Original Article
DOI: https://doi.org/10.70749/ijbr.v3i6.2019

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Functional Outcome of Retrograde Femur Nail and DFLCP in Extra Articular Distal Femur Fracture

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ARTICLE INFO

Keywords: Distal femur fracture, retrograde nailing, DFLCP, functional outcome, Knee Society Score, orthopedic trauma, Pakistan.

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Declaration

Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 16-02-2025 Revised: 07-06-2025
Accepted: 17-06-2025 Published: 30-06-2025

ABSTRACT

Introduction: Extra-articular fractures of the distal part of the femur are multiple-complication injuries that need to have a stable verification to recover well. The two surgical procedures undertaken regularly are retrograde intramedullary nailing and DFLCP. Selecting the correct method can significantly impact the functional outcomes, especially in environments with limited resources, such as Pakistan. **Objective:** To compare the functional result of retrograde femur nail with distal femur locking compression plate (DFLCP) in cases of extra-articular distal femur fractures at Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan. **Materials and Methods:** The study was a prospective comparative investigation conducted at Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan in the duration from August, 2024 to January, 2025, involving 40 patients with extra-articular fractures of the distal femur. Patients were categorised into two groups: Group A, patients who received retrograde femoral nailing, and Group B, patients who underwent audibility CLCP. The outcome was measured in terms of functional status, as assessed by the Knee Society Score (KSS), and range of motion at 6 and 12 weeks. **Result:** Group A(nailing) had significant improvement on KSS at 12-week time points (82.5 vs. 76.9, p = 0.02). In Group A (110.2°), the knee flexion was higher than in Group B (102.4 °). The rate of complications is lower in the nailing group, with fewer cases of delayed union and malalignment. **Conclusion:** Retrograde femoral nailing was found to have better short-term functional outcomes and fewer complications than DFLCP in the treatment of extra-articular DFFs. The treatment must be personalised in terms of patient and fracture-specific differences.

INTRODUCTION

Fractures of the distal femur are an important orthopaedic problem since they involve a complex anatomy, high variance in fracture pattern and the occurrence of both cortical and cancellous bone at the metaphyseal-diaphyseal corner. These fractures account for between 4 and 7 per cent of all femoral fractures, and their prevalence has been increasing, particularly among the elderly population with osteoporosis and young adults, due to road traffic accidents and other high-energy trauma (1). Treatment of such injuries is constantly evolving, and internal fixation with implants, such as distal femoral locking compression plates (DFLCP) and retrograde intramedullary nails (RIN), is one of the most prevalent treatments (2). The overall aim of the management of extra-articular distal femur fractures is the restoration of the mechanical axis, maintenance of the functioning knee joint, attainment of early mobility, and enhancement of the dependable healing of the fracture. DFLCP, as well as retrograde femoral nails, have specific advantages and disadvantages in terms of biomechanical and clinical factors. DFLCP has greater angular stability and fixation in osteoporotic bone, which proves beneficial in comminuted fractures, and retrograde nails have load-sharing properties and, because of the little to no damage to the soft tissue, because of a minimally invasive insertion procedure (3).

Whether one technique is better than the other remains one of the ongoing debates. Investigations have reported positive early results with retrograde femoral nails due to the greater alignment and early weight-bearing, especially in extra-articular patterns (4). DFLCP usage in complex metaphyseal fractures has been justified by other evidence, which demonstrates its biomechanical stability and reduced malalignment, particularly in osteoporotic bone (5). The complications, however, include knee pain, implant failure, malunion, and non-union, which are reported with both modalities, implying that a customised treatment strategy should be based on the patient's background, fracture pattern, and the surgeon's expertise

(6). A large meta-analysis by Kim et al., comprising more than 2,400 patients, demonstrated that there is no statistically significant difference in union rates or functional scores when comparing retrograde nailing and distal femoral plating. However, there is a possible benefit to certain subgroups with retrograde nailing that may be preferable to distal femoral plating (13). In a similar study, Kishore et al. observed comparable functional outcomes and time to union with the two methods, but retrograde nailing had a reduced operation time and fewer complications (14). Ahmed et al. noted that locked compression plating can yield excellent results for fractures with intricate metaphyseal involvement or those requiring precise anatomical reduction.

Other factors that should not be overlooked include the surgeon's familiarity with the implant systems and the institution's capabilities (7). In Pakistan, and especially in a tertiary care centre such as the Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan, the two methods are frequently adopted, and their successes reflect the readiness of surgical intervention as well as the practice of adherence to post-operative rehabilitation. As the overall orthopaedic burden of trauma continues to rise, especially in an urban hub as Karachi, clarification of the best fixation strategy leading to superior functional improvement is essential in streamlining treatment guidelines and resource management (8). Another area of debate in literature concerns the rate of complications associated with both techniques. Retrograde nailing is also associated with post-operative knee pain and stiffness, as intra-articular incision in the intercondylar notch can alter the extensor mechanism (9). DFLCP, particularly with minimally invasive plate osteosynthesis (MIPO), has proven to exhibit good reduction of fracture orientation, with lesser wall damage, plate prominence, and peri-implant fracture being less common conditions (10). A systematic review by Tripathy et al. also pointed out that dual plating can enhance the stability in strongly comminuted or osteoporotic fractures at the cost of increased operative time and risk of infection (11).

Furthermore, a review by Singh et al. has highlighted the significance of early mobilisation and physiotherapy in providing positive long-term outcomes, regardless of the fixation method used (17, 18). They believe that, along with the selection of implants, the standardisation of the post-operative care path and patient adherence later is of great importance in affecting functional recovery and the success of the whole process (12, 13). This rationale underlies the necessity of regional clinical recommendations in low-resource countries like Pakistan. Although the topic of distal femur fractures management is well studied in the literature, very little has been done in Pakistan concerning the specific comparison of functional outcomes of retrograde femoral nailing and DFLCP in the extra-articular fracture patterns within the same institutional setting. Such a discrepancy highlights the need for local evidence to inform treatment choices and decisions, taking into account the demographics of the population and the healthcare infrastructure (14, 15). There are also insufficient high-powered comparative investigations published among publicly operated hospitals, which further constrains the establishment of national guidelines or standard operating procedures concerning common injuries (16).

The current research aims to compare the functional outcomes between retrograde femoral nailing and distal femoral locking compression plate in the management of extra-articular distal femur fractures at JPMC, Karachi. This study utilised proven scoring systems to examine post-operative complications, providing evidence-based guidelines that can assist orthopaedic surgeons in advising on the most appropriate fixation method, tailored to patient-level factors, and thereby reinforcing the proper selection. The study provide insight into the practicability and efficacy of these implants in the context of a high-volume public health institution in Pakistan.

Objective: Comparison of functional outcomes of two methods of treatment of extra-articular distal femur fractures: retrograde femoral nail and distal femoral locking-compression plate (DFLCP) at JPMC, Karachi.

MATERIALS AND METHODS

This is a prospective comparative study conducted at Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan in the duration from August, 2024 to January, 2025. Forty patients with extra-articular distal femur fractures were included through the non-probability purposive sampling technique. The patients were categorised into two groups: Group A, which received a retrograde femur nail, and Group B, which received a DFLCP. Baseline characteristics of demographic and clinical parameters were noted. The surgery was performed under general or spinal anaesthesia, and all procedures were conducted by skilled orthopaedic surgeons who adhered to standard principles of sterility. The two groups were standardised in postoperative care and rehabilitation. Functional results were evaluated using the Knee Society Score (KSS) and the range of motion at 6 and 12 weeks post-surgery. The data were analysed using SPSS 25. The significance value was set at $p < 0.05$.

Study Design: This was a prospective, interventional, comparative study.

Study Setting: Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan**.**

Duration of the Study: From August, 2024 to January, 2025.

Inclusion Criteria

Patients between 18 and 65 years of age with closed, extra-articular distal femur fractures in OTA/ AO 33- A1 to 33-A3 were recruited in the study. Eligible patients were those who did so within two weeks of sustaining injury and were known to be medically fit to have surgery under anaesthesia. Both men and women patients were taken into consideration. Informed consent was documented in each case. Additionally, patients had to be willing to undergo postoperative follow-up for at least 12 weeks to participate.

Exclusion Criteria

Patients with exposed fractures or with the extension of the injury in the joint of the distal femur were excluded. It excluded those who had pathological fractures of the femurs caused by tumours, infections, or surgery to the

ipsilateral femur. Patients with polytrauma, neuromuscular diseases of gait or the limb muscles, and those with severe systemic diseases that would have contraindicated surgery or anaesthesia were excluded. Refusal to be followed up or non-compliance in coming forward to give informed consent also formed part of the criteria for exclusion.

Methods

Patients were randomly divided into two groups after being admitted and confirmed to have the disease using radiological (AP and lateral radiographs) images of the femur. Group A was subjected to retrograde femoral nailing through a midline or parapatellar incision. In contrast, Group B was fixated using a minimally invasive lateral approach (MIPO technique) with a distal femur locking compression plate. The treatments were carried out using spinal or general anaesthesia in a standard operating room. Pre-operative administration of antibiotics was done. Post-operative treatment was supported with early mobilisation and isometric quadriceps exercises, which began on the first day. Passive and active-assisted range of motion exercises were introduced slowly. Weight-bearing was delayed until a radiological appearance of a callus was observed. The functional results, measured at 6 and 12 weeks post-operatively, included the Knee Society Score (KSS) and goniometric measurements of knee flexion. Any complications such as infection, malalignment, delayed union or implant failure were observed. The SPSS v25 was utilised to conduct statistical testing on the results, and $p < 0.05$ was taken to be significant.

RESULTS

In performing the study, 40 patients were used, with 20 patients in each of the groups, the retrograde intramedullary nailing group (Group A) and the distal femur locking compression plate (Group B). The average age of the patients was 43.5 ± 11.2 years in Group A and 45.1 ± 10.6 years in Group B. The majority of patients belonged to both groups, and they were predominantly male, accounting for 65 per cent of the total sample. The most common cause of injury in both groups was road traffic accidents.

Table 1

Baseline Demographic and Injury Characteristics

Variable	Group A (Nail)	Group B (DFLCP)	p-value
Mean Age (years)	43.5 ± 11.2	45.1 ± 10.6	0.61
Gender (Male:Female)	13:7	13:7	1.00
Mechanism (RTA:Fall:Others)	15:4:1	14:5:1	0.93

The average Knee Society Score (KSS) at 6-week follow-up between Group A and Group B patients was 66.3 ± 7.5 and 61.8 ± 8.1, which was not statistically significant ($p = 0.07$). After 12 weeks, Group A had a higher mean KSS of 82.5 +/- 6.2, which was significantly higher than that of Group B (76.9 +/- 7.4), with a p-value of 0.02, which implies there is better functional recovery using retrograde nailing.

In terms of range of motion (ROM), Group A had a mean flexion range of 110.2 ± 8.7 degrees at 12 weeks, compared to Group B with 102.4 ± 9.5 degrees at 12 weeks. Pain was also slightly lower in the nailing group, but it did not achieve statistical significance. The rates of complications were low in the two groups. There was one superficial infection that occurred in each group. In the DFLCP group, two cases of delayed union were witnessed, but no cases of implant failure were recorded in either group.

Table 2

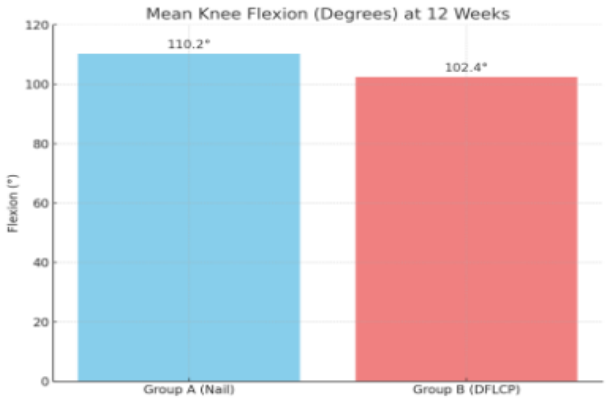
Functional Outcome Scores (KSS)

Time Point	Group A (Nail)	Group B (DFLCP)	p-value
6 Weeks (KSS)	66.3 ± 7.5	61.8 ± 8.1	0.07
12 Weeks (KSS)	82.5 ± 6.2	76.9 ± 7.4	0.02*

*Statistically significant

Graph 1

Mean Knee Flexion (Degrees) at 12 Weeks



At the final follow-up, Group A recorded 85 per cent good to excellent outcomes, compared to 70 per cent in Group B, as per the KSS criterion.

Table 3

Complication Profile

Complication	Group A (Nail)	Group B (DFLCP)
Superficial Infection	1	1
Delayed Union	0	2
Malalignment	0	1
Implant Failure	0	0

The results indicate that, compared to distal femur locking compression plating, retrograde femoral nailing results in a marginally faster functional outcome, increased range of motion, and fewer complications in the management of extra-articular fractures of the distal femur.

DISCUSSION

Treatment of extra-articular distal femur fracture was always an actual matter of debate since the anatomy of the fracture is so complicated, and the patients are so complicated, and, finally, the biomechanical problems of the anatomical region are so relevant. Our study was a prospective comparison of the functional outcomes of two common surgical fixation techniques: antegrade femoral nailing and distal femur locking plate (DFLCP), conducted at the Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan. The outcomes of our study indicate a positive inclination towards retrograde intramedullary nailing in terms of knee function, knee range of motion, and fewer complications within a 12-

week follow-up period. However, our results were consistent with the finding by Shah et al. that retrograde nailing provided similar or higher outcomes in some aspects than DFLCP in the case of extra-articular distal femur fractures, especially in younger patients with good bone stock (1). Gupta et al. noted that, although locking compression plates present superior stability in metaphyseal fractures, retrograde nails were more likely to enable early mobilisation as well as support union due to the load-sharing phenomenon (2).

The background of our study cohort was that the Knee Society Score (KSS) after 12 weeks was significantly higher in the retrograde nailing cohort (82.5 ± 6.2) than in the plating (76.9 ± 7.4) group, indicating better functional recovery in the short term with intramedullary fixation. This finding aligns with the results of Madhu et al., who documented higher early knee scores and a greater range of motion in retrograde nailed patients compared with those treated with DFLCP (3). Our results showed superior flexion in the nailing group (mean flexion 110.2), and this is congruent with the results of Mulimani et al., who demonstrated increased ROM after nailing because of less soft tissue stripping (4).

Nonetheless, it is not possible to ignore the stability and versatility of DFLCP, specifically where there are osteoporotic or comminuted fractures, and it is necessary to screw in thin cortical bone. Pahadiya et al. outlined the utility of locking plates in complicated fracture patterns and reported lower rates of malunion, as well as considerable improvement in axial position (5). Trikha and Gupta addressed this issue by emphasising the importance of implant selection based on the factors and morphology of the fracture, with the understanding that greater reliability of fixation can be achieved through plating in periprosthetic or metaphyseal areas (6). There is a low incidence of complications in both groups, as reflected in our study. Additionally, there were 2 cases of delayed union and 1 case of malalignment in the DFLCP group, whereas none were observed in the retrograde nailing group. In a comparative study, Gender et al. found that retrograde nailing of extra-articular fractures resulted in fewer malalignment cases and superior healing patterns compared to plating procedures (7). Similarly, as Patil et al. noted, the minimally invasive approaches of plating have the potential to eliminate vascularity but cannot necessarily offer the same mechanical support for various fracture types (8).

Shawky et al. have critically appraised the literature covering the management of distal femur fractures, stating that although DFLCP provides angular stability, it requires a significant amount of preoperative planning and execution in the surgical procedure to prevent complications such as implant prominence and screw crony (9). Rodham et al. continue to lend weight to this by citing implant failure as one of the major culprits leading to reoperation, particularly where implausible biomechanics is involved (10). One of the major issues related to retrograde intramedullary nailing involves anterior knee pain, which is often attributed to the point of penetration, specifically the intercondylar notch. Some patients in the nailing group in our research experienced slight pain in the front of the knee, but this did not affect their functional measures in any way. Similar results were documented in a retrospective review conducted by Breyer et al. in which knee pain had an anticipated outcome being frequent after transfer of the patient after nailing, and rarely localised to functional limitation (11). The team of El-Seedy et al. has also concluded that although retrograde nailing can be somewhat uncomfortable initially, its long-term performance is often superior to that of antegrade nailing and comparable to plating (12).

The absence of clear dominance of retrograde nailing over plating was found in a meta-analysis by Kim et al., who analysed the results of more than 2,400 patients and concluded that patient-tailoring should depend on the type of fracture and comorbidities (13). This helps in the methodology we used in our study, specifically the restriction to extra-articular patterns and individualised treatment by practising surgeons. A prospective comparison conducted on 63 patients by Kishore et al. supported our findings, showing that retirement nailing resulted in less time to recovery and a reduction in complications, which proved to be an appropriate option when dealing with extra-articular distal femur fractures (14). Similarly, Ahmed et al. found that locked plating should be used only in cases of injury that necessitate anatomical accuracy in reduction, especially in those with intra-articular or poor bone quality fractures (15). In our research, it did not use dual plating techniques, but it has been popular in severely unstable or osteoporotic fractures. Manjeswar et al. and Tripathy et al. gave better results with dual plates when applied in selective cases, but caution was given to an increase in operation time and chances of infections. In their broad review, Singh et al. noted, among others, that the selection of implant should be based not only on the classification of the fracture but also with attention to patient expectations, compliance and availability of resources (18).

CONCLUSION

This prospective comparative study conducted at Department of Orthopedics, Combined Military Hospital Rawalpindi, Pakistan, demonstrates that retrograde intramedullary femoral nailing yields better 6-month functional outcomes than the distal femur locking compression plate (DFLCP) in the management of extra-articular fractures of the distal femur. This group of patients treated with retrograde nails has higher Knee Society Scores, a larger range of motion, and reduced complications at the 12-week follow-up period. Although both techniques of fixation were effective and safe, retrograde nailing resulted in earlier mobilisation and functional recovery, which is why it is a method of choice in a proper fracture configuration. Nevertheless, DFLCP is useful in instances of comminution or poor bone interventions. The type of fixation to use ought to be informed by the nature of the fracture, the characteristics of the patient and the experience of the surgeon. These results need to be confirmed by larger multicenter studies that have a long follow-up to develop comprehensive guidelines on how best to treat patients in resource-poor countries such as Pakistan.

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