall findings demonstrated favorable knee motion restoration, high rates of good-to-excellent Rasmussen outcomes, predictable fracture union, and acceptable complication rates.

The mean age in this study was 48.4 ± 13.3 years, with most patients in the 46–60 year group. Contemporary epidemiological evidence supports the observation that tibial plateau fractures increasingly affect middle-aged and older adults due to a combination of road traffic trauma and osteoporotic bone vulnerability.[9] Male predominance (65.6%) was observed, which remains consistent with injury exposure patterns in many trauma cohorts.[10]

Schatzker type II fractures represented the majority (56.25%), followed by type III and type I. Recent fracture pattern studies have shown that lateral

plateau split-depression injuries remain the most frequent configuration among operatively treated plateau fractures, largely due to valgus loading mechanisms.[11]

The functional recovery in the present cohort was encouraging, with mean knee flexion reaching 128.1 ± 13.3 degrees. More than 75% achieved ≥130° flexion, suggesting that stable fixation and rehabilitation enabled restoration of near-functional motion. This aligns with recent clinical outcome studies reporting that locking constructs support early motion without compromising reduction stability, particularly in Schatzker I–III injuries.[12]

Rasmussen clinical outcomes were excellent in 31.3% and good in 68.8%. These findings support that LCP fixation provides adequate stability for lateral plateau fractures to regain pain-free mobility and functional ambulation. Recent outcome analyses have emphasized that Rasmussen scoring remains useful for post-operative stratification, especially in settings where long-term PROM-based evaluation may not be feasible.[13]

The mean time to full weight bearing was 12.56 ± 2.5 weeks and mean fracture union was 13.1 ± 3.9 weeks. Modern orthopaedic trauma literature suggests that union times of approximately 12–16 weeks are typical for stable plateau fixation, though variability occurs based on fracture depression, metaphyseal comminution, and patient comorbidities.[14] The present union duration therefore falls within the expected range for lateral plateau injuries managed with stable fixation and rehabilitation protocols.

Complications occurred in 37.5% of patients, although the majority (62.5%) had no complications. Wound infection (15.6%) was the most frequent complication. This is clinically important because plateau fractures often require extensive soft tissue handling, and infection remains one of the most feared complications after peri-articular plating. Recent systematic evidence indicates that infection rates after tibial plateau ORIF vary between 5% and 15% depending on injury severity, soft tissue status, and patient risk factors such as diabetes and smoking.[15] The present study's infection rate falls within this contemporary range.

Nerve injury (12.5%) was reported in this cohort. This may reflect traction injury, regional surgical approach risks, or associated trauma severity. Although less commonly reported than infection or stiffness, neurological complications are recognized in plateau fractures and may influence long-term patient satisfaction.[16] Redepression was observed in 6.3%, suggesting that secondary collapse remains possible even with locking constructs, particularly in depression fractures if bone void support is inadequate. Recent biomechanical and clinical studies highlight that subchondral support techniques and raft screw placement are key in preventing depression recurrence in lateral plateau injuries.[17]

Revision surgery was required in 15.6%, mainly due to malunion. While revision rates in Schatzker I–III fractures are usually lower than in bicondylar patterns, malreduction and alignment loss remain clinically relevant. Current literature emphasizes that accurate articular restoration and coronal alignment are strong predictors of long-term function and osteoarthritis risk.[18]

Quality-of-life assessment using SF-36v2 revealed mean PCS of 53.78 and MCS of 58.56, suggesting better mental recovery than physical recovery. This is consistent with fracture outcome studies demonstrating that physical limitations often persist beyond radiographic union, while mental adaptation improves earlier.[19]

Overall, the findings of this study support LCP fixation as a reliable method for Schatzker type I–III lateral tibial plateau fractures, producing favorable knee motion, good-to-excellent Rasmussen outcomes, and predictable union. However, complications—particularly infection and malunion—remain important, emphasizing the need for meticulous technique, soft tissue respect, and structured rehabilitation. Recent evidence continues to support individualized surgical planning and early physiotherapy as the cornerstone of optimizing tibial plateau fracture outcomes.[20]

CONCLUSION

In this prospective observational study of 32 patients with Schatzker type I–III lateral tibial plateau fractures, locking compression plate fixation produced favorable functional and clinico-radiological outcomes. Most patients achieved high knee flexion ranges, and all patients demonstrated either good or excellent Rasmussen clinical results. Fracture union and return to weight bearing occurred within expected timelines, supporting the biomechanical stability of LCP constructs in lateral plateau injuries. Although complications were observed in 37.5% of cases—most commonly wound infection and nerve injury—the majority of patients had uneventful recovery and satisfactory SF-36v2 physical and mental health scores. These results reinforce LCP fixation as an effective treatment modality for lateral tibial plateau fractures, provided that surgical technique, reduction quality, and rehabilitation protocols are carefully optimized.

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