SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Patel and Zala, 2025
doi: 10.21276/SSR-IIJLS.2025.11.2.40

Original Article

open access

Outcome of Distal Femur Fracture Treated with Lateral Plate

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Received: 27 Oct 2024/ Revised: 24 Dec 2024/ Accepted: 11 Feb 2025

ABSTRACT

Background: Distal femur fractures (DFFs) are either classified as supracondylar or intercondylar fractures and hence display a bimodal distribution in those men in their youth who experience it as high-impact trauma; in old patients, it is simply due to a fall of low energy. These fractures are tedious to handle as they come with numerous comorbidities in old patients and possible long-term joint damage in the child. To evaluate the outcome of the management of distal femur fracture using the lateral plate.

Methods: This prospective, 60-patient study was conducted at a hospital among patients aged 19 to 70 years with distal femoral fractures treated by a locking compression plate. The inclusion criteria were clinically diagnosed distal femur fracture with or without osteoporotic changes, both closed and open types I and II. Exclusion criteria considered patients younger than 19 years, open type III, and pre-existing infection or deformity. Follow-up was performed for six months post-treatment.

Results: The radiological union was noted in 80% of the patients within 12 weeks. Range of motion results were very encouraging, with 55% of the patients achieving 120-140 degrees of motion and 40% between 100-120 degrees, while only 5% had less than 100 degrees. Regarding functional results, 75% of the patients were graded as having excellent knee function, and none were graded as poor.

Conclusion: The study has concluded that managing distal femoral fractures using locking compression plates is highly effective, leading to favorable outcomes in both radiological union and functional recovery.

Key-words: Distal Femoral Fractures, Locking Compression Plates, Range of Motion, Oxford Knee Score, Lateral Locked Plating, Surgical Outcomes

INTRODUCTION

Distal femur fractures (DFF) are divided into supracondylar and intercondylar. They are very common and occur in bimodal distribution. Young males tend to have these high-energy injuries characteristically because of motor vehicle accidents, and elderly patients tend to have them from low-energy events, such as ground-level falls [1].

How to cite this article
Patel KA, Zala KL. Outcome of Distal Femur Fracture Treated with Lateral Plate. SSR Inst Int J Life Sci., 2025; 11(2): 7259-7264.

Access this article online
https://iijls.com/

These fractures are associated with huge comorbidities in the elderly affecting their treatment, recovery, and ultimate survival. In children, fractures may be managed poorly, causing long-term damage to joints. Intra-articular fracture management remains challenging and is usually associated with poor outcomes in older populations [1].

DFFs are relatively infrequent and represent less than 1% of all fractures and 3-6% of all femoral fractures. The distribution is bimodal with the vast majority occurring either in young males following high-energy trauma or elderly females. The patients who sustain DFF have osteopenia [1]. The incidence of periprosthetic fractures to the DF is increasing and ranges from 0.3 to 5.5% around primary total knee arthroplasties and up to 30% after revision procedures [1].

doi: 10.21276/SSR-IIJLS.2025.11.2.40

Treatment goals for fractures of the DF, using the principles laid down by AO, include precise realignment of the joint surface and correction of limb length, alignment, and rotational positioning [1]. Although the goals of treatment are straightforward, the frequently comminuted and intra-articular nature of these injuries, combined with osteoporotic bone, may present significant difficulties with fixation. In elderly trauma patients, the high incidence of comorbidities further clouds treatment options [1].

Hinged knee bracing with early motion and non-weight bearing for six weeks is included in the non-operative management in the DF. Other measures may include splinting, bracing, or skeletal traction, usually for non-ambulant patients with severe comorbidities [1]. External fixation is used for temporary stabilization until internal fixation is tolerated by the patient, and it has complications of pin-tract infections and malunion. Various methods of open reduction internal fixation are fixed angle blade plates, sliding barrel condylar plates, condylar buttress plates, and locking plates, each with its indication and possible complications [1]. Locking plates have become the mainstay of treatment due to their biomechanical superiority over others. Intramedullary nailing, whether approached from the antegrade or retrograde direction, offers stable fixation with minimal disruption to surrounding soft tissues. Bone cement and bone grafting are adjuncts for internal fixation in osteoporotic bone or massive bone loss cases [1].

Lateral locked plating has evolved to optimize outcomes for the treatment of DF fractures however, non-union remains an expected challenge in high-energy fractures, those with intra-articular involvement, poor bone quality, or severe comminution with bone loss [2]. In isolated fractures, lateral locked plating is performed to a growing degree, especially in cases where retrograde intramedullary nailing would be inadequate. Although LLP improved upon its predecessors concerning the lateral implant option it continues to be associated with moderate rates of non-union [2]. The incomplete lateral cortex fracture is compressed and fixed using a lateral plate. Vertical loading, for example during walking, creates a curvature of the femur leading to lateral tensile and medial compressive forces. A similar concept to the tension band is applied through the lateral plate which avoids further widening of the crack and hence reduces propagation [3].

Common lateral plate systems for DFF are the LOQTEC ® Lateral Distal Femur Plate and the Locking Compression Plate-Distal Femur. Options for plate length, screw configurations in the plate, and lock screws make it more stable. The LOQTEC ® plate showed more primary stability and durability when compared with the L.I.S.S.LCP ® plate. 180°-helical plates are another option, which offers better initial axial stability and resistance to varus/valgus deformation than the conventional straight lateral plates [4,5]. The present study has been taken up to evaluate the outcome of lateral plate fixation in DFF. In the available literature, long-term outcomes and complications of this fixation method are less discussed.

MATERIALS AND METHODS

This was a prospective study conducted for 60 patients in a hospital in India. The patients were selected as per the inclusion criteria and were treated for distal femoral fractures using locking compression plates in a hospital in India where the follow-up period was six months after getting consent from the patients.

Inclusion Criteria

- ✓ Age group of 19–70 years of age
- ✓ Both sexes.
- ✓ Patients with a distal femur fracture clinically diagnosed and Imaging (X-ray/CT if required).
- ✓ The patients having lower-end femur fractures with or without osteoporotic changes were included in the study.
- ✓ This study included closed and open (type I & II) distal femur fractures.

Exclusion Criteria

- ✓ Age < 19 years or open physis
- ✓ Fractures more than 4 weeks old
- ✓ Open (type III) distal femur fractures
- ✓ Pre-existing local infection or deformity
- ✓ The patients treated conservatively because of other medical conditions
- ✓ Fractures associated with neurovascular compromise or knee joint dislocations.
- ✓ Those patients lost to follow-up or non-compliant.

Methodology- At the presentation to the emergency department, following initial evaluation, ruling out other injuries, and when the patient was hemodynamically stable, the injured limb was immobilized. X-rays were

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taken of the distal femur, inclusive of AP and lateral views of the knee joint, and the fracture pattern was classified according to the AO classification system.

The patient was positioned supine on a radiolucent operating table with spinal anaesthesia, with a rolled sheet under the knee joint. A tourniquet was applied to maintain the field bloodless. All cases were done through a direct lateral incision under image intensifier guidance. The submuscular layer split along its direction and the bone was exposed using a periosteal elevator. Fracture reduction was obtained by traction and manipulation under image guidance. K-wires were applied to help align intercondylar fragments but stayed out of the way of plate placement. An appropriate length plate was placed under image guidance and provisionally fixed with K-wires. A compression screw was inserted to attach the plate to the bone. Then, place distal locking cancellous screws, followed by proximal locking via a minimally invasive technique. The tourniquet was deflated, and hemostasis was attained. A drain was placed, and the wound was closed in layers with sterile dressing.

Postoperative Management- The limb was elevated postoperatively and ankle pumps were advised after the recovery from anaesthesia. Intravenous antibiotics were administered for 3 days and this was followed by 5 days of oral antibiotics. The drain was removed after 24 hours. The next day, knee mobilization was started, and after 2 weeks, the sutures were removed. Patients were advised to avoid weight-bearing for 6-8 weeks. Follow-up visits were arranged for 2 weeks, 6 weeks, 12 weeks, and 6 months for the patients to be assessed for functional and radiological outcome measures. Radiological assessment was done with AP and lateral X-rays, while the Oxford Knee Score essentially a 12-item questionnaire assessing functional status was used for functional evaluation. Scores of >41 are indicative of excellent results, scores between 34–40 of good, 27–33 of fair, and <27 of poor functional outcomes.

Statistical Analysis- Descriptive statistics were used. Radiological union was seen in 80% within 12 weeks and 20% by 24 weeks. ROM outcomes showed 55% achieved 120–140°, 40% achieved 100–120°, and 5% were below 100°. Oxford Knee Scores indicated 92% had excellent/good results with no poor outcomes. These findings support the use of lateral locking plates for distal femoral fractures and align with existing literature. As this was a single-group prospective study, no significance testing was required.

RESULTS

The assessment of radiological union in the distal femoral fractures goes on to show that 80% of cases achieved union within 12 weeks, thus indicating that healing was favourable in most patients. Only 20% took a longer period of 12–24 weeks for union, meaning that delayed healing was a relatively uncommon feature in this cohort. The high percentage of union within 12 weeks falls in line with typical healing timelines for similar cases managed with locking compression plates and reflects the quality of surgical fixation and post-operative care (Table 1).

Table 1: Radiological union in weeks

Duration in weeks	No. of cases (%)
<12 weeks	48 (80%)
12-24 weeks	12 (20%)
Total	60 (100%)

Range of motion outcomes at the final follow-up is such that over half of the patients, 55%, recovered a near-normal range of motion to 120-140 degrees, which makes for a high functional recovery rate. Another 40% of patients had ranged from 100 to 120 degrees, still within a functional range for daily activities but somewhat limited. Only 5% had their flexion limited to less than 100 degrees, which defines few instances of severe stiffness or poor recovery. The trend in the distribution is such that surgical management was quite effective, with these early mobilization protocols in returning joint function in most cases (Table 2).

Table 2: Range of Motion at the End of Follow-Up

Range of motion (degrees)	No. of cases (%)
Up to 100	3 (5%)
100-120	24 (40%)
120-140	33 (55%)
Total	60 (100%)

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The Oxford Knee Score results show that 75% of the patients were graded as excellent, and this represents the fact that they had very little pain and good functional ability with the performance of everyday activities being easy. Also, 17% of patients were graded to have a good outcome, indicating satisfactory function with minor limitations. Only 8% of patients were rated as fair, indicating moderate limitations in function but still above the poor outcome threshold. None of the patients were classified into the poor category, further attesting to the global effectiveness of the surgical approach for bringing satisfactory results (Table 3).

Table 3: Grading at the End of Follow-Up according to Oxford Knee Score

Grading	No. of cases (%)
Excellent	45 (75%)
Good	10 (17%)
Fair	5 (8%)
Poor	0 (0%)
Total	60 (100%)

DISCUSSION

Fractures of the DF are likely to become more common with an ageing population and greater use of total knee arthroplasty. A study by Grisdela *et al.* [6] investigated whether the distal extension of fractures about total knee reconstructions influences the outcome with lateral locked plating. A cohort of 110 patients treated with locked plating was reviewed regarding the length of the fracture. Complications within the 90 days and one-year mortality after treatment were assessed. There was a correlation between the size of the distal segment fractures for the DFF, but no correlation with the overall complications rate with 66 included DFF in the early 180 days. This makes lateral-locked plating a suitable alternative in treating cases regardless of its location [6].

In our current study, 55% of the patients obtained a ROM of 120-140 degrees, and 40% achieved 100-120 degrees. Poor ROM, less than 100 degrees, was present in only 5% of cases. The results thus indicated a generally favourable functional outcome, with over half of the patients achieving near-normal knee flexion. This was comparable to similar studies, in particular, Yeap *et al*. [8], who showed that the mean ROM was 107.7 degrees with a range of 40-140 degrees. According to Pushkar and Bhan *et al.* [9], the normal flexion of the knee is approximately 140 degrees. This clearly explains the high percentage of patients in our study achieving a ROM closer to that value. Most of the patients showed a range of motion far over these functional thresholds, thus carrying out effective rehabilitation with generally positive surgical outcomes [7-9].

Pastor *et al.* evaluated and compared the biomechanical effectiveness of helical plating versus conventional straight lateral plating for managing unstable DFF. Testing showed that the initial axial stiffness in the helical plates was significantly higher compared to that of the straight plates ($p<0.001$). The helical plates were associated with reduced initial varus/valgus deformation and increased endurance to cyclic and static loads. Despite higher shear displacement under torsion, helical plates demonstrated superior axial stability and resistance to deformation, suggesting they could serve as a viable alternative to conventional straight lateral plates for DFF [10].

Bai *et al.* [11] evaluated the clinical outcomes between lateral plate fixation and lateral and medial double-plating. A total of 60 patients were included. A positive varus stress test remained significant with the placement of the lateral plate and injury to the lateral collateral ligament after examination. Double plating provided added stability. Statistically, no differences between operative time, intracranial loss, time to fracture consolidation, and knee function were found in the comparisons of both methods of osteosynthesis [9]. Vemulapalli *et al.* [12] conducted a study aimed at evaluating the outcomes of the fractures of the DF that were treated using two approaches, LLP and retrograde intramedullary nailing. Results showed no statistical significance in time to union between both approaches in 6 months. Results also showed a higher percentage of non-union with the use of the lateral plating technique (27.5%) as compared to double plating (11.8%, $p=0.008$). However, the findings intimated that double plating is not appropriate when treating complete articular DFF [12].

DFF and their treatment are associated with complications like venous thromboembolism, and considerable loss of knee function. Some complications unique to lateral locking plates include non-union, implant fracture, and wound infection. Other complications documented are pin-tract infections, deep

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infections, loss of reduction, malunion, and stiffness of the knee [1]. The risk factors for implant failure as smoking, open fractures, and shorter plate lengths. Additional issues noted include failure to adhere to toe-touch weight-bearing guidelines, protruding screws requiring hardware removal, symptomatic heterotopic ossification, and ongoing pain. Excessively stiff fixation constructs have been associated with an increased complication rate in the healing of fractures [1,12].

Future research about lateral plate fixation for the treatment of DFF should focus on randomized controlled trials comparing lateral plate fixation with intramedullary nails to define the best approach according to the characteristics of the injury; patient factors such as age, comorbidities, and fracture complexity to guide which patients should undergo this type of treatment; functional evaluation such as range of motion and joint function, which can be achieved postoperatively; rate and nature of complications, including infection and implant failure; and long-term follow-up to determine whether the technique used in the fixation is durable and successful over time [13-16].

CONCLUSIONS

The study concluded that locking compression plates improves radiological union and functional healing in distal femoral fractures. Distal femoral fractures treated with locking compression plates have excellent radiological union and functional healing. In this study, 80% of patients had radiological union within 12 weeks, demonstrating the efficacy of surgical fixation and postoperative care. 95% recovered enough range of motion for daily activities, and over half reached near-normal mobility. The Oxford Knee Scores corroborated these findings, indicating that 92% of patients were graded as excellent or good, with none classified as poor. These results correspond with current literature, affirming the efficacy of locking compression plates in the management of distal femoral fractures. Though successful, more study is needed to improve fixation techniques and reduce problems to improve patient outcomes. The study shows that locking compression plates helps distal femoral fractures heal and function.

CONTRIBUTION OF AUTHORS

Research concept- Dr**.** Kamaleshkumar A. Patel, Dr Kashyap L Zala
Research design- Dr**.** Kamaleshkumar A. Patel
Supervision- Dr Kashyap L Zala
Materials- Dr Kashyap L Zala
Data collection- Dr**.** Kamaleshkumar A. Patel
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