e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(1); 1152-1158

Original Research Article

Unlocking the Role of Locking Compression Plates in Managing Distal Femoral Fractures

Vijaya Kumari Thadiparthi[1], Rajeev Kumar Giri[2], Varun Kumar Paka[3]

[1]Associate Professor, Department of Orthopaedics, Government Medical College, Paderu, Andhra Pradesh, India.

[2]Assistant Professor, Department of Pharmacology, Sukh Sagar Medical College and Hospital, Jabalpur, Madhya Pradesh India.

[3]Assistant Professor, Department of Orthopaedics, Siddhartha Medical College, Vijayawada, Andhra Pradesh, India.

Received: 01-10-2025 / Revised: 15-11-2025 / Accepted: 21-12-2025

Corresponding author: Dr. Vijaya Kumari Thadiparthi

Conflict of interest: Nil

Abstract

Background: Distal femoral fractures account for approximately 3–6% of all femoral fractures and remain a formidable challenge owing to complex fracture patterns, periarticular involvement, and frequent association with osteoporotic bone. Although multiple fixation strategies exist, there is no clear consensus regarding the optimal implant. Distal femoral locking compression plates (LCPs) provide angular stability and biomechanical advantages, particularly in comminuted and osteoporotic fractures. This study aimed to evaluate fracture union, functional outcomes, and complication rates following LCP fixation of distal femoral fractures. Patients and **Method:** This prospective observational study included 24 adult patients with closed or Gustilo–Anderson type I open distal femoral fractures treated with LCP fixation. Standardized surgical techniques and postoperative rehabilitation protocols were employed. Patients were followed for a minimum of 18 months. Clinical and radiological outcomes were assessed at regular intervals, with functional evaluation performed using Neer's scoring criteria.

Results: Fracture union was achieved in 23 patients (95.8%), with a mean time to union of 15.1 weeks (range, 12–20 weeks). Functional outcomes were graded as excellent in 37.5%, good in 54.2%, and fair in 8.3% of patients. More than half of the cohort achieved knee flexion ≥90°. Reported complications included knee stiffness (19.3%), limb shortening (8.3%), superficial infection (8.3%), and varus malalignment in one patient. No cases of implant failure or non-union were observed.

Conclusion: Locking compression plate fixation for distal femoral fractures yields high union rates and favourable functional outcomes with an acceptable complication profile. This technique is particularly advantageous in osteoporotic and comminuted fracture patterns. Meticulous surgical technique, appropriate implant selection, and early mobilization are essential for optimizing clinical outcomes.

Keywords: comminution, joint incongruity, locking compression plate, osteoporotic bone, periprosthetic injuries.

DOI: 10.25258/ijcpr.18.1.194

Introduction

Distal femur fractures constitute approximately 3–6% of all femoral fractures, with their incidence expected to rise due to an aging population and the increasing prevalence of periprosthetic injuries. These fractures exhibit a bimodal age distribution: high-energy trauma predominates in younger adults, whereas low-energy mechanisms, often associated with osteoporotic bone, are more common in the elderly.

Distal femur fractures are complex injuries frequently characterized by comminution and intra-articular extension. Anatomical challenges such as a widened medullary canal, thin cortices, and poor bone quality complicate open reduction and internal fixation (ORIF) in this region. Historically, conservative management has been associated with significant risks, including prolonged immobilization, persistent angular deformities, joint incongruity, and reduced knee range of motion—all contributing to suboptimal functional outcomes

Surgical stabilization is currently the preferred treatment modality, as it facilitates anatomical reconstruction of the articular surface, limb realignment, and early mobilization, thereby promoting timely fracture union and improved knee function. However, no single implant design is universally suitable for all distal femur fracture patterns. This has led to the development of distal femoral locking compression plates (LCPs), specifically engineered to address the limitations of conventional fixation methods.

ORIF using an LCP allows for precise fracture reduction, restoration of joint congruity, and early postoperative mobilization. These plates are designed to enhance stability in cases with comminution, widened canals, thin cortices, and compromised bone stock—conditions that often challenge traditional fixation techniques. Despite these advancements, complications such as fixation failure and varus collapse remain prevalent, particularly in complex fracture configurations.

The objective of this study was to assess the union rates, functional outcomes, and complication profile associated with ORIF using distal femoral locking compression plates.

Patients and Method: A prospective observational study was conducted at our institution over a period of two years, involving 24 adult patients with distal femoral fractures managed surgically using locking compression plates. Functional and radiological outcomes were assessed at scheduled follow-up intervals.

Inclusion Criteria: Patients aged 18 years and above with closed or Gustilo-Anderson type I open distal femur fractures who consented to surgical intervention were included.

Exclusion Criteria: Patients with pathological fractures, polytrauma, Gustilo-Anderson type II and III open fractures, or those deemed medically unfit for surgery were excluded.

Prior to study initiation, approval was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants.

Initial assessment included evaluation of soft tissue status and fracture classification based on the AO system. All patients were stabilized in accordance with Advanced Trauma Life Support (ATLS) protocols and immobilized using either an above-knee slab, proximal tibial skeletal traction, or Bohler-Braun splint. Medical comorbidities were identified and management planned appropriately prior to surgery. Surgical procedures were performed under spinal or epidural anaesthesia, with patients positioned supine on a radiolucent operating table. A bump was placed under the operative hip to maintain neutral or slight internal rotation, facilitating posterior displacement of neurovascular structures. A pillow was positioned under the thigh to counteract the pull of the gastrocnemius (Fig 1).

Fig 1: Pre operative placement of pillow under knee to maintain knee flexion and avoid muscle pull on femur

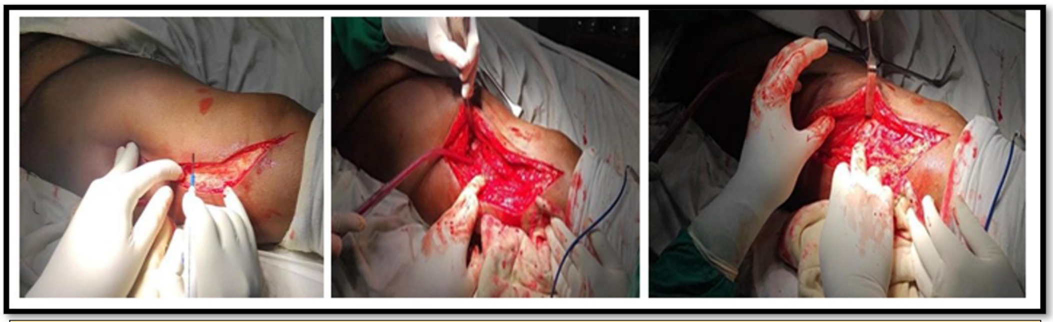

Fig 2: Swashbuckler approach to distal femur which allows for proper visualization of the articular surface of the distal femur

Surgical exposure was achieved using either the lateral or Swashbuckler approach (Fig 2). An additional medial approach was employed in cases involving medial condylar or Hoffa fractures. A minimally invasive lateral approach was utilized selectively. Complex intra-articular fractures were managed using combined lateral and medial parapatellar approaches to allow direct visualization. Locking compression plating system was used for fixation in all fractures (Fig 3).

Fig 3: Locking compression plating work set used for fixation of distal femur fractures

During the lateral approach, tensor fascia lata and vastus lateralis were split in line with the skin incision and retracted anteriorly. In cases with significant comminution extending into the articular surface, a lateral parapatellar arthrotomy or Swashbuckler approach was employed to facilitate direct reduction of both condyles. A Steinmann pin inserted into the lateral cortex of the lateral condyle was used as a lever to manipulate the condylar fragments. Reduction was temporarily secured with Kirschner wires, and a bump placed beneath the knee helped to maintain alignment and prevent posterior angulation. Following reduction, the locking compression plate was positioned along the lateral aspect of the distal femur, and fixation was stabilized using locking screws to create a fixed-angle construct. Intra operative reduction, screw placement and positioning of plate was confirmed on c am images and later post operatively on radiographic images (Fig 4).

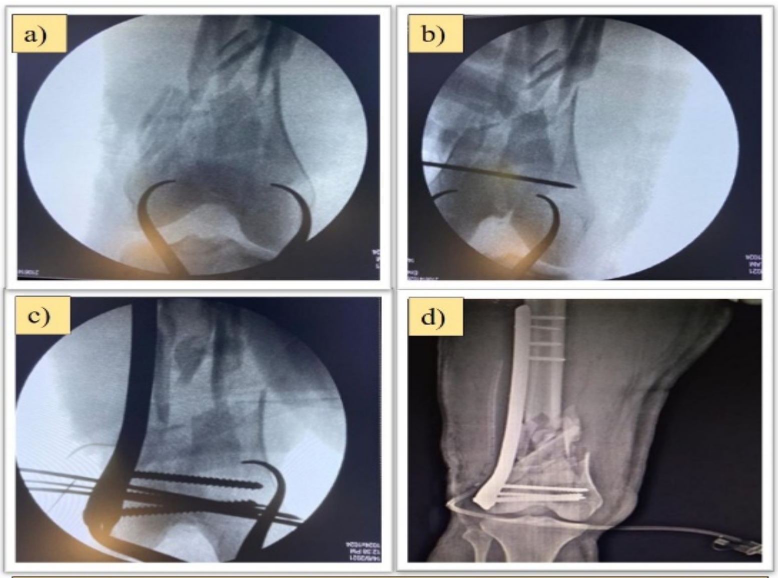

Fig 4: Intra operative C arm images showing a) reduction of condylar segments using reduction forceps b) Preliminary maintenance of reduction using K c) Subsequent placement of locking compression plate d) Post operative image with well secured intra articular reduction and alignment.

Postoperatively, intravenous antibiotics were administered for five days. Vitals and drain output were closely monitored. Analgesics and anti-inflammatory medications were prescribed as needed. Passive and active range of motion exercises were initiated on the first postoperative day. Strict non-weight-bearing was maintained for six weeks post-surgery, followed by partial weight-bearing.

Full weight-bearing was permitted at eight weeks, based on radiographic evidence of callus formation.

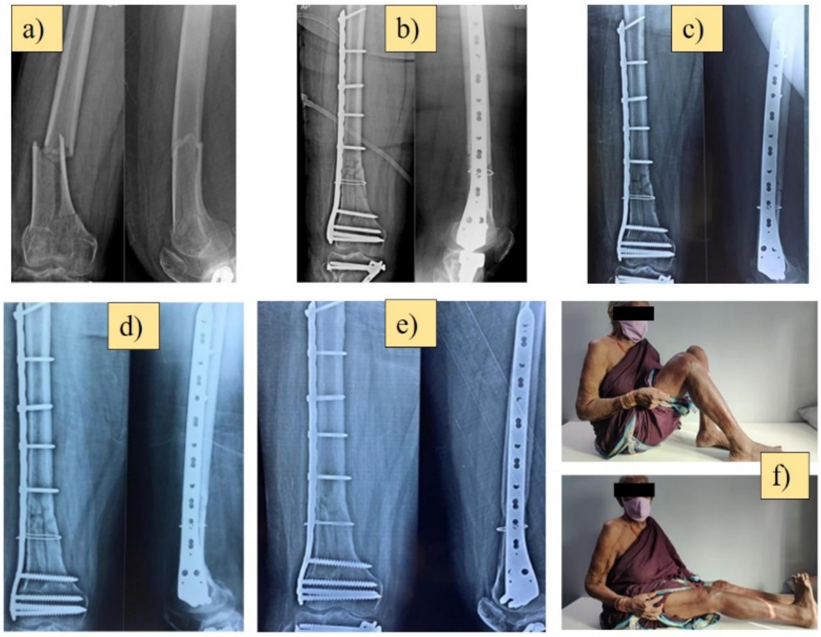

Fig 5: a)Pre operative x ray showing distal femur fracture b) Post operative x-ray showing well attained reduction through LCP . At follow ups serial x ray images were taken c) at one month d) 3 months and e) 10 months post surgery. Clinical evaluation of active range of knee flexion and extension at the end of follow up period.

Patients were followed weekly during the first month, biweekly up to three months, and subsequently at 6, 12, 18, and 24 months (Fig 5). Clinical, functional, and radiological assessments were conducted using Neer's criteria. Parameters evaluated included implant positioning, evidence of loosening or failure, fracture union (clinical and radiological), limb length discrepancy, alignment, rotational profile, and knee joint range of motion.

Results:

All 24 patients completed a minimum follow-up of 18 months and were included in the final analysis. The mean age of the cohort was in the sixth decade (range, 21–70 years), with the highest incidence observed in patients aged 51–60 years (29%). There was no significant sex predilection, with a male-to-female ratio of 1.1:1. The right distal femur was involved in 14 patients (58.3%).

High-energy trauma was the predominant mechanism of injury, with road traffic accidents accounting for 75% of cases, while low-energy falls contributed to the remaining 25%. According to the AO/OTA (Müller) classification, type C2 fractures were most common (29.2%), followed by type A2 (25%) and type A3 (20.8%). Associated injuries were present in several patients and included fractures of the proximal tibia, patella, distal radius, humeral shaft, femoral neck, and both bones of the leg.

Radiological union was achieved in 23 patients (95.8%). Union occurred within 12–16 weeks in 19 patients (79.2%) and between 16–20 weeks in 4 patients (16.7%). One patient (4.1%) demonstrated delayed union beyond 20 weeks.

At final follow-up, 7 patients (29.2%) were completely pain-free, 4 (16.7%) reported occasional activity-related pain, and 13 (54.2%) experienced pain during strenuous or work-related activities; no patient reported rest pain.

Range-of-motion assessment demonstrated knee flexion >120° in 9 patients (37.5%). Five patients (20.8%) achieved <70° of flexion, while over 50% of patients regained ≥90° of knee flexion, adequate for activities of daily living. Functional weight-bearing was restored in more than 80% of patients by the fifth postoperative month.

Functional outcomes assessed using Neer's scoring system were excellent in 9 patients (37.5%), good in 13 patients (54.2%), and fair in 2 patients (8.3%); no poor outcomes were recorded. The most frequent complication was knee stiffness (19.3%; Fig. 6a). Limb shortening and superficial infection occurred in 8.3% of patients each (Fig. 6b). One patient developed varus malalignment (Fig. 6c). No cases of implant failure or established non-union were observed.

Fig 6: Few complications observed were a) knee stiffness, b) superficial infection controlled through antibiotic course. c) Varus deformity due to poor plate contouring to bone as seen on x-ray image

Discussion

The present study evaluated the clinical and radiological outcomes of open reduction and internal fixation (ORIF) using locking compression plates (LCPs) in 24 patients with distal femur fractures. Distal femur fractures account for approximately 6% of all femoral fractures and continue to pose a significant orthopaedic challenge due to complex periarticular anatomy, substantial mechanical forces across the knee joint, and the necessity for accurate restoration of the articular surface to achieve optimal functional outcomes [1,2,3]. The objective of this study was to assess union rates, functional outcomes, and complications associated with LCP fixation and to compare these results with existing literature.

Achieving a painless, stable, and mobile knee joint following distal femur fractures requires anatomical reduction of the articular surface, restoration of the mechanical axis, and a stable fixation construct. Suboptimal outcomes are frequently attributed to inadequate reduction, particularly of intra-articular fragments, leading to residual step-offs and an increased risk of post-traumatic osteoarthritis. Locking compression plate technology provides angular stability and is especially advantageous in comminuted fractures, where conventional fixation methods often fail due to insufficient purchase and construct instability [4]. This enhanced stability facilitates early mobilization and contributes to improved functional recovery.

Locking compression condylar plates offer multiple fixed-angle screw–plate interfaces, increasing construct stiffness and resistance to varus collapse. This feature is particularly beneficial in osteoporotic bone and metaphyseal comminution, where conventional implants are prone to loosening. These biomechanical advantages were reflected in our series, with high union rates and predominantly good-to-excellent functional outcomes. Appropriate implant selection has a critical influence on functional recovery and long-term outcomes in distal femur fractures [5].

The demographic profile of our cohort is consistent with previously published studies. The male-to-female ratio of 1.1:1 aligns with findings by Yeap et al., who reported a slight male predominance in their series [6]. The mean age distribution was also comparable to that reported by Hosam M et al., who observed a higher incidence of distal femur fractures in patients over 50 years of age [7]. This trend reflects the increasing prevalence of fragility fractures in the elderly population and highlights the importance of fixation strategies suitable for osteoporotic bone. Open fractures are well-recognized independent risk factors for infection and non-union, as demonstrated by Ricci et al. and

Rodriguez et al. in large patient cohorts. In the present study, two cases were managed using minimally invasive percutaneous plate osteosynthesis (MIPPO) with satisfactory outcomes.

Previous studies have shown that clinical and radiological outcomes with MIPPO are comparable to conventional ORIF, although intraoperative reduction may be technically more demanding. Less invasive approaches may reduce soft tissue complications, particularly in high-risk patients.

Union rates observed in this study were encouraging. More than 75% of patients achieved radiological union by five months, with the remainder achieving union by six months. The mean time to union was 15.1 weeks (range: 12–22 weeks), which is consistent with reports by Schandelmaier et al. (14.3 weeks), Fankhauser et al. (12 weeks), and Kohli et al. (16.1 weeks) [8,9,10]. These findings reinforce the reliability of LCP fixation in achieving timely fracture union.

Functional weight-bearing was initiated following radiographic evidence of callus formation, in accordance with protocols described by Bhimani et al., who advocated progression to weight-bearing at 12–14 weeks based on patient tolerance [11]. The angular stability of locking plates supports early mobilization and rehabilitation, particularly in osteoporotic bone.

Postoperative complications were limited. Superficial surgical site infections occurred in two patients (8.3%) and were successfully managed with antibiotics and local wound care. No deep infections were observed, and this infection rate is comparable to the 3% reported by Kregor et al. using less invasive stabilization systems [12].

Knee stiffness was noted in two patients (8.3%), while one patient developed varus malalignment, attributed to early weight-bearing in a comminuted fracture. Varus collapse remains a known complication following distal femur fixation, particularly in the presence of poor bone quality or inadequate fixation. Similar rates of malalignment have been reported by Yeap et al. and Miller et al. No cases of non-union were observed in the present study, consistent with findings reported by Lal AK et al. [13].

Functional outcomes assessed using the Neer scoring system were favorable, with 39% of patients achieving excellent results, 52% good results, and 9% fair results. These outcomes are comparable to those reported by Ketterel et al., who observed good-to-excellent results in approximately 90% of cases [14]. Yeap et al. also demonstrated satisfactory functional outcomes following fixation with titanium LCPs. These findings further support the role of rigid fixation with locking plates in enabling early rehabilitation and favourable long-term outcomes.

Biomechanical considerations are critical when using locking plate technology. Rancho et al. highlighted potential complications during screw insertion, including lateral displacement of the proximal fragment and subsequent varus deformity, particularly in osteoporotic bone. Locking screws provide a biomechanically superior alternative by distributing stress across multiple fixed-angle interfaces, thereby reducing the risk of implant failure [15].

Nevertheless, locking plates may fail when physiological loads exceed design parameters [16]. Technical errors such as inadequate screw torque, cross-threading, or incongruent screw placement can compromise construct stability and lead to failure [17]. Despite these challenges, surgical management of distal femur fractures has consistently demonstrated superior outcomes compared with conservative treatment when performed by experienced surgeons [18].

Conclusion

Distal femoral locking compression plates are a safe and effective implant for the management of complex distal femur fractures, particularly in osteoporotic bone. In this study, LCP fixation provided stable constructs with high union rates and no instances of implant failure, non-union, or need for revision surgery. Knee stiffness was the most common complication and may be minimized through meticulous surgical technique, careful soft tissue handling, early mobilization, and adherence to rehabilitation protocols. While these results support the use of LCPs as a preferred implant for distal femur fractures, the study is limited by its small sample size and relatively short follow-up. Larger randomized controlled trials are required to further validate these findings and compare LCP fixation with alternative treatment modalities.

References

1. Martinet O, Cordey J, Harder Y, Maier A, Bühler M, Barraud GE. The epidemiology of fractures of the distal femur. Injury. 2000 Sep 1; 31:62-94.
2. Saini RA, Shah N, Sharma D. Functional outcome of distal femoral fractures treated with DF-LCP [Distal femur locking compression plate]. Int J Orthop Sci. 2018;4(1):439-4.
3. Petsatodis G, Chatzisymeon A, Antonarakos P, Givissis P, Papadopoulos P, Christodoulou A. Condylar buttress plate versus fixed angle condylar blade plate versus dynamic condylar screw for supracondylar intra-articular distal femoral fractures. Journal of Orthopaedic Surgery. 2010 Apr;18(1):35-8.

4. Zlowodzki M, Williamson S, Cole PA, Zardiackas LD, Kregor PJ. Biomechanical evaluation of the less invasive stabilization system, angled blade plate, and retrograde intramedullary nail for the internal fixation of distal femur fractures. Journal of orthopaedic trauma. 2004 Sep 1;18(8):494-502.
5. AA FA, Karunakaran G, Hameed H. Assessment of efficacy of locking compression plate in distal femur fractures. International Surgery Journal. 2021 Aug 27;8(9):2589-94.
6. Yeap EJ, Deepak AS. Distal femoral locking compression plate fixation in distal femoral fractures: early results. Malaysian Orthopaedic Journal. 2007;1(1):12-7.
7. Hosam M, Khaled. Condylar plating in treatment of intercondylar supracondylar fractures of distal femur. Pan Arab J orth Trauma 2007;11(1):26-34.
8. Schandelmaier P, Partenheimer A, Koenemann B, Grün OA, Krettek C. Distal femoral fractures and LISS stabilization. Injury. 2001 Dec 1; 32:55-63.
9. Fankhauser F, Gruber G, Schippinger G, Boldin C, Hofer H, Grechenig W, Szyszkowitz R. Minimal-invasive treatment of distal femoral fractures with the LISS (Less Invasive Stabilization System) A prospective study of 30 fractures with a follow up of 20 months. Acta Orthopaedica Scandinavica. 2004 Jan 1;75(1):56-60.
10. Kohli S, Chauhan S, Vishwakarma N, Salgotra K. Functional and radiological outcomes of distal femur intra articular fractures treated with locking compression plate. International Journal of Orthopaedics Sciences. 2016;2(4): 17-21.
11. Bhimani R, Bhimani F, Singh P. Functional Outcome of Distal Femur Fractures Treated with Locking Compression Plate. J Orthop Ther. 2019; 10:1132.
12. Kregor PJ, Stannard J, Zlowodzki M, Cole PA, Alonso J. Distal femoral fracture fixation utilizing the Less Invasive Stabilization System (LISS): the technique and early results. Injury. 2001 Dec 1; 32:32-47.
13. Lal AK, Kaushik SK, Gupta U, Agarwal V, Anant S. Evaluation of Results of Locking Compression Plate in Distal Femur Fractures. International Journal of Scientific Study. 2018 Apr 26;6(1):41-6.
14. Krettek C. Minimally invasive percutaneous plate osteosyntesis (MIPPO) using the DCS in proximal and distal femoral fractures. Injury. 1997; 28:42-8.
15. Krishna KR, Nayak BS, Amrit G. Study of surgical management of distal femoral fractures by distal femoral locking compression plate osteosynthesis. Indian Journal of Orthopaedics Surgery. 2015;1(1): 22-6.
16. Konuganti SR, Jakinapally SR, Rao VP, Rapur S. Management of distal femur fractures with locking compression plate: a prospective study. Int J Res Orthop. 2018 Mar;4(2):208-13.
17. Sommer C, Babst R, Müller M, Hanson B. Locking compression plate loosening and plate breakage: a report of four cases. Journal of orthopaedic trauma. 2004 Sep 1;18(8):571-7.
18. Jhatoth DS. Clinical and radiological outcome of distal femur fractures treated surgically with locking compression plate. National J Clin Orthop. 2019;3(1):140-6.