



FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF DISTAL FEMUR FRACTURES TREATED WITH MINIMALLY INVASIVE PERCUTANEOUS PLATE OSTEOSYNTHESIS USING LOCKING COMPRESSION PLATES: A PROSPECTIVE OBSERVATIONAL STUDY

Orthopaedics

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ABSTRACT

Background: Distal femur fractures are challenging periarticular injuries associated with significant morbidity and functional impairment. Conventional open reduction techniques often require extensive soft-tissue dissection, which may compromise fracture biology and increase complication rates. Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) using locking compression plates has emerged as a biological fixation technique that preserves periosteal blood supply and promotes fracture healing while providing stable fixation. **Objective:** To evaluate the functional and radiological outcomes of distal femur fractures treated with MIPPO using distal femur locking compression plates. **Methods:** This prospective observational study was conducted in the Department of Orthopaedics at Zydus Medical College and Hospital, Dahod, between March 2024 and September 2025. Thirty adult patients with closed distal femur fractures were included and treated surgically using distal femur locking compression plates with or without supplementary screw fixation via the MIPPO technique. Functional outcomes were assessed using the Neer Scoring System, along with evaluation of radiological union, knee range of motion, and postoperative complications. **Results:** The mean age of patients was 47.03 ± 16.85 years, with road traffic accidents being the most common cause of injury (63.3%). The mean knee range of motion improved significantly from the postoperative period to final follow-up ($p = 0.001$). Radiological union occurred at a mean of 5.80 ± 1.32 months. Excellent and good functional outcomes were achieved in 53.3% and 23.3% of patients respectively according to the Neer score. Joint stiffness was the most frequent complication. **Conclusion:** MIPPO with distal femur locking compression plates provides stable fixation, preserves fracture biology, and results in satisfactory functional outcomes with minimal complications.

KEYWORDS

Distal Femur Fracture, Mippo, Locking Compression Plate, Minimally Invasive Fixation, Neer Score.

INTRODUCTION

Distal femur fractures account for approximately 3–6% of femoral fractures and present significant management challenges due to their proximity to the knee joint and frequent comminution [1,2]. High-energy trauma in young individuals and low-energy osteoporotic fractures in elderly patients are the most common causes [2,3,4].

Traditional open reduction and internal fixation methods require extensive exposure and periosteal stripping, which may impair fracture healing and increase complications [4,5]. Modern orthopaedic practice emphasizes biological fixation techniques that preserve blood supply and soft tissue integrity [6,14].

Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) using locking compression plates provides angular stability and allows indirect fracture reduction while preserving fracture hematoma and biology [8,15]. The present study evaluates the functional and radiological outcomes of distal femur fractures treated with MIPPO.

Materials and Methods

Study Design

Prospective observational study.

Study Location

Department of Orthopaedics
Zydus Medical College and Hospital, Dahod, Gujarat.

Study Duration

March 2024 – September 2025.

Sample Size

30 patients with distal femur fractures.

Inclusion Criteria

- Age >18 years
- Closed distal femur fractures
- Patients fit for surgery

Exclusion Criteria

- Open fractures
- Pathological fractures
- Neurovascular injuries
- Multiple fractures

Surgical Technique

All patients underwent fixation using distal femur locking compression plates via the MIPPO technique under fluoroscopic guidance.

Outcome Measures

- Neer functional score
- Radiological union
- Knee range of motion
- Time to weight bearing
- Postoperative complications

Statistical Analysis

Data were analysed using SPSS software. Quantitative variables were expressed as mean $\pm$ standard deviation. A p -value <0.05 was considered statistically significant.

RESULTS

Demographic Data

- Mean age: 47.03 ± 16.85 years
- Male: 60%
- Female: 40%

Mode of Injury

- Road traffic accident: 63.3%
- Fall: 36.7%

Fracture Type (AO/OTA)

- Type 33C: 40%
- Type 33A: 36.7%
- Type 33B: 23.3%

Functional Outcome (Neer Score)

Outcome	Number	Percentage
Excellent	16	53.3%
Good	7	23.3%
Fair	4	13.3%
Poor	3	10%

Radiological Parameters

Parameter	Mean $\pm$ SD
Injury-to-surgery time	3.43 $\pm$ 1.92 days
Hospital stay	9.40 $\pm$ 3.00 days
Knee ROM	91.67° $\pm$ 16.63°
Radiological union	5.80 $\pm$ 1.32 months
Full weight bearing	5.37 $\pm$ 1.13 months

Complications

Complication	Percentage
Joint stiffness	30%
Infection	3.3%
Non-union	3.3%
Delayed union	3.3%

DISCUSSION

Distal femur fractures require stable fixation to allow early mobilization and prevent knee stiffness [2,4,5]. The MIPPO technique preserves fracture biology while providing stable fixation through locking compression plates [8,15].

In the present study, the majority of fractures were caused by road traffic accidents, consistent with previous studies [5,9,10]. Radiological union occurred at approximately six months, which aligns with reported union times in similar studies [6,8,10]. Functional outcomes were favourable, with the majority of patients achieving excellent to good Neer scores [5,6,12].

The complication rate was low, and joint stiffness was the most frequent complication [9,13]. Early physiotherapy and proper surgical technique are essential to minimize such complications and improve outcomes [14,15].

CONCLUSION

MIPPO using distal femur locking compression plates is a reliable and effective technique for the treatment of distal femur fractures. The method preserves fracture biology, allows early mobilization, and produces satisfactory functional outcomes with minimal complications.

Figures and Graphs**Figure 1****Age distribution of patients**

Bar graph

X-axis: Age groups

Y-axis: Number of patients

18–30 $\rightarrow$ 8

31–45 $\rightarrow$ 4

46–60 $\rightarrow$ 14

60 $\rightarrow$ 4

Figure 2**Mode of Injury**

Pie chart

• RTA $\rightarrow$ 63.3%

• Fall $\rightarrow$ 36.7%

Figure 3**AO/OTA fracture classification**

Bar graph

33A $\rightarrow$ 36.7%

33B $\rightarrow$ 23.3%

33C $\rightarrow$ 40%

Figure 4**Functional outcome (Neer score)**

Bar graph

Excellent $\rightarrow$ 53.3%

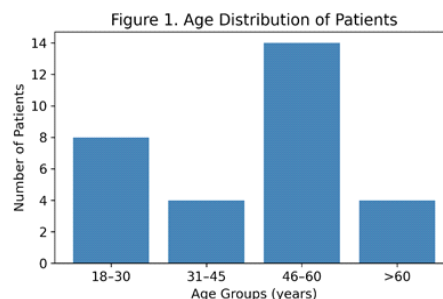
Good $\rightarrow$ 23.3%

Fair $\rightarrow$ 13.3%

Poor $\rightarrow$ 10%

Figure 5**Preoperative vs Final Knee Range of Motion**

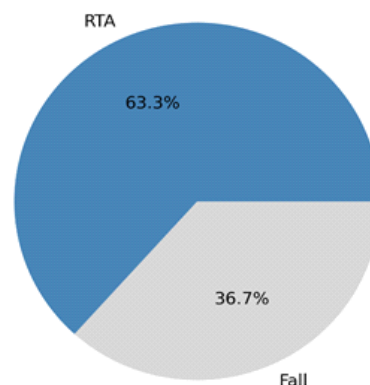
Line graph showing improvement in ROM.

Figure 1**Age distribution of patients with distal femur fractures**

Age groups

- 18–30 years
- 31–45 years
- 46–60 years
- 60 years

Figure 1: Distribution of patients according to age group showing maximum cases in the 46–60 years category.

Figure 2. Mode of Injury**Figure 2****Mode of injury**

- Road traffic accidents – 63.3%
- Fall – 36.7%

Figure 2: Distribution of patients according to mechanism of injury.

Figure 3**AO/OTA fracture classification**

- 33A – 36.7%
- 33B – 23.3%
- 33C – 40%

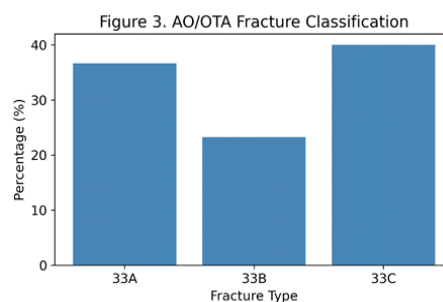


Figure 3: Distribution of distal femur fractures according to AO/OTA classification.

Figure 4**Functional outcome according to Neer scoring system**

- Excellent – 53.3%
- Good – 23.3%
- Fair – 13.3%
- Poor – 10%

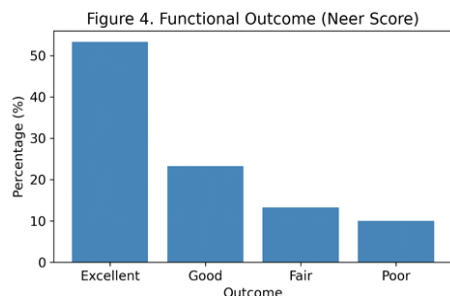


Figure 4: Functional outcome of patients according to Neer score.

Figure 5

Improvement in knee range of motion

Points:

- Postoperative ROM
- Final follow-up ROM

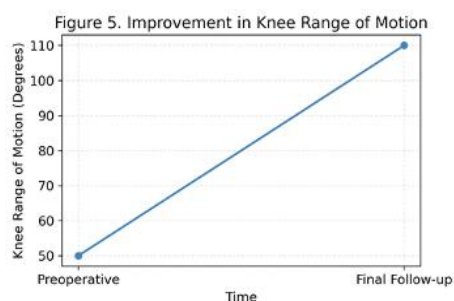


Figure 5: Comparison of knee range of motion between immediate postoperative period and final follow-up showing significant improvement.

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