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FUNCTIONAL OUTCOME IN PATIENTS WITH DISTAL FEMUR FRACTURE TREATED WITH LOCKING COMPRESSION PLATE

Original Research

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ABSTRACT

Background: Distal femur fractures pose significant treatment challenges due to their anatomical complexity and varied injury mechanisms. Locking compression plates (LCPs) have emerged as a favorable fixation method, particularly for complex and osteoporotic fractures. Despite global advancements, limited local data exist on the functional outcomes following LCP fixation in the regional population.

Objective: To determine the functional outcome in patients with distal femur fractures treated with locking compression plates using Neer's scoring system.

Methods: This descriptive study was conducted over six months at the Department of Orthopedics, Khyber Teaching Hospital, Peshawar. A total of 152 patients aged 18–60 years with AO type A or C distal femur fractures were included. Exclusion criteria were open wounds, pathological fractures, peri-prosthetic fractures, delayed presentations, and significant comorbidities. Surgical fixation was performed using the Swashbuckler approach, followed by individualized rehabilitation protocols. Functional outcomes were assessed four weeks postoperatively using Neer's criteria. Data were analyzed using SPSS version 25.

Results: Among 152 patients, the mean age was 38.6 ± 11.5 years; 63.8% were male. Right-sided fractures were more common (56.6%). Type A fractures slightly outnumbered type C (50.7% vs. 49.3%). Neer's score showed excellent outcomes in 55.9% of cases, good in 29.6%, fair in 13.2%, and poor in 1.3%. Type A fractures showed superior results compared to type C. No major intraoperative complications were reported.

Conclusion: LCP fixation for distal femur fractures yields promising early functional outcomes, particularly in type A fractures. It supports early mobilization, anatomical alignment, and satisfactory recovery, reinforcing its role as a preferred surgical modality in such injuries.

Keywords: Bone Plates, Femoral Fractures, Fracture Fixation Internal, Knee Injuries, Locking Compression Plate, Orthopedic Procedures, Postoperative Recovery.

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INTRODUCTION

Distal femur fractures, though relatively uncommon, present a significant clinical challenge due to their complex anatomy, mechanism of injury, and patient demographics. Representing approximately 3–6% of all femoral fractures, these injuries typically involve the supracondylar and condylar regions of the femur, extending from the femoral condyles to the metaphyseal-diaphyseal junction, roughly 10–15 cm of the distal femur (1). The etiology often involves high-energy trauma such as road traffic accidents, particularly in younger males, or low-energy mechanisms like simple falls in elderly osteoporotic females. Epidemiological data reveals a bimodal distribution, with incidence peaking in young males under 40 years and postmenopausal females above 50 years, each accounting for approximately 40% and 60% of cases respectively (2,3). The axial loading mechanism is a common causative factor in both age groups (4). These fractures pose considerable treatment dilemmas for orthopedic surgeons, as improper management can lead to malalignment, joint stiffness, or post-traumatic osteoarthritis. Historically, multiple treatment modalities have been employed—including conservative methods, external fixation, intramedullary nailing, and devices like condylar blade plates (CBP) or dynamic condylar screws (DCS)—each associated with varied outcomes and limitations (5,6). The development of locking compression plates (LCPs) introduced a biomechanically superior solution, providing fixed-angle stability through multiple points of fixation, which minimizes the risk of varus collapse and improves fracture union in both comminuted and osteoporotic bone (7). Several studies have demonstrated favorable functional outcomes with LCPs, reporting excellent to good results in over 90% of patients based on Neer's scoring system (8-10). Despite encouraging evidence from international studies, there remains a notable paucity of localized data addressing the functional outcomes of distal femur fractures treated with LCPs. This knowledge gap limits the ability of clinicians to optimize treatment strategies and offer evidence-based counseling to patients in specific populations. Recognizing this void, the present study has been designed to evaluate and document the functional outcomes in patients with distal femur fractures treated using locking compression plates. This effort aims to contribute region-specific evidence that may enhance clinical decision-making and improve overall patient care. The objective of this study is to determine the functional outcome in patients with distal femur fracture treated with locking compression plate.

METHODS

This descriptive study was conducted in the Department of Orthopedics at Khyber Teaching Hospital, Peshawar, over a period of six months following approval from the institutional review board. Ethical clearance was obtained from the hospital's Research and Ethics Committee prior to the commencement of data collection. All participants provided written informed consent after a detailed explanation of the study's purpose, potential risks, and benefits. The sample size was calculated using the World Health Organization (WHO) sample size calculator, based on an anticipated proportion of fair outcomes with locking compression plate (LCP) in distal femur fracture patients of 17.2% (6), with a 6% margin of error and 95% confidence level. This yielded a required sample size of 152 patients, who were selected using a non-probability consecutive sampling technique. Participants included in the study were adults aged 18 to 60 years of both genders, diagnosed with distal femur fractures classified as Muller AO types A and C. Exclusion criteria comprised patients with open wounds, pathological fractures, delayed presentation beyond three weeks, peri-prosthetic fractures, or those with associated injuries such as neurovascular trauma, fractures in the same limb, head, chest, visceral, or vascular injuries. Additionally, patients suffering from malignancy or other major chronic illnesses, as well as those deemed unfit for surgery, were excluded to maintain sample homogeneity and reduce confounding (11). Data were collected using a structured proforma designed specifically for this study. Baseline demographics including age, gender, height, weight, body mass index (BMI), education level, socioeconomic status, duration of injury, fracture classification, and laterality were documented at the time of admission. Detailed clinical history, systemic and local examinations, and vital signs were recorded. Preoperative evaluations involved routine blood tests, chest radiographs, and electrocardiography to ensure anesthesia fitness. Computed tomography (CT) was utilized to classify fractures, evaluate comminution, guide implant selection, and aid in preoperative surgical planning.

Surgical intervention was performed under standardized conditions. Patients were positioned supine on a radiolucent operating table, with a knee frame to allow adequate knee flexion. An image intensifier was positioned contralaterally, and a bolster was placed under the ipsilateral hip for better access. The Swashbuckler approach, involving an anteromedial incision over the knee, was employed for

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fracture exposure. Articular reconstruction was achieved through anatomical reduction using reduction clamps, Kirschner wires, and inter-fragmentary screws. Osteochondral fragments larger than 5 mm were fixed with headless screws, while smaller fragments were excised. A distal femur lateral locking compression plate was used for metaphyseal fixation (12). In cases with metaphyseal comminution, bridge plating was supplemented with bone grafting. Alignment and limb length were meticulously restored. In select cases requiring additional medial support, a T-buttress or reconstruction plate was used through the same incision. Postoperative care included administration of intravenous antibiotics (cefuroxime 1.5 g and amikacin 750 mg), analgesics, and deep vein thrombosis prophylaxis (13,14). Rehabilitation protocols were tailored according to the stability of fixation. Isometric quadriceps and hamstring exercises were initiated on postoperative day one, while passive knee range-of-motion exercises began on day two, progressing to 45 degrees of flexion within the first week and 90–110 degrees by 8–12 weeks. Sutures were removed between postoperative days 14 and 18. Immediate postoperative anteroposterior and lateral knee radiographs were obtained, and patients were followed up on day 10 and again at four weeks postoperatively to assess functional outcomes using Neer's rating scale as per operational definitions. Data were analyzed using IBM SPSS version 25. Quantitative variables such as age, BMI, duration of fracture, and Neer's score were reported as means ± standard deviations or medians with interquartile ranges, depending on data normality assessed via the Shapiro-Wilk test. Categorical variables including gender, residence, profession, laterality, fracture type, and outcome categories were presented as frequencies and percentages. Functional outcomes were stratified based on age, gender, duration of fracture, laterality, and fracture type to identify potential effect modifiers. Post-stratification, chi-square or Fisher's exact tests were applied, and a p-value ≤0.05 was considered statistically significant.

RESULTS

The study included 152 patients with distal femur fractures treated using locking compression plates. The mean age of participants was 38.6 ± 11.5 years. A majority were male (63.8%), with a female representation of 36.2%. The mean body mass index (BMI) was calculated as 24.7 ± 3.6 kg/m². Most participants belonged to the lower socioeconomic group (51.3%), followed by middle (38.8%) and upper classes (9.9%). Employment status showed that 67.1% of patients were employed. Urban residents constituted 58.6% of the sample, and 59.9% of the patients were classified as educated. Regarding fracture specifics, the right limb was affected in 86 patients (56.6%), and the left in 66 patients (43.4%). Based on Muller AO classification, 77 patients (50.7%) had type A fractures, while 75 patients (49.3%) had type C fractures. The mean duration from injury to surgical intervention was 6.2 ± 3.1 days. Functional outcome assessed via Neer's scoring at 4 weeks showed that 85 patients (55.9%) had excellent results, 45 (29.6%) had good outcomes, 20 (13.2%) were classified as fair, and 2 (1.3%) had poor functional results. When stratified by Muller AO type, type A fractures showed slightly better functional outcomes, with 52 patients (67.5%) achieving excellent scores compared to 33 patients (44.0%) in type C. The rate of fair or poor outcomes was similar across both types. Further stratification by laterality revealed that right-sided fractures had a slightly higher rate of excellent outcomes (58.1%) compared to left-sided fractures (53.0%), though the proportion of fair and poor outcomes remained comparable.

Table 1: Demographics

Variable		Value
Age (mean ± SD)		38.6 ± 11.5 years
Gender	Male	97 (63.8%)
	Female	55 (36.2%)
BMI (mean ± SD)		24.7 ± 3.6 kg/m²
Socioeconomic Status	Lower	78 (51.3%)
	Middle	59 (38.8%)
	Upper	15 (9.9%)
Occupation Status	Employed	102 (67.1%)
	Unemployed	50 (32.9%)
Residence	Urban	89 (58.6%)
	Rural	63 (41.4%)
Education	Educated	91 (59.9%)
	Uneducated	61 (40.1%)

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Table 2: Functional Outcomes Summary

Functional Outcome	Frequency (n)	Percentage (%)
Excellent	85	55.9%
Good	45	29.6%
Fair	20	13.2%
Poor	2	1.3%

Table 3: Neer's Score by Muller AO Type

Muller AO Type	Excellent	Good	Fair	Poor
A	52	25	10	1
C	33	20	10	1

Table 4: Functional Outcomes by Laterality

Laterality	Excellent	Good	Fair	Poor
Right	50	22	13	1
Left	35	23	7	1

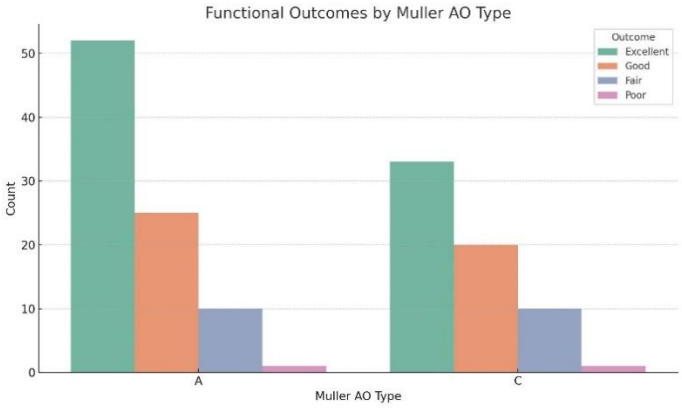

Figure 1 Functional Outcomes by Muller AO Type

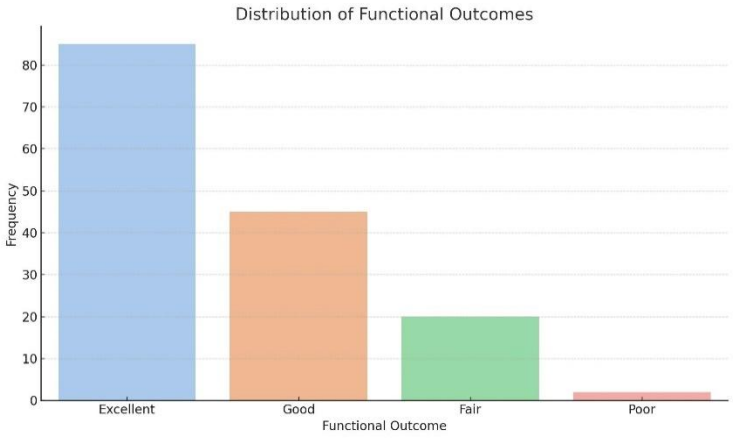

Figure 2 Distribution of Functional Outcomes

DISCUSSION

The findings of this study demonstrate that locking compression plates (LCPs) provide favorable short-term functional outcomes in patients with distal femur fractures, particularly among those with type A and C fractures. At four weeks postoperatively, 55.9% of patients achieved excellent functional results, and an additional 29.6% were classified as having good outcomes. These results align with those reported in multiple recent studies, further affirming the role of LCPs as a reliable and biomechanically sound fixation option for complex distal femoral injuries (15-17). A study reported that 45.3% of patients treated with distal femoral LCPs had excellent outcomes and 25.6% had good results based on Oxford scores, with poorer outcomes associated with comorbid conditions like diabetes and hypertension (17). Similarly, a study observed excellent to satisfactory results in a majority of patients using LCPs, with noted benefits in alignment preservation and reduced complications such as varus collapse (18). These parallels underscore the reproducibility of the outcomes observed in the present cohort. In this study, AO type A fractures demonstrated slightly better functional outcomes than type C fractures, which may be attributable to the simpler fracture patterns and more straightforward reconstructive requirements. This finding is consistent with prior observations of a study which found that extra-articular (type A) fractures healed more predictably and had lower rates of complications compared to intra-articular (type C) injuries (19). The use of a standardized surgical approach, including the Swashbuckler technique and systematic rehabilitation protocols, may have contributed to the overall success of the treatment. Studies

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have emphasized the importance of early mobilization and precise anatomical reduction in achieving good functional scores and minimizing complications like stiffness and malunion (20-22).

One of the strengths of this study is its relatively large sample size and clearly defined inclusion and exclusion criteria, which reduced confounding and selection bias. Furthermore, the prospective nature of data collection and stratification based on fracture classification and laterality allowed for more nuanced interpretations of outcome variation. However, certain limitations must be acknowledged. The short follow-up period (four weeks) may not fully capture long-term complications such as implant failure, post-traumatic arthritis, or delayed union. In contrast, studies with extended follow-up, such as a study, report long-term outcomes showing that range of motion and union quality improve significantly beyond three months postoperatively (23). Another limitation is the absence of control or comparison groups treated with alternative fixation methods like retrograde intramedullary nailing or dynamic condylar screws, which restricts generalizability. Additionally, the Neer's score, while widely used, has subjective components that may introduce measurement bias. Despite these constraints, the study provides valuable insights for orthopedic practice, particularly in resource-constrained settings where reliable and standardized approaches are vital. The high proportion of excellent and good outcomes reinforces the LCP's utility, especially when used with meticulous surgical technique and comprehensive rehabilitation. Future research should focus on multicenter, randomized controlled trials with longer follow-up durations to establish comparative efficacy between LCPs and other fixation devices. Incorporating objective functional assessments, such as gait analysis or strength testing, and evaluating the economic burden and cost-effectiveness of various treatment options would further enhance clinical decision-making. In conclusion, the findings affirm that locking compression plates are a dependable and effective treatment modality for distal femur fractures, offering satisfactory functional outcomes in the majority of patients. With adequate surgical planning, early rehabilitation, and attention to comorbidities, LCP fixation remains a cornerstone in the management of these complex injuries.

CONCLUSION

This study concludes that locking compression plates offer a reliable and effective surgical option for managing distal femur fractures, yielding excellent to good functional outcomes in the majority of patients. The technique ensures stable fixation, supports early mobilization, and is particularly beneficial in both simple and complex fracture patterns. These findings support its continued use in orthopedic trauma care and emphasize the importance of structured rehabilitation for optimal recovery.

AUTHOR CONTRIBUTION

Author	**Contribution**
Muhammad Maaz Raza*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Awal Hakeem	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Tufail	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Syed Zeeshan Hassan Arif	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Waqar Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ubaid Ullah	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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