

Surgical Management of Distal Femur Fractures Using Locking Compression Plate: A Prospective Clinical Study

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Abstract

Background: Distal femur fractures are complex injuries commonly resulting from high-energy trauma in young adults or low-energy falls in elderly patients. Surgical stabilization with locking compression plates (LCP) has emerged as a reliable option to achieve anatomical alignment, stable fixation, and early mobilization. The objective is to evaluate the clinical, radiological, and functional outcomes of distal femur fractures treated with locking compression plates. **Material and Methods:** This prospective observational study was conducted on 20 adult patients with displaced distal femur fractures admitted to Government Medical College (SIMS) and Government General Hospital, Ramagundam, between December 2021 and November 2023. Patients were managed with closed or minimally open reduction and internal fixation using LCP. Demographic data, injury characteristics, union time, complications, and functional outcomes were analyzed. Functional assessment was performed using the NEER scoring system at immediate postoperative, 6, 12, and 24 weeks of follow-up. **Results:** The mean age of patients was 45.7 years, with males predominating (85%). Road traffic accidents accounted for 80% of fractures, and right-sided involvement was more frequent (65%). The majority of fractures were classified as type C2 and C3 (25% each). Union was achieved in most cases within 12–16 weeks, with 70% regaining a range of motion between 80–100°. Functional outcomes improved significantly over time; at 24 weeks, 90% of patients achieved excellent results, and 10% had good outcomes according to NEER scores. **Conclusion:** Locking compression plate fixation provides stable osteosynthesis, satisfactory union rates, and excellent functional recovery in distal femur fractures, making it a preferred treatment modality.

Keywords: Distal femur fracture, locking compression plate, internal fixation, union, NEER score, functional outcome.

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INTRODUCTION

Fractures of the distal femur represent a complex subset of injuries, accounting for nearly 6% of all femoral fractures and demonstrating a bimodal age distribution, with high-energy trauma being common in young adults and low-energy osteoporotic fractures more prevalent in the elderly.^[1] Owing to their proximity to the knee joint and frequent intra-articular extension with comminution, these fractures pose considerable challenges in achieving anatomical reduction and are often associated with prolonged morbidity if inadequately managed.^[2]

Conservative approaches, including skeletal traction, casting, and bracing, were historically the mainstay of treatment. However, these methods were associated with complications such as malunion, joint stiffness, delayed rehabilitation, and significant socioeconomic impact due to prolonged immobilization.^[3] With advances in surgical techniques and the development of modern implants, the management paradigm has shifted toward operative stabilization, which aims to restore articular congruity, maintain proper limb alignment, and facilitate early mobilization.^[4]

Among the surgical options available, the locking compression plate (LCP) has gained prominence due to its biomechanical superiority. Its fixed-angle construct provides

stable fixation even in osteoporotic bone, while minimally invasive plate osteosynthesis (MIPO) techniques help preserve the periosteal blood supply and enhance fracture healing. Several studies have reported that LCP fixation offers high union rates, fewer complications, and improved functional outcomes compared to conventional plating methods.^[5]

Given these advantages, evaluating the functional outcomes of distal femur fractures treated with LCP fixation remains clinically relevant, particularly in populations with high trauma incidence due to road traffic accidents. This study was undertaken to analyze the union time, complications, and functional recovery in patients with distal femur fractures managed surgically with locking compression plates.

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MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study conducted in the Department of Orthopaedics, Government Medical College (SIMS) and Government General Hospital, Ramagundam, Telangana. The study was carried out over a period of two years, from December 2021 to October 2023. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement. Written informed consent was taken from all participants before enrollment.

Study Population: A total of 20 adult patients with distal femur fractures admitted to the hospital during the study period were included. All patients were followed for a minimum of six months.

Inclusion Criteria

- Skeletally mature patients (>18 years) with distal femur fractures.
- Patients with osteoporotic fractures.
- Open distal femur fractures up to Gustilo–Anderson type I, II, and IIIA.
- Patients willing to provide informed consent.

Exclusion Criteria

- Open distal femur fractures of type IIIB and IIIC.
- Associated tibial plateau fractures.
- Pathological fractures (other than osteoporosis).
- Patients <18 years of age with open growth plates.
- Distal femur fractures with neurovascular compromise.
- Patients managed conservatively or lost to follow-up.

Surgical Procedure: All patients underwent closed or

minimally invasive open reduction and internal fixation using a pre-contoured distal femoral locking compression plate. The standard lateral approach to the distal femur was used. Fracture fragments were provisionally stabilized with K-wires, followed by definitive fixation with locking screws. Care was taken to preserve soft tissue attachments and periosteal blood supply.

Postoperative Care and Rehabilitation: Patients received intravenous antibiotics and analgesics as per protocol. Early mobilization with quadriceps strengthening and knee range-of-motion exercises was encouraged from the second postoperative day. Partial weight bearing was initiated after 3–4 weeks, and full weight bearing was allowed after radiological evidence of union (12–16 weeks).

Outcome Assessment: Patients were assessed clinically and radiologically at 6, 12, and 24 weeks postoperatively. Fracture union time, range of motion, and complications were documented. Functional outcomes were evaluated using the NEER scoring system, classified as excellent (>85), good (70–84), fair (55–69), and poor (<55).

RESULTS

This prospective study included 20 patients with displaced distal femur fractures treated with locking compression plates.

Demographic Profile: The mean age of participants was 45.7 ± 15.6 years, with a range of 18–75 years. The highest proportion of cases (30%) were in the 41–50 years age group, followed by 25% in the 31–40 years group. Only 5% were below 20 years and above 70 years. Males predominated, accounting for 85% of the cohort, while females constituted 15% [Table 1].

Table 1: Demographic Profile of Patients (N = 20)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	<20	1	5.0
	21–30	2	10.0
	31–40	5	25.0
	41–50	6	30.0
	51–60	1	5.0
	61–70	4	20.0
	>70	1	5.0
Gender	Male	17	85.0
	Female	3	15.0

Mode of Injury and Fracture Characteristics: Road traffic accidents (RTA) were the leading cause of fractures, responsible for 80% of cases, while falls accounted for the remaining 20%. According to the AO classification, type C2

and C3 fractures were most frequent, observed in 25% each. Types A1 and A3 comprised 15% each, while A2 and C1 were present in 10% each [Table 2].

Table 2: Mode of Injury and Fracture Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Mode of Injury	RTA	16	80.0
	Fall	4	20.0
Type of Fracture (AO Classification)	A1	3	15.0
	A2	2	10.0
	A3	3	15.0
	C1	2	10.0
	C2	5	25.0
	C3	5	25.0

Clinical Characteristics: Closed injuries were more common (90%) compared to open fractures (10%). Right-

sided involvement predominated (65%), while 35% had left-sided fractures. The most frequent initial management was

AK skin traction with BB splint (50%), followed by AK POP slab (30%). External fixation and UTPT with BB splint were

required in 10% each [Table 3].

Table 3: Clinical Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Type of Injury	Closed	18	90.0
	Open (Grade II)	2	10.0
Side Affected	Right	13	65.0
	Left	7	35.0
Initial Treatment	AK Skin Traction with BB splint	10	50.0
	AK POP Slab	6	30.0
	External Fixation	2	10.0
	UTPT with BB Splint	2	10.0

Union Time and Range of Motion: The majority of patients achieved fracture union within 12–16 weeks (50%), while 15% required up to 18 weeks and another 15% up to 20

weeks. Range of motion (ROM) assessment at final follow-up revealed that 70% achieved flexion between 80–100°, 15% between 60–80°, and 15% between 100–120° [Table 4].

Table 4: Union Time and Range of Motion

Parameter	Category	Frequency (n)	Percentage (%)
Time for Union	12 weeks	5	25.0
	14 weeks	4	20.0
	16 weeks	5	25.0
	18 weeks	3	15.0
	20 weeks	3	15.0
Range of Motion (ROM)	60–80°	3	15.0
	80–100°	14	70.0
	100–120°	3	15.0

Functional Outcome: Functional assessment using the NEER scoring system demonstrated progressive improvement over time. Immediately after surgery, 55% of patients were graded as “good,” while 45% were “fair.” At 6 weeks, 80% remained “good,” 10% “excellent,” and 10%

“fair.” By 12 weeks, 50% achieved “excellent” outcomes, 45% “good,” and 5% “fair.” At 24 weeks, the majority (90%) had “excellent” outcomes, while 10% maintained “good” results, with no patient remaining in the “fair” category [Table 5].

Table 5: Functional Outcome by NEER Score

Time Interval	Excellent (>85)	Good (70–84)	Fair (55–69)
Immediate Post-op	–	11 (55.0%)	9 (45.0%)
6 weeks	2 (10.0%)	16 (80.0%)	2 (10.0%)
12 weeks	10 (50.0%)	9 (45.0%)	1 (5.0%)
24 weeks	18 (90.0%)	2 (10.0%)	–

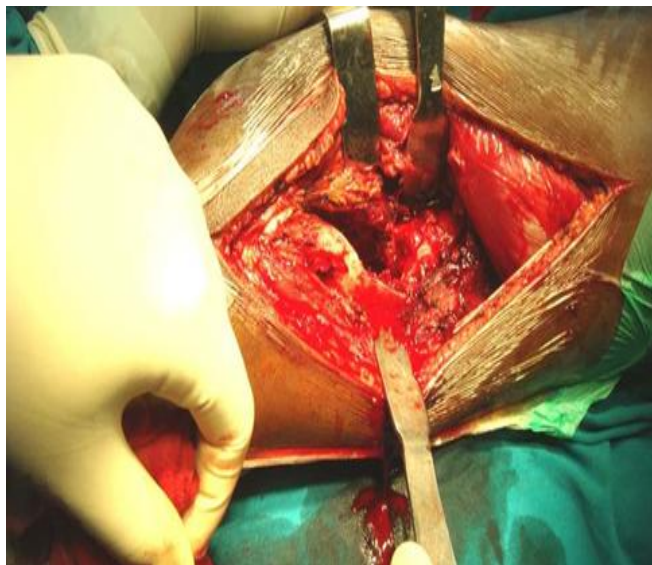


Figure 1: Fracture Exposed through Lateral incision



Figure 2: Reduction under image intensifier

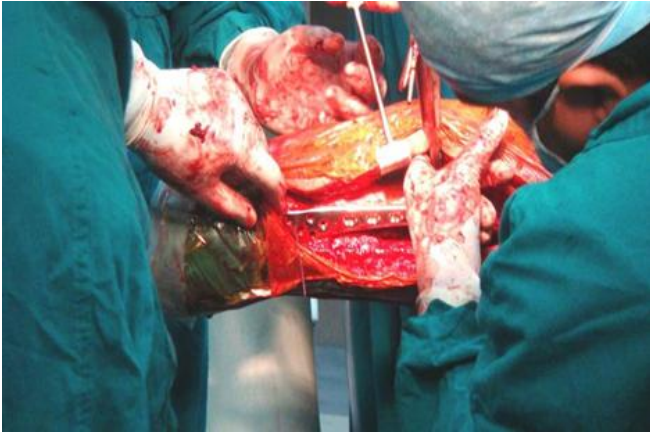


Figure 3: Plate fixed to Femur

DISCUSSION

Distal femur fractures remain among the most difficult injuries to manage owing to their anatomical complexity, frequent comminution, and close relation to the knee joint. In this prospective study, 20 patients with displaced distal femur fractures were treated with locking compression plates (LCP), and both clinical and functional outcomes were assessed. Our findings demonstrated encouraging union rates, satisfactory range of motion, and excellent functional recovery in the majority of cases, thereby reinforcing the value of LCP in the management of these challenging fractures.

Fracture union was achieved within 12–20 weeks in nearly all patients, with half uniting by 12–16 weeks. These results are consistent with the observations of Liu et al., who reported favorable outcomes with locking plate fixation of non-periprosthetic fragility fractures of the distal femur, emphasizing the ability of LCP to provide stable fixation even in compromised bone quality.^[6] The recovery of knee function in our series was also satisfactory, with 70% achieving flexion between 80–100°, underscoring the importance of early mobilization enabled by stable fixation. This is in line with evidence synthesized in the Cochrane review by Claireaux et al., which highlighted the clinical benefits of surgical fixation, particularly using locking plates, in improving mobility and functional outcomes compared with conservative strategies.^[7]

Our study demonstrated excellent functional outcomes based on NEER scores, with 90% of patients achieving excellent results at 24 weeks. Virk et al. previously emphasized that distal femur locking plates serve as an effective solution for a wide spectrum of distal femur fractures, particularly by addressing issues of stability and maintaining alignment in osteoporotic bone.^[8] Similarly, Kiran Kumar et al. reported favorable union rates and good-to-excellent functional recovery in their series of intra-articular distal femoral fractures managed with LCP, findings that resonate closely with the outcomes of our patients.^[9] Kiyono et al. also demonstrated consistent results in their retrospective cohort study, where LCP fixation achieved reliable union with acceptable complication rates, further consolidating the evidence for its efficacy.^[10]

When comparing LCP to alternative fixation techniques, Shah et al. observed that LCP fixation provided superior surgical and functional outcomes compared to intramedullary supracondylar nailing, particularly in terms of range of motion and early recovery, though both modalities remain valuable depending on fracture pattern and patient factors.^[11] Our results are in agreement with these findings, suggesting that LCP provides more predictable stability in complex fracture configurations.

Importantly, complications were minimal in our study, with only mild stiffness encountered in a few cases. Toro et al., however, cautioned that locking plate fixation of distal femoral fractures is technically demanding and associated with a learning curve, which may influence outcomes and complication rates if meticulous technique is not adhered to.^[12] This underlines the importance of surgical expertise, careful preoperative planning, and early physiotherapy in minimizing adverse events. In resource-limited settings, the prospective study by Tsegaye et al. further demonstrated that distal femur locking plates offer a reliable solution, yielding favorable union times and functional recovery, thereby validating their role across diverse clinical environments.^[13]

Overall, the findings of our study, in conjunction with the existing literature, confirm that locking compression plate fixation ensures stable osteosynthesis, permits early mobilization, and achieves high union rates with excellent functional outcomes. By providing angular stability and acting as an internal fixator, LCP offers distinct biomechanical advantages that translate into superior clinical performance. The collective evidence supports its role as the preferred treatment modality for distal femur fractures, particularly in cases involving comminution, osteoporotic bone, and intra-articular extension.

Clinical Implications

The results of this study reaffirm that LCP fixation ensures stable osteosynthesis, promotes early mobilization, and yields excellent functional recovery in the majority of cases. This makes it particularly valuable in populations with high trauma burden and in patients with osteoporotic bone.

CONCLUSION

The present prospective study demonstrates that distal femur fractures, though complex and associated with significant morbidity, can be effectively managed with locking compression plate fixation. This technique provided stable osteosynthesis, facilitated early mobilization, and yielded high union rates with minimal complications. The majority of patients regained satisfactory knee function, with 90% achieving excellent outcomes by 24 weeks according to NEER scoring. Compared with conventional fixation methods, LCP offers superior biomechanical stability and better results in both high-energy trauma and osteoporotic bone. Hence, LCP fixation should be considered a preferred modality for the surgical management of distal femur fractures.

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Conflicts of interest

There are no conflicts of interest.

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