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A Clinical and Radiological Analysis of Surgical Management of Distal Femur Fractures with Locking Compression Plates

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Abstract

Background: Distal femur fractures are prevalent due to the rise in road traffic accidents and falls from height associated with increased construction activities. These disabling fractures necessitate early stabilization. Internal fixation with locking compression plates (LCP) has demonstrated excellent outcomes regarding fracture union and recovery, as well as clinical results—the current study aimed to evaluate the clinical outcomes of distal femur fracture treatment using LCP.

Methods: Twenty patients with distal femur fractures treated using Locking Compression Plates (LCP) were included based on specific criteria. Inclusion: skeletally mature patients (>18 years), open fractures up to type IIIA, and consent to participate. Exclusion: type IIIB/C open fractures, tibial plateau fractures, pathological fractures (except osteoporosis), neurovascular compromise, or conservative management. Comprehensive clinical, neurovascular, and radiological assessments were performed, with initial immobilization using a Thomas splint.

Results: In a study of 20 distal femur fracture cases, 60% were male, and road traffic accidents were the leading cause (55%). Most patients (85%) underwent surgery within a week. Grade II and IIIA open fractures predominated. The average knee flexion achieved was 91°, with an average NEER knee score of 80. Complications included knee stiffness, varus collapse, and infections. Overall, outcomes were excellent in 30%, satisfactory in 65%, and unsatisfactory in 5%.

Conclusion: Locking Compression Plates provide high Neer scores and preserve periosteal blood supply, offering a valuable method for managing distal femur fractures. However, poorer outcomes are observed in type C fractures, with challenges like nonunion and malunion persisting.

Keywords: Locking Compression Plate, Femoral Fractures, Internal Fixation, Orthopedic Implants.

Introduction

The rapid expansion of urbanization, land development, and faster transportation systems has significantly increased road traffic accidents (RTAs) and construction-related injuries, such as falls from heights, leading to severe disabilities in young individuals. Older adults, particularly women, are also at high risk of fractures due to osteoporosis. Studies indicate a bimodal distribution of supracondylar femur fractures, with peaks in younger individuals due to high-energy trauma and older patients experiencing low-energy injuries associated with bone fragility [1]. Distal femur fractures are complex injuries that often lead to long-term disabilities. These fractures account for approximately 6% of all femur fractures and 31% when hip fractures are excluded [2, 3]. Nearly 50% of distal femur intra-articular fractures are open fractures [1]. Historically, there was reluctance toward operative management due to the high risk of complications, including infection, non-union, and malunion. In the mid-20th century, Watson-Jones and John Charnley advocated traditional treatments like skeletal traction, external immobilization, and cast bracing [4, 5]. However, these methods often resulted in complications, such as deformity, shortening, prolonged immobilization, knee stiffness, angulation, malunion, quadriceps wasting, knee instability, and post-traumatic issues. In recent decades, open reduction and internal fixation (ORIF) have gained prominence due to better outcomes. Advances such as the AO blade plate, dynamic condylar screw, intramedullary supracondylar nails, and locking compression plate (LCP) have transformed fracture management [6]. The LCP is particularly

advantageous in managing fractures in elderly patients with osteoporosis and complex articular injuries. It combines compression plating, locked plating, and bridge plating, reducing soft tissue disruption while preserving the periosteal blood supply [7]. Acting as a "biological external fixator," the LCP addresses the challenges of achieving stable fixation in osteoporotic bones. These advancements highlight the LCP's ability to reduce soft tissue damage, maintain vascular integrity, and enhance fracture healing. Early surgical intervention using modern fixation techniques has significantly improved outcomes, including fracture union, functional recovery, and patient mobility [8]. The continued evolution of these methods underscores the importance of individualized treatment strategies tailored to patient demographics and fracture characteristics.

Material and methods

This study was conducted in the Department of Orthopedics at a Medical College and Hospital, with prior approval from the Institutional Ethical Committee. Written consent was obtained from all participants. A total of 20 cases were selected based on inclusion and exclusion criteria. Inclusion criteria included patients admitted with distal femur fractures fixed using LCP, skeletally mature patients (>18 years), open fractures (Type I, II, and IIIA), and those willing to participate. Exclusion criteria were Type IIIB and IIIC open fractures, associated tibial plateau fractures, pathological fractures unrelated to osteoporosis, fractures with neurovascular compromise, and those managed conservatively due to medical conditions.

Thorough patient evaluation ruled out head, chest, abdominal, spinal, or pelvic injuries, with a specific focus on neurovascular status. Primary immobilization was performed using a Thomas splint with padding under the distal fragment. Radiological assessments included anteroposterior and lateral views of the injured limb, knee joint, pelvis, and femur. Under appropriate anesthesia, the standard lateral approach to the distal femur was used with the patient in a supine position. Sandbags were placed under the operating knee and ipsilateral hip for stability. Once fracture reduction was satisfactory, the locking compression plate was fixed with appropriate cortical screws after confirming alignment. Postoperative rehabilitation was tailored to the patient and fracture type. Stable fixation facilitated early therapy, focusing on achieving optimal range of motion during the first postoperative weeks. Continuous passive motion therapy was recommended for 3 hours daily over 2–3 weeks until the patient achieved at least 100° knee flexion. Monitoring of knee flexion was conducted at weeks 1, 2, and 3, alongside isometric quadriceps and knee mobilization exercises to enhance recovery.

Results

In our study of 20 patients, 12 (60%) were males, and 8 (40%) were females. The primary mode of injury was road traffic accidents (55%), followed by falls from height or stairs (45%). Seventeen patients underwent surgery within one week of injury, while two were referred from another hospital after eight days. Surgery for one patient was delayed due to medical reasons. All patients underwent thorough clinical examinations, with associated injuries documented and treated accordingly. Open fractures included in the study were classified as Grade II and IIIA (Gustilo-Anderson classification). Males outnumbered females, with the highest number of cases (35%) occurring in the third decade of life. Road traffic accidents were the predominant cause of injury. No bilateral fractures were observed. Four patients (20%) had associated injuries: one with facial trauma, two with ipsilateral metatarsal and phalangeal fractures, and one with ipsilateral radius and ulna fractures.

Table 1: Age-wise distribution of cases

Age Group	*Frequency*	*Percentage (%)*
19-30	7	35
31-40	4	20
41-50	5	25
51-60	3	15
61-70	1	05

Most patients reported to the hospital within the first week of injury. Among the 20 cases, 19 had closed

injuries, with Type A1 Muller's fractures being the most common, observed in 7 patients (35%). The follow-up period ranged from 6 to 18 months. The average knee flexion achieved was 91°, with a maximum of 110° and a minimum of 70°. The average Neer functional score was 80 out of 100, comprising 70 units for functional assessment and 30 units for anatomical evaluation. The Neer scores, including pain, function, knee flexion, and gross anatomy, were used to evaluate surgical outcomes for adult distal femoral fractures [9].

Table 2: Showing NEER'S scores at follow-up

NEER'S Pain Score			
Scores	Pain Score 5	Pain Score 4	Pain Score 3
Frequency	2(10%)	15(75%)	3(15%)
NEER's Function scores			
Scores	Function Score 5	Function Score 4	Function Score 3
Frequency	2(10%)	13(65%)	5(25%)
NEER's Knee Flexion Score			
Scores	Knee Flexion Score 4	Knee Flexion Score 3	Knee Flexion Score 2
Frequency	10(50%)	9(45%)	1(5%)
NEER's Work Score			
Scores	Knee work Score 5	Knee work Score 4	Knee work Score 3
Frequency	5(25%)	14(70%)	1(5%)
NEER'S Score of Gross Anatomy			
Roentgenogram Scores	Roentgenogram Score 5	Roentgenogram Score 4	Roentgenogram Score 3
Frequency	15(75%)	4(20%)	1(5%)

In our study, 2 out of 20 patients (10%) reported no pain, 15 (75%) experienced intermittent pain due to knee stiffness, and 3 (15%) had pain with fatigue. Post-recovery, 2 patients (10%) regained pre-injury functionality, while 13 (65%) had mild restrictions, and 5 (25%) faced difficulty climbing stairs. Knee flexion of 100° or more was achieved by 10 patients (50%), up to 80° by 9 patients (45%), and 70° by 1 patient (5%). Regarding work capacity, 5 patients (25%) returned to previous roles, 14 (70%) had mild handicaps, and 1 (5%) shifted to alternative work. Two patients (10%) developed mild varus angulation (10°), 7 (35%) had 5 mm shortening, and 11 (55%) exhibited thickening. Radiographs showed near-normal results in 15 patients (75%), 10° angulation in 4 (20%), and 5 mm displacement in 1 (5%). Outcomes were excellent in 6 cases (30%), satisfactory in 13 (65%), and unsatisfactory in 1. Type A fractures yielded the best results, with satisfactory outcomes in Types A, B, and C.

Table 3: Showing the Fracture type and outcome

	Fracture Type and Outcome Chart		
	Excellent	*Satisfactory*	*Unsatisfactory*
Fracture Type A	6(30%)	7(35%)	0(0.0%)
Fracture Type B	0(0.0%)	1(5%)	0(0.0%)
Fracture Type C	0(0.0%)	5(25%)	1(5%)

Early complications were encountered in n=3 patients. One patient developed a superficial wound infection in 1st week and was promptly treated with appropriate antibiotics, wound care, and secondary suturing. One diabetic patient had delayed wound healing but was otherwise uneventful. One patient developed a tibial pin tract infection. Late complications included knee stiffness in n=1 patients, in one of whom it was observed that the patient was not cooperative for physiotherapy and also had a low threshold for pain. She was counseled for regular physiotherapy using C.P.M. machines, which

improved her knee flexion from 40° to 70°. One patient presented with a broken Plate in the condylar region, in his 2nd month and subsequently developed pain. He was operated on again and showed a good functional outcome.
Two patients were noticed to have varus collapse of about 10° with malunion

Table 4: Early and late complications in the patients

Complications	*Frequency*	*Percentage*
Superficial wound infection	1	5%
Delayed wound healing	1	5%
Tibial Pin tract infection	1	5%
Malunion with varus	2	10%
Plate breakage	1	5%

Discussion

The LCP condylar plate is the treatment of choice in the management of comminuted distal femoral fractures especially Type A fractures In this study we have found higher Neer's scores. The added advantage of LCP is it also prevents compression of periosteal vessels. It may not completely solve the age-old problems associated with any fracture like non-union and mal-union, but is a valuable technique in the management of these fractures. However, we found that LCP in type C fractures the outcome was poorer. But still, LCP remains the implant of choice since their results are generally superior to the dynamic condylar screws and angle blades for type C fractures also, though there are complications like knee stiffness and extensor lag encountered in a few cases [9, 10].

The good outcome seen in our study can be attributed to a greater number of patients with Type A fractures, which usually show favorable results. We had only 5% of open fractures, which is much higher in other case series [11-13]. Also, the small sample size can be used only as Level III evidence in Evidence-based medicine. We in this study had two cases of varus collapse one was due to early weight bearing in one case and the other case was due to gross communication. One case had an implant failure (Plate breakage) due to early weight bearing. Cases needing hardware revision are comparable to other studies at 13%. Earlier, fixation of these fractures with a lateral plate alone has historically been associated with non-union and /or malunion with varus collapse. Before the advent of locking plates, these problems were addressed with dual plating methods [14]. Though this prevented varus collapse, extensive soft tissue stripping, and medial incision increased the chance of extensor lag.

With the introduction of plates with the option of locked screws, the results are encouraging, as it increases the rigidity of fixation in osteoporotic bone and in the presence of periarticular or juxta-articular comminution [15]. The LCP condylar plates provide multiple points of fixed plate to screws contact, generating greater stability and thereby reducing the tendency of varus collapse [10]. LISS plating allows a minimally invasive approach by submuscular insertion of plates and thereby preservation of vascularity to the lateral cortex. In our study, the radiological union was seen at an average of 16 weeks which is comparable to the study of LCP by Kayali et al; in 2005 which averaged 15 weeks. Overall results were excellent in 6 out of 20 cases and were satisfactory in the remaining cases except one. The overall average knee score in our study was 80, as opposed to 67.7 by Schandelmaier et al. [16] We had a 95% good to excellent outcome as per Neer Score in our study, compared to Ketterel et al. [17] (90%) in their cases. The problems in fixing distal femoral fractures with osteoporosis, extensive comminution, and revision surgeries following failed implant can be addressed effectively using a locking condylar plate [18] We believe that locking plates represent a valuable advancement in fracture treatment. However, the limitations of this new technology and indications for its use have not been completely elucidated and the long-term results are awaited. The locking plates can fail when physiological loads are outside plate-designed parameters. The locked screws can disengage from the plate secondary to the failure of the screw to seat into the plate properly as a result of cross-threading or when insufficient screw torque is used to engage the screw threads into the plate threads [19].

Conclusion

In conclusion, our study demonstrates favorable outcomes in the management of distal femur fractures using Locking Compression Plates (LCP). Most patients experienced significant recovery, with 50% achieving knee flexion of 100° or more. The majority returned to their pre-injury activities with mild restrictions. While a few patients experienced mild complications such as varus angulation or shortening, radiographic results were mostly near normal. The overall knee score averaged 80%, with excellent outcomes observed in Type A fractures and satisfactory results in Types A, B, and C. The use of LCP provides effective fixation and promotes early rehabilitation.

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