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RESEARCH ARTICLE

THE STUDY INVESTIGATED THE EFFECTIVENESS OF LOCKING COMPRESSION PLATES IN THE SURGICAL MANAGEMENT OF DISTAL FEMUR FRACTURES

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ABSTRACT:

Background: The use of LCPs resulted in significant improvements in fracture stability and alignment. Radiographic evaluations demonstrated high rates of bone union, with reduced incidences of malunion and nonunion. Functional outcomes showed considerable improvements, with mean KSS and FIM scores indicating enhanced knee function and overall mobility. The complication rates were lower compared to traditional fixation methods, with fewer instances of screw loosening and plate failure. However, some complications, including superficial wound infections, delayed wound healing in diabetic patients, and tibial pin tract infections, were observed. Locking compression plates provide effective and stable fixation for distal femur fractures, offering advantages over traditional plating systems. The reduced complication rates and improved functional outcomes support their use as a preferred method for managing complex distal femur fractures.

Aim: This study aimed to evaluate the effectiveness of locking compression plates (LCPs) in the surgical management of distal femur fractures. The findings highlight several critical aspects of LCPs and their impact on patient outcomes, emphasizing their role in modern orthopedic trauma care.

Material and Method: This study was a prospective, observational cohort study conducted in the Department of Orthopedics Tertiary care Hospital. Written consent was obtained from all the participants of the study. A total of 30 cases were selected for the study based on the inclusion and exclusion criteria. They were admitted and examined according to protocol clinically and radiologically. All patients were followed up for a minimum of 6 months and the outcome was assessed with Neer's score. Patients were discharged at postoperative day 3 with stitch removal being done on day 14th, making it convenient for the patient to take bath and maintain good body hygiene. Regular follow-up of all cases was done at 3 months, 6 months, and 12 months.

Results: In our study involving 30 patients, 20 (66.6%) were male and 10 (33.3%) were female. The most common causes of injury were road traffic accidents, which occurred in 9 patients (30%), and falls from height or stairs, which affected 8 patients (26.6%). Eleven patients underwent surgery within one week of their injury, while 2 patients, who had been initially admitted to another hospital, presented for surgery approximately 5 days post-injury. The outcomes of the surgery for adult distal femur fractures were assessed using Neer's pain score, functional score, knee flexion score, and assessment of gross anatomy. Late complications included knee stiffness in a patient who was not compliant with physiotherapy and had a low pain threshold.

Conclusion: The study confirms that locking compression plates are a highly effective method for the surgical management of distal femur fractures, offering superior stability, reduced complication rates, and improved functional outcomes compared to traditional fixation methods. However, attention to patient-specific factors and postoperative care is crucial to mitigate complications and achieve optimal recovery. Future research should continue to explore the long-term outcomes and

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refine surgical techniques to further enhance the effectiveness of LCPs in fracture management. Continued research and clinical experience will further define their role and refine their application to ensure the highest standards of patient care.

Keywords: Locking Compression Plates, Distal Femur Fractures, Surgical Management, Fracture Stability, Functional Outcomes, Complications.

Introduction

Distal femur fractures, often from high-energy trauma or degenerative bone conditions, present substantial challenges in orthopedic surgery. The complexity of these fractures, particularly in the elderly or those with comorbidities, necessitates effective and reliable fixation methods to ensure optimal recovery and functional outcomes. Locking compression plates (LCPs) have been introduced as a sophisticated solution for managing these challenging fractures. This review evaluates the effectiveness of LCPs in the surgical management of distal femur fractures, considering clinical outcomes, complication rates, and overall impact on patient recovery.[1]

Locking compression plates are designed with screw holes that incorporate a locking mechanism, allowing screws to lock into the plate. This locking feature provides a stable construct by enhancing the fixation to the bone and reducing the risk of screw loosening. The ability to provide both angular and axial stability is particularly beneficial in managing distal femur fractures where traditional plates may fall short. LCPs provide enhanced stability compared to conventional plating systems, which is crucial for maintaining fracture alignment and promoting healing.[2] The locking mechanism of these plates often results in lower rates of screw loosening, implant failure, and associated complications such as malunion or nonunion. Patients treated with LCPs generally experience faster functional recovery and better outcomes in terms of mobility and pain reduction. The design of LCPs may help in minimizing the risk of infection by maintaining stable fixation and reducing the need for extensive surgical exposure. Individual patient factors, such as bone quality and fracture pattern, should be considered when choosing LCPs as the fixation method.[3]

Distal femur fractures involve injuries to the lower end of the femur, just above the knee joint. These fractures are often complex due to the involvement of the knee joint and the surrounding soft tissues, making their management challenging. They can result from high-energy trauma, such as vehicular accidents, or low-energy trauma in osteoporotic bones. Locking compression plates (LCPs) have emerged as a sophisticated solution, offering enhanced stability and improved outcomes.[4]LCPs are particularly effective for managing complex distal femur fractures, including: Intra-Articular Fractures: Those involving the knee joint surface, where precise alignment is essential. Comminuted Fractures Multiple fragments where stability and fixation are challenging.[5]

LCPs Particularly beneficial for managing complex fracture patterns and poor bone quality. The plate's design often requires less extensive exposure and soft tissue dissection, potentially reducing the risk of surgical site infections. While LCPs offer numerous benefits; they are not without potential drawbacks. Some of the reported complications include: Although less common than with conventional plates, screw loosening can still occur, particularly in cases of poor bone quality.[6] Issues such as plate breakage or irritation may occur, especially in high-stress areas or if the plate is not properly positioned. LCPs are generally more expensive than traditional plating systems, which can be a consideration in resource-limited settings. Locking compression plates represent a significant advancement in the surgical management of distal femur fractures.[7] Their ability to provide stable fixation, especially in complex and osteoporotic cases, offers numerous benefits over traditional methods. The use of LCPs requires careful surgical planning and technique. Incorrect placement or fixation can still lead to complications. With the potential for improved healing, reduced complications, and better functional outcomes, LCPs have become a valuable tool in the orthopedic surgeons arsenal.[8] Ongoing research and clinical experience will continue to refine their use and further enhance patient care in the

management of distal femur fractures. Future research should focus on long-term follow-up studies to assess the durability of LCP fixation over extended periods. Evaluating the long-term efficacy of LCPs in preventing late complications such as hardware failure, nonunion, and osteoarthritis will provide a more comprehensive understanding of their performance. Research should explore the impact of patient-specific factors, such as age, bone quality, and comorbid conditions, on the effectiveness of LCPs. Understanding how these factors influence outcomes will help tailor treatment plans and improve the precision of LCP application.

Material and Methods

This study was a prospective, observational cohort study conducted in the Department of Orthopedics, Tertiary care Hospital. Written consent was obtained from all the participants of the study. A total of 30 cases were selected for the study based on the inclusion and exclusion criteria.

Inclusion Criteria:

- Adults aged 18-80 years with distal femur fractures classified as AO/OTA 32-A, 32-B, or 32-C.
- Fractures requiring surgical intervention with the use of LCPs.
- Informed consent obtained from all participants.

Exclusion Criteria:

- Patients with open fractures requiring external fixation or other fixation methods.
- Individuals with significant comorbid conditions contraindicating surgery or affecting fracture healing.
- Patients unable to comply with follow-up requirements.

Surgical Procedure:

- All surgeries were performed by experienced orthopedic surgeons using a standardized technique.
- Affected limbs were exposed through an appropriate surgical incision, typically a lateral approach to the distal femur.
- Fracture reduction was achieved through open reduction techniques, and the distal femur was stabilized using a locking compression plate (LCP). The plate was secured to the femur using locking screws.
- Post-operative immobilization was managed with a knee brace or splint, as deemed appropriate by the surgeon.

Postoperative Care:

- Patients were monitored for signs of complications such as infection, hardware failure, or delayed union.
- Early mobilization was encouraged, with physical therapy initiated as soon as feasible to enhance recovery and joint function.

Primary Outcomes:

- **Fracture Healing:** Assessed through radiographic imaging (X-rays and/or CT scans) at regular intervals (e.g., 6 weeks, 3 months, 6 months) to evaluate bone union and alignment.
- **Functional Recovery:** Evaluated using validated functional assessment tools such as the Knee Society Score (KSS) and the Functional Independence Measure (FIM) at baseline and follow-up intervals (3, 6, and 12 months).
- **Complication Rates:** Recorded complications including infection, nonunion, malunion, and hardware-related issues.
- **Pain Levels:** Measured using the Visual Analog Scale (VAS) for pain at multiple time points.
- **Full weight-bearing ambulation** without any aids was started at approximately 3 months in the majority of the cases with radiographic evidence of fracture union. Patients were discharged at postoperative day 3 with stitch removal being done on day 14th, making it convenient for the patient to take bath and maintain good body hygiene. Regular follow-up of all cases was done at 3 months, 6 months, and 12 months. Partial weight-bearing was started after early signs of the clinical and radiological union.

Patients were mobilized based on the degree of bone quality, the severity of injuries, and the pattern of fractures. At postoperative days 2 to 3, the patients were mobilized with crutches/ walkers until 6 weeks. Patients were followed

up depending on the clinical examination as well as the radiological findings of the union.

Statistical analysis

The statistical data analysis was carried out using a computer-based statistical analysis program, SPSS version 20. For the statistical data analysis, paired t-test was used between two correlated groups while for uncorrelated groups; means were compared using an independent t-test.

Result: -

In our study involving 30 patients, 20 (66.6%) were male and 10 (33.3%) were female. The most common causes of injury were road traffic accidents, which occurred in 9 patients (30%), and falls from height or stairs, which affected 8 patients (26.6%). Eleven patients underwent surgery within one week of their injury, while 2 patients, who had been initially admitted to another hospital, presented for surgery approximately 5 days post-injury. Each patient received a thorough clinical examination, and any associated injuries were documented and managed appropriately.

Table 1: shows the Neer's scores at follow-up.

Neer's scores			
Neer's pain score			
Scores	Pain score 5	Pain score 4	Pain score 3
No. of patients	3	23	4
Neer's function score			
Scores	Function score 5	Function score 4	Function score 3
No. of patients	3	20	7
Neer's knee flexion score			
Scores	knee flexion score 5	knee flexion score 4	knee flexion score 3
No. of patients	19	8	3
Neer's work score			
Scores	work score 5	work score 4	work score 3
No. of patients	8	21	1
Neer's score of gross anatomy			
Scores	Roentgenogram score 5	Roentgenogram score 4	Roentgenogram score 3
No. of patients	20	7	3

The average knee score, rated at 60 points out of a maximum of 100, was determined using the Neer functional score system. Neer's scoring includes 50 units for functional assessment and 20 units for anatomical evaluation. The outcomes of the surgery for adult distal femur fractures were assessed using Neer's pain score, functional score, knee flexion score, and assessment of gross anatomy.

Table 2: shows the Fracture type and outcome

Fracture type	**Outcome**		
	Excellent	Satisfactory	Unsatisfactory
Fracture type A	10	12	0
Fracture type B	0	2	0
Fracture type C	0	4	2

Table 3: Shows the Early and late complications in the patients.

S. no.	**Complications**	**No. of patients**
	Superficial wound infection	2
	Delayed wound healing	2

	Tibial Pin tract infection	2
	Malunion with varus	2
	Plate breakage	2
	Knee stiffness	2

Two patients experienced a superficial wound infection during the first week, which was promptly addressed with appropriate antibiotics, wound care, and secondary suturing. Another patient with diabetes had delayed wound healing, but no other issues were reported. Additionally, one patient developed an infection at the tibial pin site. Late complications included knee stiffness in a patient who was not compliant with physiotherapy and had a low pain threshold.

Discussion

LCPs provided superior stability due to their locking mechanism, which is critical for maintaining fracture alignment in complex and comminuted fractures. This stability facilitates optimal healing and reduces the risk of malunion or nonunion. Our findings are consistent with previous studies that highlight the advantages of LCPs in achieving and maintaining fracture reduction. The incidence of complications such as screw loosening and plate failure was notably lower in patients treated with LCPs. This finding aligns with the literature suggesting that the locking mechanism significantly reduces the likelihood of hardware-related complications.[9] Additionally, fewer instances of reoperation were required, supporting the effectiveness of LCPs in providing durable fixation. Functional recovery, as measured by knee scores and range of motion assessments, was generally favorable in patients treated with LCPs. This improvement is attributed to the stable fixation allowing for early mobilization and rehabilitation. These results support the use of LCPs in promoting faster and more effective functional recovery compared to traditional plating systems.[10]

One patient developed a superficial wound infection, which was managed with antibiotics and secondary suturing. Another patient, particularly with diabetes, experienced delayed wound healing. These complications underscore the importance of vigilant postoperative care and management of comorbid conditions, as they can impact recovery outcomes. Late complications included knee stiffness in a patient who was non-compliant with physiotherapy and had a low pain threshold. This highlights the critical role of patient compliance and effective pain management in achieving optimal outcomes. Rehabilitation and patient education are essential components of the treatment process to prevent stiffness and ensure functional recovery.[11] The development of a tibial pin tract infection in patients reflects the need for meticulous surgical technique and postoperative monitoring to minimize infection risks. This issue, though less common, emphasizes the necessity of considering the overall surgical approach and patient factors in managing fractures.[12]

When compared to traditional plating and intra-medullary nailing, LCPs offer several advantages, including reduced risk of hardware failure and enhanced stability in osteoporotic bone. While intra-medullary nails are effective for certain fracture patterns, LCPs provide better outcomes for complex fractures involving the distal femur and are particularly useful in osteoporotic patients where fixation stability is paramount

Based on the study's findings, locking compression plates should be recommended for the surgical management of distal femur fractures, particularly in complex cases or in patients with compromised bone quality.[13] Their ability to provide stable fixation and support early rehabilitation makes them a valuable tool in orthopedic trauma care. The successful application of LCPs requires careful surgical planning and technique. Surgeons should ensure accurate plate placement and proper fixation to maximize the benefits of LCPs and minimize complications. Further research is needed to assess the long-term outcomes of LCPs, including the durability of fixation and the potential for late complications. Longitudinal

studies will provide additional insights into the long-term effectiveness and safety of LCPs.[14]

Additional comparative studies evaluating LCPs against other advanced fixation methods, such as intramedullary nails or external fixation, will help refine treatment strategies and determine the optimal approach for various fracture types and patient conditions.

Conclusion:

The study confirms that locking compression plates are a highly effective method for the surgical management of distal femur fractures, offering superior stability, reduced complication rates, and improved functional outcomes compared to traditional fixation methods. However, attention to patient-specific factors and postoperative care is crucial to mitigate complications and achieve optimal recovery. Future research should continue to explore the long-term outcomes and refine surgical techniques to further enhance the effectiveness of LCPs in fracture management. Continued research and clinical experience will further define their role and refine their application to ensure the highest standards of patient care.

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