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Functional And Radiological Outcome Of The Distal Femur Fractures Fixed With Locking Compression Plate By Minimally Invasive Plate Osteosynthesis

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Abstract

Introduction: *Distal femur fractures are complex injuries often caused by high-energy trauma, and their management remains a challenge. Minimally Invasive Plate Osteosynthesis (MIPO) using Locking Compression Plates (LCP) has gained popularity as it aims to reduce soft tissue dissection and preserve vascularity, which may improve fracture healing and functional outcomes.*

Objective: *The purpose of this prospective study was to evaluate the functional and radiological outcomes of distal femur fractures treated with LCP and the MIPO technique.*

Methodology: *This study was conducted on twenty patients who presented with distal femur fractures at Adichunchanagiri Institute of Medical Sciences between February 2023 and July 2024. Patients were treated with the MIPO technique using LCP. Functional and radiological outcomes were assessed during follow-up at 1, 3, and 6 months post-operatively. Outcomes were graded using the Neer's scoring system, which evaluates factors such as pain, function, range of motion, and stability.*

Results: *The average time for fracture union was 18.15 weeks. Ninety percent of the patients achieved fracture union, while two patients (10%) experienced a non-union. Complications included one case of implant failure due to a fall, and one case of a superficial infection. Based on the Neer's score, 75% of patients had excellent or good results, while 15% had fair results and 10% had poor results.*

Conclusion: *The use of Locking Compression Plates with the Minimally Invasive Plate Osteosynthesis technique is a reliable and effective treatment for distal femur fractures, providing good to excellent functional and radiological outcomes with a high rate of fracture union.*

Keywords: *Distal femur fractures, MIPO, Locking Compression Plate, Minimally Invasive Plate Osteosynthesis, Functional outcome, Radiological outcome.*

INTRODUCTION:

Distal femur fractures are complex injuries that present significant treatment challenges [1]. These fractures are more frequently observed in elderly individuals and polytrauma patients, as they tend to be unstable and comminuted, often leading to prolonged functional impairment [2]. Among all femoral fractures, distal femur fractures account for approximately 7% [2].

The incidence of distal femur fractures follows a bimodal age distribution. In young adults, they commonly result from high-energy trauma, such as motor vehicle accidents, often leading to complex, multi-system injuries [3]. Conversely, in elderly patients, these fractures are primarily caused by low energy trauma, such as falls, particularly in osteoporotic bone.

Before the 1960s, surgical intervention for distal femur fractures was largely discouraged due to concerns about high rates of infection, non-union, and malunion [4]. Instead, traditional management strategies—such as skeletal traction, fracture manipulation, external immobilization, and the use of casts and cast bracing—were advocated by Watson Jones and John Charnley [5]. However, these approaches were associated with complications including deformity, shortening, angulation, mal-union, quadriceps atrophy, knee instability, and post-traumatic sequelae.

In recent years, open reduction and internal fixation have gained widespread acceptance, with implants such as the AO Blade Plate, Dynamic Condylar Screw, Intramedullary Supracondylar Nail, and Locking Compression Plate demonstrating favourable outcomes [6]. Locking compression plates are particularly advantageous, as maintaining stable fixation remains a key challenge in these patients [7]. Locking compression plates offer the

combined benefits of compression plating, locked plating, and bridge plating. They help preserve periosteal blood supply and minimize soft tissue disruption, functioning similarly to an external fixator while allowing for stable internal fixation [8].

MATERIALS AND METHODS

This prospective study was conducted at the Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences, from February 2023 to July 2024. The study included a total of twenty patients who presented with distal femur fractures (AO/OTA types A, C). All patients were informed about the study's purpose and provided written informed consent. The study received approval from the Institutional Ethics Committee.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Age from 18 to 70 years
- Both sexes
- Cases of distal femur fractures - simple, open type-1, 2
- AO OTA subtypes 33A1, A2, A3 and C1, C2

Exclusion Criteria:

- Age < 18 years and > 70 years
- Polytrauma cases with poor GCS
- Patients with associated patella fractures
- Patients with severe OA knee
- Associated vascular injuries
- AO OTA subtypes 33 B, and C3

Surgical Technique

All patients underwent open reduction and internal fixation with a pre-contoured locking compression plate using the MIPO technique. The surgical procedure involved a small incision over the fracture site to achieve indirect reduction, followed by the insertion of the LCP through a proximal and distal incision. Fluoroscopy was used to confirm accurate plate placement and fracture reduction.

Post-operative Management

Post-operatively, the patients were placed in a long knee brace. Early knee range of motion exercises were initiated as tolerated. Partial weight bearing was allowed at 6 weeks, and full weight bearing was permitted after radiological evidence of fracture union.

Outcome Assessment

Patients were followed up at 1, 3, and 6 months post-operatively. The primary outcomes assessed were functional and radiological outcomes. The Neer's scoring system was used to assess both, evaluating factors such as pain, function, range of motion, and stability. A score of 89-100 was considered excellent, 80-88 good, 70-79 fair, and less than 70 poor.

RESULTS

A total of twenty patients with distal femur fractures were included in the study. The patient cohort comprised 15 males and 5 females, with a mean age of 41.45 years. The majority of fractures were caused by road traffic accidents (70%), followed by falls (30%). The most common fracture types were AO/OTA Type A fractures (65%) and Type C fractures (35%).

The mean duration of surgery was 106 minutes. All patients were operated on within 24 hours of admission.

1. **PATIENT DEMOGRAPHICS**

GENDER	NO. OF PATIENTS	PERCENTAGE
MALE	15	75
FEMALE	5	25

TABLE 1: GENDER DISTRIBUTION

The gender distribution depicting male: female being 3:1 i.e., male patients are more commonly affected than female patients

SIDE	NO. OF PATIENTS	PERCENTAGE
RIGHT	12	60

LEFT	8	40

TABLE 2: SIDE DISTRIBUTION

The right side was more commonly affected than the left, with right-side involvement observed in 60% of cases.

2. MODE OF INJURY

MODE OF INJURY	NO. OF PATIENTS	PERCENTAGE
RTA	14	70
SELF FALL	5	25
FALL FROM HEIGHT	1	5

TABLE 3: MODE OF INJURY

Road traffic accidents were the most common cause of injury, accounting for 70% of the cases, followed by falls.

3. OPEN VS CLOSED FRACTURES

INJURY TYPE	NO. OF PATIENTS	PERCENTAGE
CLOSED	16	80
OPEN TYPE I	3	15
OPEN TYPE II	1	5

TABLE 4: OPEN VS CLOSED FRACTURES

GRAPH 1: OPEN VS CLOSED FRACTURES

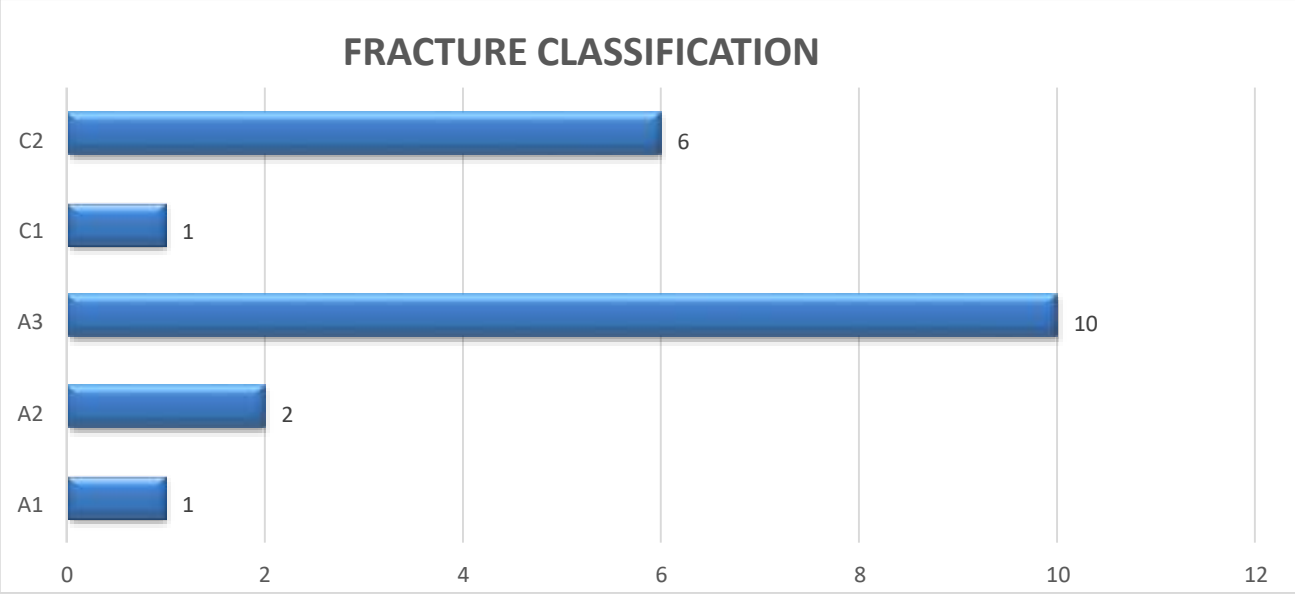
Closed fractures were more prevalent, observed in 80% of the cases, whereas open fractures made up the remaining 20%.

4. FRACTURE CLASSIFICATION

FRACTURE CLASSIFICATION	NO. OF PATIENTS	PERCENTAGE
A1	1	5

A2	2	10
A3	10	50
C1	1	5
C2	6	30

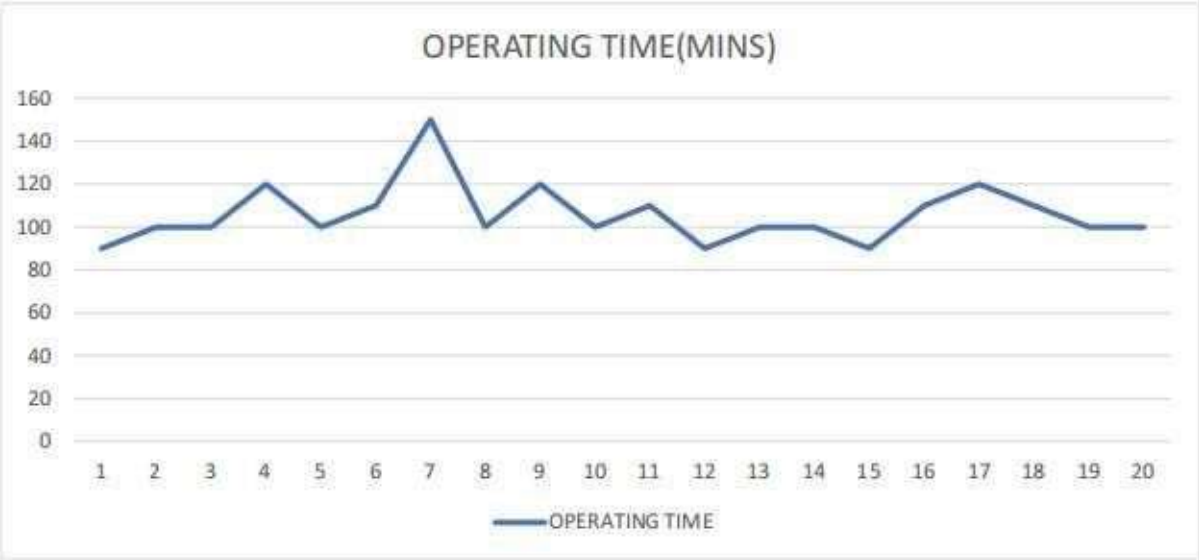
TABLE 4: FRACTURE CLASSIFICATION



GRAPH 2: FRACTURE CLASSIFICATION

A3 type of AO/Muller classification were found to be more prevalent the present study group.

5. OPERATIVE TIME



GRAPH 3: OPERATIVE TIME

The operating time ranges from 90 to 150 minutes with mean operating time of 106 minutes

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6. UNION TIME

GRAPH 4: UNION TIME

Union was achieved in all patients with average union time of 18.15 weeks.

7. BLOOD LOSS

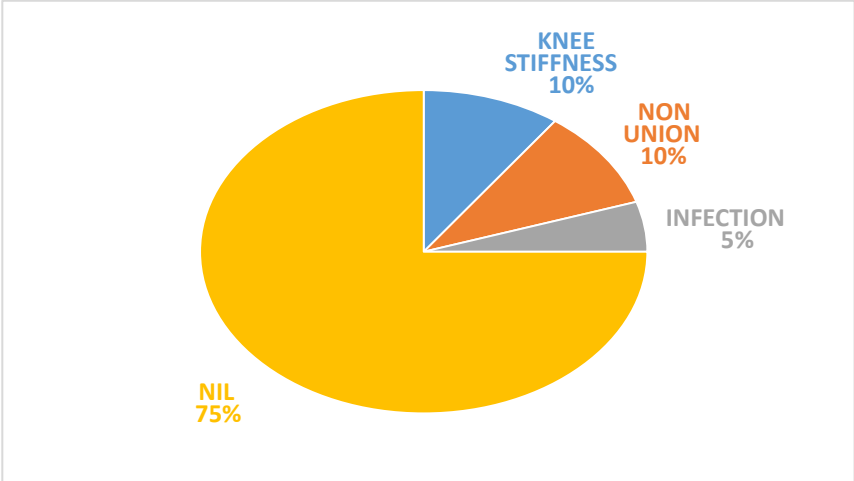
The average blood loss during surgery was 157.5 ml with highest being 200 ml and lowest being 140 ml.

8. COMPLICATIONS:

75% of the patients did not develop any complications three of the major complications were deep infection, knee stiffness and non- union.

COMPLICATION	NUMBER OF PATIENTS	PERCENTAGE
KNEE STIFFNESS	2	10
NON - UNION	2	10
INFECTION	1	5
NIL	15	75

TABLE 5: COMPLICATIONS



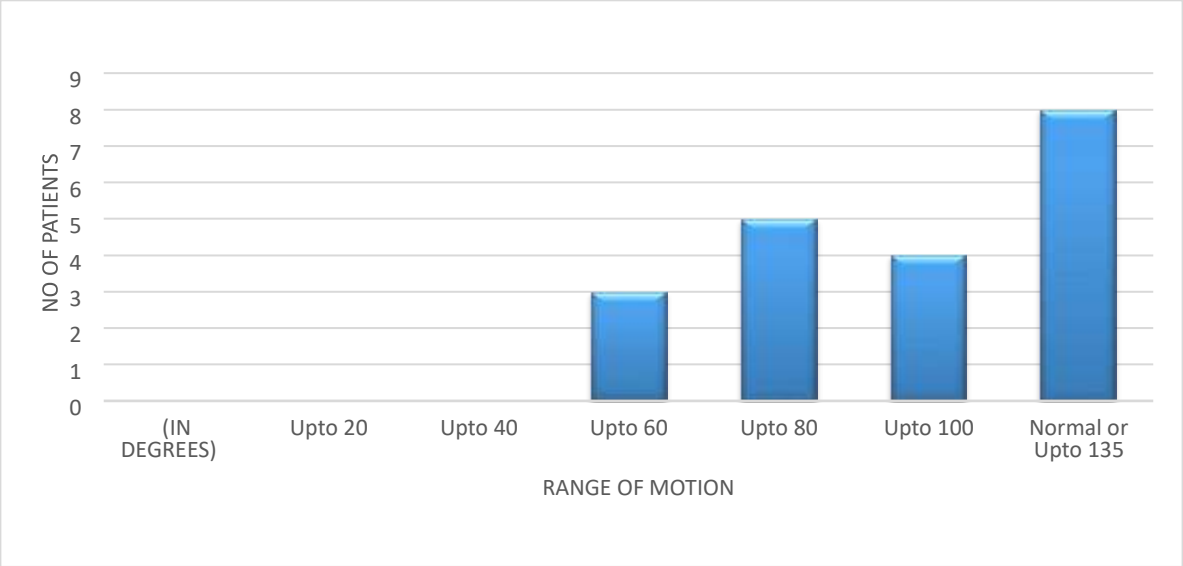
GRAPH 5: COMPLICATIONS

9. RANGE OF MOTION

RANGE OF MOTION (IN DEGREES)	NO OF PATIENTS	PERCENTAGE
Up to 20	0	0
Up to 40	0	0

Up to 60	3	15
Up to 80	5	25
Up to 100	4	20
Normal or Up to 135	8	40

TABLE 6: RANGE OF MOTION



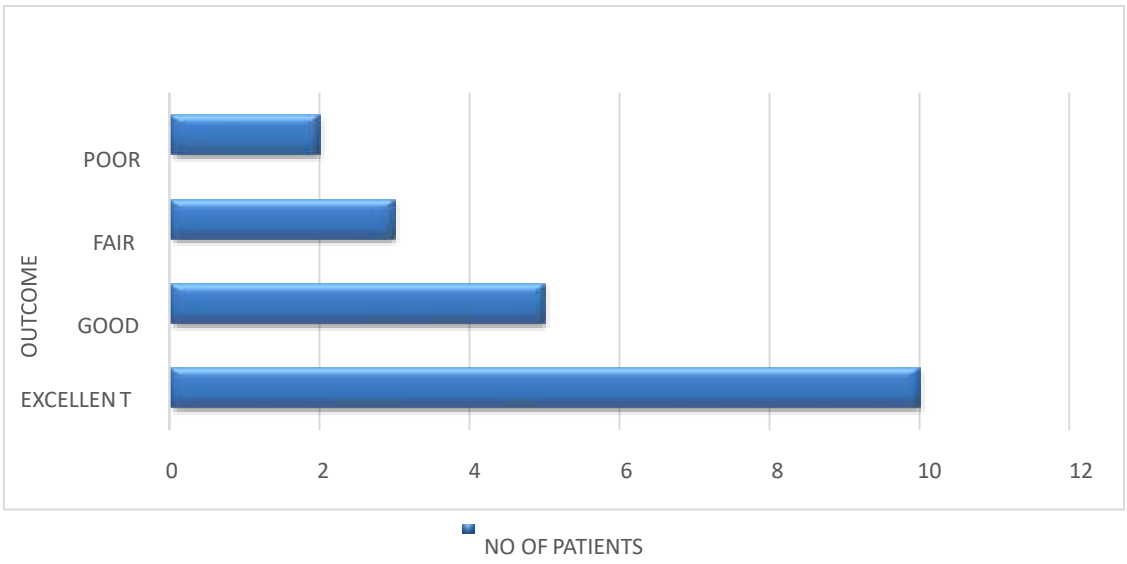
GRAPH 6: KNEE FLEXION

40% of the patients achieved normal or up to 135° of knee flexion the least amount of knee flexion was noted to be up to 60°.

10. OUTCOME

OUTCOME	NO OF PATIENTS	PERCENTAGE
EXCELLENT	10	50
GOOD	5	25
FAIR	3	15
POOR	2	10

TABLE 7: OUTCOME



GRAPH 7: OUTCOME

75% of the patients achieved excellent and good outcome according to Neer's scoring system.

CASE ILLUSTRATION

FIG. 1: Pre-operative X-ray:

FIG. 2: Intra-operative picture

FIG.3: Reduction techniques

Fig.4: Immediate Post-op

FIG. 5 : 6 months follow up X -ray

FIG.6: 6 months follow up clinical pictures showing functional outcome

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COMPLICATIONS

FIG 7: KNEE STIFFNESS

FIG 8: MECHANICAL FAILURE LEADING TO NON - UNION

FIG 9: DEEP INFECTION

DISCUSSION

The management of distal femur fractures remains a significant challenge in orthopedic surgery [9]. The use of biological fixation methods, such as the MIPO technique with locking compression plates, has gained favor due to its potential to reduce soft tissue morbidity and improve fracture healing [10]. Our study evaluated the functional and radiological outcomes of this technique in a series of twenty patients.

Our findings demonstrate a high rate of fracture union (90%), with an average union time of 18.15 weeks [11]. This is consistent with results from other studies that have reported a high union rate with the MIPO technique. For instance, a study by Krettek et al. [12] reported a union rate of over 90% with this technique. Similarly, a study by Gautier et al. [13] demonstrated a union rate of 92%, supporting the effectiveness of this minimally invasive approach [14]. The rapid healing observed in our study highlights the biological benefits of preserving the soft tissue envelope [15].

In our study, two patients experienced complications: one non-union due to implant failure following a fall and a superficial infection. These complication rates are comparable to those reported in the literature [16]. Non-union, while a known risk, can be reduced with strict adherence to surgical principles and patient compliance with post-operative instructions [17].

The functional outcomes, as measured by the Neer's score, were excellent or good in 75% of our patients. This is in line with the findings of other authors [18], [19]. A study by Schandelmaier et al. [20] reported satisfactory results in 70% of cases treated with similar methods. The high rate of good to excellent outcomes in our study

reinforces that the MIPO technique not only promotes fracture healing but also facilitates a return to good function [21].

In conclusion, our study confirms that the MIPO technique using LCP for distal femur fractures is a reliable and effective treatment modality. It offers a high rate of fracture union, low complication rates, and good functional outcomes. This approach, by preserving the biological environment, provides a significant advantage over traditional open reduction techniques [22].

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