e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.7.35

International Journal of Pharmaceutical Quality Assurance 2025; 16(7); 225-230

Original Research Article

Functional Outcome of Distal Femur Fracture Treated by Distal Femur Locking Compression Plate

Paritosh B Solanki[1], Smit Prajapati[1], Parth Bhalani[2]

[1]Assistant Professor, Department of Orthopaedic, B. J. Medical college, Civil hospital, Ahmedabad, Gujarat, India

[2]3rd Year Resident, Department of Orthopaedic, B. J. Medical college, Civil hospital, Ahmedabad, Gujarat, India

Received: 25-05-2025 / Revised: 24-06-2025 / Accepted: 25-07-2025

Corresponding Author: Smit Prajapati

Conflict of interest: Nil

Abstract:

Introduction: Distal femur fractures account for 6% of femoral fractures and present significant management challenges due to their complex nature, proximity to the knee joint. This study evaluates the functional outcomes of treating these fractures using distal femur locking compression plates (DF-LCPs).

Materials & Methods: This prospective, quasi-experimental study evaluated 50 patients with distal femur fractures treated using locking compression plates at B.J. Medical College Hospital, Ahmedabad from December 2022 to March 2025. Patients above 18 years with type I, II, and IIIA open fractures were included. Functional outcomes were assessed using the NEER scoring system at 1, 3, and 6-month follow-ups.

Results: The study population had male predominance (62.75%) with most patients aged 41-60 years (34%). Falls were the predominant injury mechanism (58%). Most surgeries were performed within 1-2 weeks post-injury. Mean radiological union time was 6.48±1.95 months. NEER scoring showed 32% excellent and 68% good outcomes with no fair/poor results. The mean total NEER score was 82.74±5.15.

Conclusion: Distal femur locking compression plates provided excellent to good functional outcomes in all patients with consistent union and minimal complications. The technique offered stable fixation allowing early mobilization, particularly beneficial in comminuted and osteoporotic fractures, making it a reliable treatment option for distal femur fractures.

Keywords: Distal Femur Fracture, Functional Outcome, Locking Compression Plate, NEER Score, Osteoporotic Fracture.

Introduction

Distal femur fractures account for approximately 6% of all femoral fractures, with a bimodal distribution affecting both younger patients with high-energy trauma and older individuals with osteoporotic bone. With an incidence density rate of 37 per 100,000 person-years, these fractures pose significant challenges due to their commonly comminuted and intra-articular nature.[1] The management of distal femur fractures has evolved significantly over recent decades, with contemporary approaches focusing on anatomic reduction, stable fixation, and early mobilization. The goals of surgical management align with principles for any articular fracture: restoring articular congruity, achieving bone contact, and maintaining correct metaphyseo-diaphyseal alignment.[2]

Historically, treatment options ranged from conservative management with skeletal traction to surgical fixation using dynamic condylar screws and retrograde intramedullary nailing. However, conservative approaches universally yielded poor results due to difficulty in maintaining rotational and coronal plane alignment despite better axial alignment. Nevertheless, even surgical management using traditional implants showed limitations, particularly in comminuted intra-articular and osteoporotic fractures.[3]

The introduction of locking compression plates (LCP) represented a paradigm shift in distal femur fracture management. Based on principles developed from PC-Fix (Point Contact Fixator) and LISS (Less Invasive Stabilization System), the LCP uniquely combines principles of internal fixation and dynamic compression.[4] Its key innovation is the combination of two anchorage technologies in one implant, allowing surgeons to utilize it as a compression plate, locked internal fixator, or a combination of both based on individual patient needs.[5]

This approach has proven particularly beneficial for distal femur fractures, especially in cases of severe comminution and osteoporosis. The fixed-angle screw system offers several advantages: angular stability preventing varus collapse, minimally invasive options preserving soft tissue and periosteal blood supply, and anatomic plate contouring ensuring good fit with minimal irritation.[6] Recent studies have confirmed these benefits, with Sebastian et al.[1] (2024) demonstrating excellent functional outcomes and union rates using locking plates for distal femur fractures. Proper surgical technique and implant selection significantly reduced complication rates and improved functional outcomes in complex distal femoral fractures.

The current study aims to evaluate the functional outcomes and complications associated with the use of distal femur locking compression plates (DF-LCPs) at a tertiary care hospital in Ahmedabad, India.

Materials and Methods

Study Design: This prospective, quasi-experimental, single-group post-test-only study was conducted at the Department of Orthopaedics, B.J. Medical College Hospital, Ahmedabad, Gujarat. The study was conducted after obtaining institutional ethical committee clearance and informed written consent from all participants.

Study Population and Duration: The study included 50 patients undergoing surgical management of supracondylar femoral fractures with locking compression plates from December 2022 to March 2025.

Sample Size: The sample size of 50 patients was estimated using the formula:

$$n = \frac{z^2 pq}{L^2}$$

where Z = 1.96, (critical value of Normal distribution at 95% confidence interval), p = 94% (taken from previous literature), q = 6%, and d = 7 (precision of estimate).

Inclusion Criteria:

- All skeletally mature patients (>18 years)
- Patients with type I, II, and IIIA open distal femur fractures
- Patients willing to provide informed consent
- Patients with distal femoral fractures with or without osteoporotic changes

Exclusion Criteria:

- Open distal femoral fractures Type IIIB & IIIC
- Associated tibial plateau fractures
- Children with distal femoral fractures or open growth plates
- Pathological distal femoral fractures other than osteoporosis
- Patients managed conservatively for medical reasons
- Distal femoral fractures with neurovascular compromise
- Revision surgery of supracondylar femur fractures

Preoperative Evaluation: All patients underwent thorough preoperative investigations including hemogram, renal function tests, serum electrolytes, blood sugar, blood grouping, coagulation profile, chest X-ray, ECG, and specific radiographs including AP and lateral views of the knee and femur. Fractures were classified according to the AO/OTA classification system.

Surgical Technique: Most surgeries were performed using the standard lateral approach to the distal femur. After appropriate exposure, articular fragments were reduced and temporarily fixed with K-wires. The metaphyseal component was then reduced, and a distal femoral locking compression plate of appropriate length was applied laterally. The position was confirmed with intraoperative imaging. Locking screws were inserted distally and standard or locking screws proximally, as per the fracture pattern.

Postoperative Protocol: Postoperative management included intravenous antibiotics for 5 days followed by oral antibiotics for 5 days. Thromboprophylaxis was provided through physical methods and early mobilization. Drains were removed by 48 hours, and wounds were checked on the 3rd and subsequent postoperative days. Sutures were removed at 12-13 days.

Rehabilitation Protocol: Early physiotherapy including quadriceps exercises and knee and ankle mobilization was initiated on the 2nd postoperative day according to patient tolerance. Continuous passive motion was started in the first week when feasible. Partial weight-bearing was allowed after 6 weeks, with full weight-bearing permitted as signs of union appeared radiologically.

Follow-up and Assessment: All patients were followed for 6 months with evaluations at 1, 3, and 6 months for wound condition, functioning, shortening, and radiological union. The functional outcome was assessed using NEER's scoring system, which evaluates pain (20 points), function (20 points), motion (20 points), work (10 points), gross anatomy (15 points), and radiographic findings (15 points). Outcomes were classified as excellent (>85 points), good (70-85 points), fair (55-69 points), or poor (<55 points).

Statistical Analysis: Data was collected and entered in Microsoft Excel 2020 and analysed using IBM SPSS Statistics software, version 20.0. Categorical

data was displayed in frequencies, percentages and continuous data was summarised in means, and standard deviations.

Results

Table 1: Demographic and Injury profile of study subjects

Age Group (years)	Number of patients	Percentage (%)
0–20	5	10.0%
21–40	15	30.0%
41–60	17	34.0%
61–80	13	26.0%
Mean ± SD	48.3 ± 13.5	
Gender		
Male	32	64.0%
Female	18	36.0%
Fracture Side		
Right	26	52.0%
Left	24	48.0%
Mode of Injury		
Fall	29	58.0%
RTA	19	38.0%
Assault	2	4.0%
Associated Injury		
Proximal tibia fracture	3	6.0%
Segmental tibia-fibula fracture	2	4.0%
Clavicle fracture	1	2.0%
Metacarpal fracture	1	2.0%
Distal femur fracture (opposite limb)	1	2.0%
Patella fracture	1	2.0%
Operated case of TKR (1 year back)	1	2.0%
Lateral malleolus fracture	1	2.0%
Radius ulna fracture	1	2.0%

Demographic Profile: A total of 50 patients with distal femur fractures treated with distal femur locking compression plates were evaluated. The majority of patients were aged 41-60 years (34%), followed by 21-40 years (30%) and 61-80 years (26%). There was male predominance with 32 males (64.0%) and 18 females (36.0%) [Table 1].

Injury Characteristics: Falls were the most common mechanism of injury (58%), followed by road traffic accidents (38%) and assaults (4%). Fractures were distributed almost equally between the right side (52%) and left side (48%). The majority (76%) had no associated injuries. Among those with associated injuries (24%), the most common were proximal tibia fracture (6%) and segmental tibia-fibula fractures (4%) [Table 1].

Table 2: Surgical timing and follow-up parameters

Surgery Timing	Number of patients	Percentage (%)
1 week	10	20.0%
1–2 weeks	28	56.0%
2–3 weeks	5	10.0%
3–4 weeks	5	10.0%
>4 weeks	2	4.0%
Other variable	**Mean ± SD**	**Range**
Hospital stays (days)	12.5 ± 4.2	7-14
Time to Union (months)	6.48 ± 1.95	3–9
Follow-Up Duration (months)	9.84 ± 2.10	6–12

Treatment Timelines: Most patients (28/50, 56%) underwent surgery between 1-2 weeks after injury. Ten patients (20.0%) were operated within 1 week, 5 patients (10.0%) each between 2-3 and 3-4 weeks, and 2 patients (4.0%) after more than 4 weeks. The mean time to radiological union was 6.48±1.95 months with a median of 6 months (IQR: 6-9 months) and range of 3-9 months. The mean follow-up duration was 9.84±2.10 months [Table 2].

NEER Score Analysis: The component-wise NEER score distribution showed mean scores of

16.16±1.82 for pain, 15.94±1.49 for function, 15.76±1.48 for motion, 8.72±1.20 for work, 13.16±1.13 for gross anatomy, and 13.00±0.95 for radiograph. The mean total NEER score was 82.74±5.15, with a median of 81 (IQR: 79-85) and range of 73-97. Based on the NEER score classification, 16 patients (32%) achieved excellent results and 34 patients (68%) achieved good results. Notably, there were no fair or poor outcomes in the study population [Figure 1 and Figure 2].

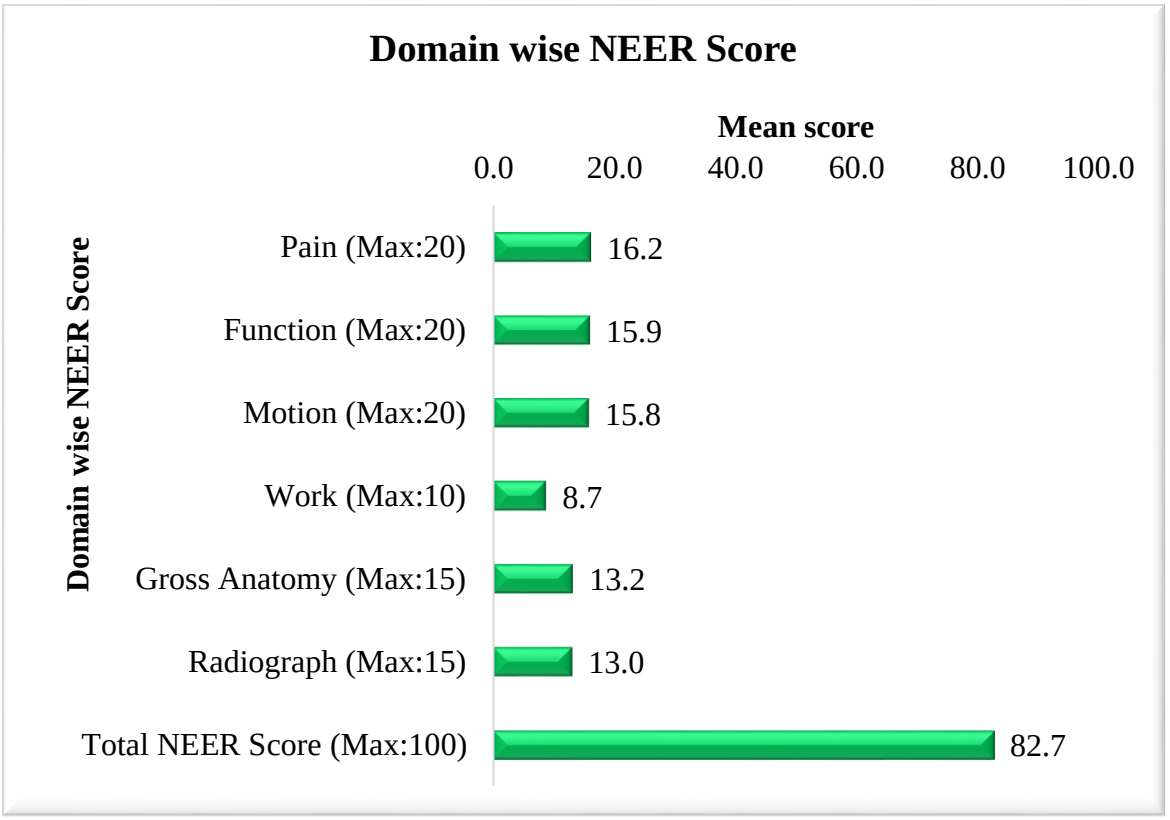

Figure 1: Domain-wise NEER score distribution

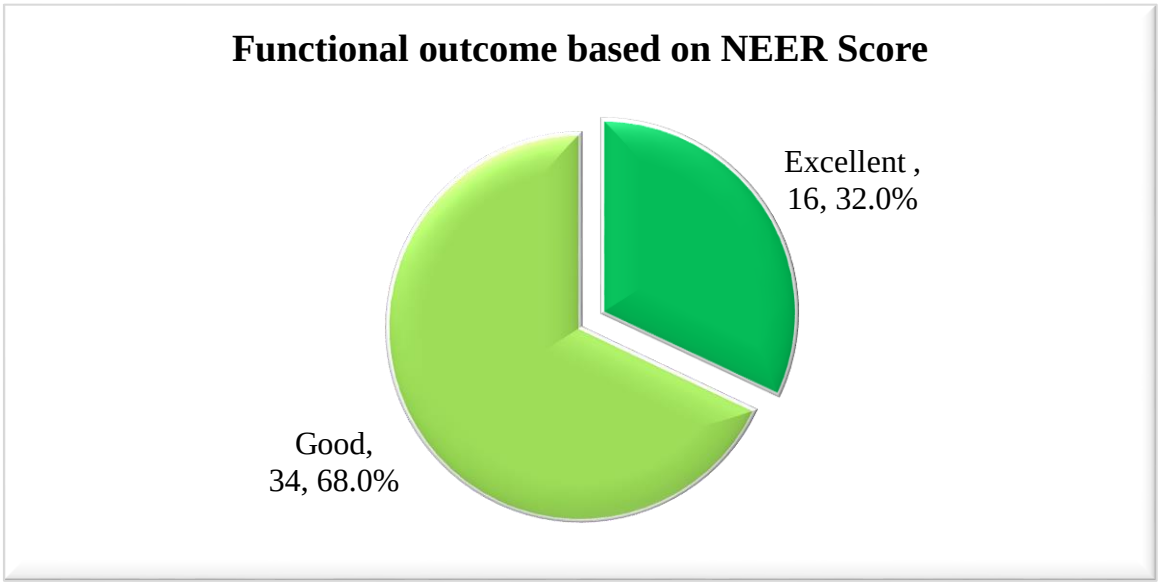

Figure 2: Overall functional outcome based on NEER score

Complications: No deep infections or implant failures were observed in the study. There were no cases of significant malalignment or limb shortening. A few patients developed superficial infections, which were managed successfully with conservative measures.

Discussion

The present study evaluated the functional outcomes and complications of distal femur fractures treated with locking compression plates in 50 patients at B.J. Medical College, Ahmedabad. The findings demonstrate the efficacy of this treatment modality with consistently good to excellent results and minimal complications.

Demographic and Injury patterns: Our study showed a bimodal age distribution with peaks in the 41-60 and 21-40 year age groups, consistent with the established epidemiology of distal femur fractures.[7] The male predominance (62.75%) aligns with previous studies by Mahajan et al. [3] (2019) and Islam et al [8]. (2022) reflecting higher male involvement in high-risk activities. Falls were the predominant injury mechanism (58%), followed by road traffic accidents (38%), which varies somewhat from other Indian studies where road traffic accidents were more common. [5] This difference may reflect regional variations in transportation patterns and population demographics.

Surgical timing and Union rates: Most patients in our study underwent surgery within 1-2 weeks of injury, allowing for soft tissue recovery and medical optimization. This timing is consistent with current orthopedic best practices for distal femur fractures. The mean time to radiological union was 6.48±1.95 months, which falls within the range of 4-8 months reported in the literature.[9] A recent prospective study by Sebastian et al. [1] (2024) reported an average union time of 19.2 weeks (approximately 4.5 months), which is somewhat shorter than our findings. This variation may be attributed to differences in fracture patterns, patient demographics, and surgical techniques.

Functional Outcomes: The functional outcomes in our study were assessed using the NEER scoring system, which provides a comprehensive evaluation of pain, joint motion, function, radiological appearance, and anatomical alignment. The mean NEER score of 82.74±5.15 with 32% excellent and 68% good outcomes compares favorably with other studies. In comparison, Shafeed et al. [6] (2016) reported 33% excellent, 52% good, 11% fair, and 4% poor outcomes in a similar study. A more recent study by Singh et al. [5] (2021) reported higher rates of excellent outcomes (56.7%) with 33.3% good outcomes. The consistent achievement of good to excellent outcomes across studies affirms the reliability of locking compression plates in distal femur fracture management. Functional parameters such as knee range of motion and pain relief were particularly impressive in our study, with mean scores of 15.76±1.48 for motion and 16.16 ± 1.82 for pain out of maximum possible scores of 20 each.

Biomechanical advantages of Locking plates: The success of locking compression plates observed in our study can be attributed to several biomechanical advantages. The angular stability provided by fixed-angle locking screws prevents varus collapse, a common mode of failure in distal femur fractures. [10] This is particularly beneficial in osteoporotic bone, which was present in a significant proportion of our older patients. Furthermore, the anatomical design of distal femoral locking plates ensures proper fit and reduces soft tissue irritation. [4]

Complications and their management: Our study reported minimal complications with no deep infections, implant failures, significant malalignment, or limb shortening. This low complication rate contrasts with some reports in the literature. A recent Indian study reported complications in 57.14% of patients with AO type 33C fractures, including knee stiffness, surgical site infections, malunion, and nonunion. [11] The lower complication rate in our study may be attributed to careful patient selection, meticulous surgical technique, and standardized post-operative protocols including early mobilization. Regular follow-up and prompt management of early complications likely contributed to preventing more serious sequelae.

Future research should focus on long-term outcomes beyond our follow-up period of 9.84±2.10 months, comparative studies with newer techniques, and patient-reported outcome measures that capture quality of life and functional satisfaction from the patient's perspective.

Limitations

This study has a few limitations. First, the lack of a control group comparing DF-LCPs with other fixation methods, such as intramedullary nailing or traditional plating, limits our ability to draw comparative conclusions. Second, the follow-up duration was limited to 12 months, which may not be sufficient to capture long-term outcomes or complications. Finally, the use of only the Neer scoring system, while comprehensive, does not include broader quality-of-life assessments like the SF-36 or KOOS.

Conclusion

This study demonstrates that distal femur locking compression plates provide excellent to good functional outcomes in the treatment of distal femur fractures. The mean NEER score of 82.74±5.15 indicates strong functional recovery, with 32% of patients achieving excellent results and 68% achieving good results. No fair or poor outcomes were observed, highlighting the reliability of this treatment modality. The implant demonstrated biomechanical stability allowing for early mobilization and consistent healing within 3-9 months (mean 6.48 months). The low complication rate further supports the use of locking plates, particularly in complex and

osteoporotic fractures. Based on these findings, distal femur locking compression plates represent an effective method for managing distal femur fractures across a wide age range, providing stable fixation, predictable healing, and excellent functional recovery.

References

1. Sebastian K, Manohar PV, Manoharan R, Mahesh K. Evaluation of functional outcome in patients treated with locking compression plate for distal femur fractures. J Bulg Orthop Trauma Assoc 2024;61(01):39-47.
2. Mahadik SK, Chandanwale AS, Bhor P, Sawant T. Functional outcome of distal femoral fractures managed surgically using locking compression plate laterally and augmented with titanium elastic nail system medially. Asian J Med Sci 2021;12(3):81-7.
3. Mahajan NP, Ravesh VA, Prasanna Kumar GS, Chandanwale A, Gadod L. Assessment of functional outcome of distal femur intra-articular fractures treated with locking compression plate. Int J Res Orthop 2020 Jan;6145-50.
4. Khajotia BL, Chauhan S, Solanki S, Hirani A. Clinical and radiological outcome of distal femoral fractures treated by distal femoral locking compression plate. Int J Res Orthop 2019; 5(6): 1100-1104.
5. Singh S, Arif M, Gupta A. Functional and radiological outcome of surgical fixation of distal femur fractures by distal femoral locking plate in a tertiary care hospital in North India. Int J Res Med Sci 2021 Nov;9(11):3411-5.
6. Shafeed TP, Bijo P. Functional outcome of fixation of distal femoral fractures with DF-LCP: a prospective study. Int J Res Orthop 2016 Oct;2(4):291-8.
7. Kiran Kumar GN, Sharma G, Farooque K, Sharma V, Ratan R, Yadav S, Lakhotia D. Locking compression plate in distal femoral intra-articular fractures: Our experience. Int Sch Res Not 2014;2014(1):372916.
8. Islam MS, Islam J, Islam MK, Khan MR, Hasan MM. Evaluation of Functional Outcome of Distal Femur Fractures Treated by Open Reduction and Internal Fixation with Locking Compression Plate and Screws. Planet 2022 Aug 15;6(01): 125-34.
9. Gwathmey WF, Jones-Quaidoo SM, Kahler D, Hurwitz S, Cui Q. Distal femoral fractures: current concepts. JAAOS-Journal Am Acad Orthop Surg 2010 Oct 1;18(10): 597-607.
10. Virk JS, Garg SK, Gupta P, Jangira V, Singh J, Rana S. Distal femur locking plate: the answer to all distal femoral fractures. J Clin diagnostic Res JCDR 2016 Oct 1;10(10): RC01.
11. Prakash A, Kumar S, Nath R, Ali S. Functional and Radiological Outcomes after Locking Plate Fixation of AO Type 33C Distal Femur Fractures. J Orthop Case Reports 2025 Feb; 15(2): 275.