Original Article

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Orthopaedics Section

# Functional Outcome of Distal Femoral Fractures using NEER Scoring Managed by Distal Femoral Locking Plate versus Retrograde Intramedullary Nail: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Distal femur fractures are a group of fractures that have been a topic of debate for the past decade, were traditionally treated mainly using conservative methods. However, with advancements in surgical techniques and implants, operative intervention has now become the preferred treatment approach. There are various methods for treating distal femur fractures and the present study compares the treatment of distal femoral fracture using distal femur nailing versus the use of locking plate.

**Aim:** To compare the functional outcomes of stabilising distal femur fractures using locking compression plating versus retrograde nailing and to evaluate the merits and drawbacks of each procedure.

**Materials and Methods:** A cross-sectional comparative study was conducted in the Department of Orthopaedics at Calcutta National Medical College and Hospital, Kolkata, West Bengal, India, over a one-year period from (January 2021 to January 2022. Total 46 patients with distal femur fractures were included, with six lost to follow-up. Two groups were divided in which total 20 patients underwent distal femoral nailing, while 20 were treated with distal femoral locking plates. Functional outcomes were assessed using the NEER Score, aiming for perfect restoration of the articular surface, stable fixation, full knee range of motion, and good functional results. Data were entered into a Microsoft Excel spreadsheet for statistical analysis using Statistical Packages for Social Sciences (SPSS) (version 27.0; SPSS Inc., Chicago, IL, USA). Numerical variables were summarised as mean and standard deviation, while categorical variables were presented as counts and percentages. A p-value of ≤0.05 was considered statistically significant.

**Results:** The study population consisted of 70% males with a mean age of approximately 55 years. Road traffic accidents were the most common mode of injury. The mean time for radiological union in the nailing group was 14.05 weeks, significantly shorter than the 16 weeks in the plating group. The mean range of knee flexion was 111° in the nailing group and 114.5° in the plating group. The average NEER score was 84.10 for the plating group and 83.30 for the nailing group. There was no statistically significant difference in functional outcomes between the two groups.

**Conclusion:** Both retrograde intramedullary nailing and the use of locking compression plates can be considered as suitable treatment options. Early weight-bearing can be initiated with retrograde nailing. No significant difference was observed in terms of outcome, fracture healing, or NEER score. The time taken for radiological union of fractures using both techniques was comparable. Proper operative planning, execution, and adherence to a strict rehabilitation protocol play crucial roles in the overall patient outcome.

**Keywords:** Distal femur nail, Implant, Neurovascular bundle

## INTRODUCTION

Distal femoral fractures comprise around 5% of all femur fractures [1]. They pose quite a challenge in terms of management. In young patients, high-energy trauma is mostly responsible for such fractures, while in older populations, low-energy trauma with underlying osteoporosis may be the cause [2]. Although in the past these fractures were treated conservatively, improved operative techniques and implants have made internal fixation the treatment of choice for such fractures [2]. The proximity of the fracture to the neurovascular bundle makes them more prone to injuries to the popliteal vessels. Commonly following high-energy trauma, there may be severe comminution and bone loss, making fracture fixation difficult. Even with the presence of modern equipment and techniques, the management of distal femur fractures still poses a challenge. Improved surgical intervention and implants have made internal fixation the treatment of choice for such fractures. These fractures are often associated with severe comminution and bone loss. The juxta-articular position of the fracture affects knee joint mobility. Thus, treatment of such fractures involves stable fixation, good physiotherapy, and gradual mobilisation exercises. Operative intervention is needed to maintain the anatomical reduction of the joint surface. The goal of management is anatomical reduction of the fracture, especially the intra-articular part, restoration of limb length, alignment, and rotation, and stable fixation that allows early mobility [2,3]. There are several options for fixation of such fractures. In this study, we have compared the outcome of such fracture fixation using the locking compression plate technique and retrograde nailing. The rationale of the study is to objectively understand the advantages and disadvantages of each method and help surgeons select the appropriate mode of surgery and implants for each specific type of fracture and patient profile. The present study aimed to compare the functional outcome of the stabilisation of distal femur fractures using locking compression plating vs. retrograde nailing. The objective of the study was to compare the merits and demerits of each procedure.

## MATERIALS AND METHODS

The study was conducted at Calcutta National Medical College and Hospital in West Bengal, India, for a period of one year (from January 2021 to January 2022). The design was a hospital-based

prospective comparative study, and the study population comprised patients admitted to the Department of Orthopaedics at Calcutta National Medical College and Hospital with distal femur fractures. The study was carried out on 46 patients over a period of 12 months after obtaining permission from the Institutional Ethics Committee (ERC/771/Inst/WB/2015/RR-18) under the New Drugs and Clinical Trials Rules, 2019, and after obtaining informed written consent from the patients. Six patients were lost to follow-up.

**Inclusion criteria:** The inclusion criteria for the study were:

1. Type A, Type B1, and Type C1 fractures of the distal femur according to the AO classification [2];
2. Patients of both gender aged above 18 years;
3. Gustilo-Anderson Type 1, 2, and 3a injuries [4].

**Exclusion criteria:**

1. Type B2, Type B3, and Type C2 and C3 distal femur fractures according to the AO classification [2];
2. Gustilo-Anderson Type 3b and 3c injuries, neurologically compromised patients, and associated neurovascular injuries [4];
3. Patients under 18 years of age;
4. Patients with head injuries, malignancies, or other long bone fractures;
5. Associated fractures of the patella.

**Data collection and interpretation:** Data were collected from patients brought to the Orthopaedic Emergency room or Outpatient Department with a chief complaint of pain and swelling in the distal thigh and around the knee. After stabilisation, a neurovascular examination was performed. Temporary limb stabilisation was done with either a long leg splint, skeletal traction, or a Bohler Browne splint. X-rays of the entire thigh, including the knee and hip joint, were taken in both anteroposterior and lateral views. A detailed history was obtained, and all necessary preoperative investigations were carried out. Surgeries were performed after obtaining the necessary consent. Patients were followed-up until union was achieved or delayed union was present. NEER's Functional Score was used to assess the patients after fracture union was achieved or after 36 weeks [5].

**Preoperative assessment:** Routine blood investigations, chest X-ray, Electrocardiogram (ECG), and echocardiography (when necessary) were performed. Surgical clearance was obtained. Packed red blood cell transfusions were administered as needed. Surgical limb preparation was conducted through antiseptic shaving and cleaning. Nail and plate sizes, as well as screw and bolt lengths, were determined with the assistance of X-rays.

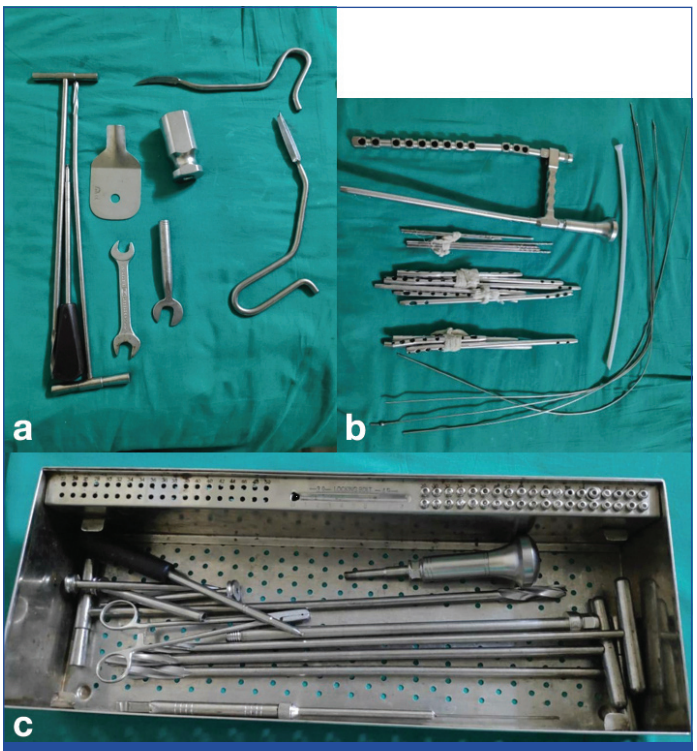
**Retrograde nailing technique:**

**Implant:** A Supracondylar nailing system was used [Table/Fig-1a-c] [2,3].

Fully cannulated stainless steel nails were used. Nail length varied from 22-30 cm, and diameter from 9-13 mm. The nail had an 8° anterior bend. The nail is designed so that the distal driving end may be countersunk below the femoral articular surface.

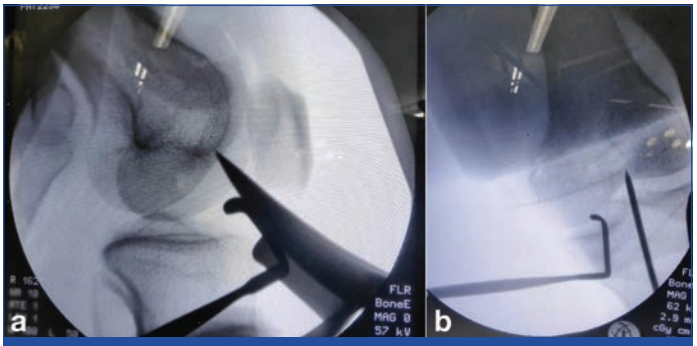
**Surgical steps [2,3,6]:** The patient was positioned supine on a radiolucent table with the knee flexed at 45-55° with a leg roll [Table/Fig-2].

Traction may be applied directly by pulling the gastrocnemius muscle or with the help of high tibial traction. A 5 cm infrapatellar incision was made for extra-articular fractures, while for intra-articular fractures, a medial parapatellar arthrotomy was performed, and anatomical reduction of the joint was achieved with interfragmentary screws. A 6.5 mm cancellous lag screw was used to stabilise the intercondylar split patterns (AO C1 type). After retracting the patellar tendon laterally, an entry portal for the nail was created medial to the mid-point of the intercondylar notch and anterior to the femoral attachment of the posterior cruciate ligament [Table/Fig-3a,b].




**[Table/Fig-1a-c]:** Supracondylar nail set.

**[Table/Fig-2]:** Patient position and draping for retrograde nailing.




**[Table/Fig-3a,b]:** Entry point for retrograde nailing checked in C-arm.

The threaded tip guide pin and cannulated drill are used to open up the femoral canal. The starting point is marked anterior to the Blumensaat line on the lateral view. A step reamer is used to prepare the entry site. An olive tip guide wire is then progressed with the help of a C-arm past the fracture site while maintaining reduction. The guidewire is placed centrally in both views of the fluoroscope. The canal is reamed with an incrementally increasing diameter of the reamer until the 'chatter' is heard, and the beaded guidewire is exchanged for a non olive tip one.

Appropriate nail length is determined and inserted [Table/Fig-4] so that the proximal end is up to the lesser trochanter. The nail apex angle is directed anteriorly. The distal end of the nail is countersunk. Distal bolts are applied with the help of the cannulated sleeve, while proximal bolts are placed using the free hand technique.

After thorough wound lavage, arthrotomy is performed, the patellar tendon is repaired, and the skin is sutured with non absorbable Ethilon. Appropriate dressing is then applied.

**[Table/Fig-4]:** Nail insertion.

### Distal Femoral Plating Technique:

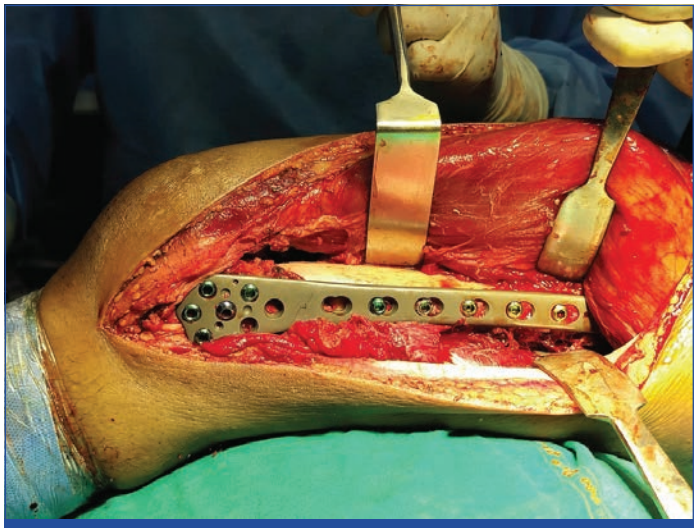
**Implant:** Combihole distal femoral locking plate with 4.0 mm and 5.0 mm locking screws was used [Table/Fig-5a-c] [2,3]. They are side-specific and manufactured from a stainless steel alloy. They are available in sizes ranging from 4 to 14 holes and are precontoured with soft edges.


**[Table/Fig-5a-c]:** Distal femur locking plate set.

**Surgical steps:** After adequate anaesthesia, the patient is positioned supine with a bolster under the affected thigh [Table/Fig-6] [2,3,7,8]. An extensile lateral approach or Swashbuckler approach is used, and a 10-15 cm long incision is made [Table/Fig-7]. The soft tissue and iliotibial band are dissected with necessary cauterisation. The lateral condyle is exposed, and the fracture site is accessed. The fracture ends are freshened, and with appropriate traction, the condylar fragment is aligned with the metaphyseal fragment. Intra-articular fracture reduction may be achieved with reduction clamps, and provisional fixation can be done with K-wires. The plate and jig assembly are then slid across the bone and held with K-wires. Reduction is confirmed and maintained with K-wires. The condyles are fixed with 6.5 mm locking cancellous screws. Non locking cortical screws are applied to the shaft followed by locking cortical screws with the help of the jig assembly [Table/Fig-8]. After satisfactory fixation, a thorough wash is performed, a drain is inserted, and the incision is closed in layers. A sterile, non bulky dressing is applied.

**[Table/Fig-6]:** Draping for distal femoral locking plate.

**[Table/Fig-7]:** Exposure for distal femoral locking plate.



**[Table/Fig-8]:** Distal femoral locking plate in-situ.

**Postoperative protocol [1-3,9]:** To achieve good knee range of motion, a strict rehabilitation protocol is followed. In the early phase of 1-3 weeks, the primary goal is to achieve full range of motion. Static and dynamic quadriceps exercises are started from postoperative day 2. Hip, knee, and ankle mobilisation are initiated. Suture removal is performed on the 14$^{th}$ day. Crutch support for non weight-bearing mobility is given at two weeks postoperative. After three weeks, partial weight-bearing is allowed. Patients are permitted to walk with toe-touching and crutch support. Full weight-bearing is allowed after radiological evidence of union is noted (6-12 weeks).

**Follow-up:** Follow-up is conducted at regular intervals. The first follow-up is done two weeks postoperative, followed by four and six weeks. Subsequently, the patient is followed-up monthly for the next three months and then every three months for the following year. During each visit, a skiagram of the affected thigh with the knee joint is obtained, and functional scoring is conducted with the help of the NEER scoring [Table/Fig-9] [5]. This scoring involves both clinical and investigative parameters and is rated out of 100. A score above 85 is considered excellent, between 70-85 is considered satisfactory, between 55-69 is considered unsatisfactory, and a score below 55 is deemed a failure.

## STATISTICAL ANALYSIS

For statistical analysis, the data were entered into a Microsoft Excel spreadsheet and then analysed using SPSS (version 27.0; SPSS

| Parameters | Score |
|---|---|
| **1. Pain** (20 points) | |
| • No Pain | 20 |
| • Intermittent pain | 16 |
| • Pain with fatigue | 12 |
| • Pain limiting function | 8 |
| • Constant pain or at night | 4-0 |
| **2. Walking capacity (20 Points)** | |
| • Same as before | 20 |
| • Mild restriction | 16 |
| • Restricted, stairs sideways | 12 |
| • Use crutches or other walking aids | 4-0 |
| **3. Joint movement (20 Points)** | |
| • Normal/135° | 20 |
| • Up to 100° | 16 |
| • Up to 80° | 12 |
| • Up to 60° | 8 |
| • Up to 40° | 4 |
| • Up to 20° | 0 |
| **4. Work capacity (10 Points)** | |
| • Same as before | 10 |
| • Regular, but with handicap | 8 |
| • Alter work | 6 |
| • Light work | 4 |
| • No work | 2-0 |
| **Parameters** | **Score** |
| **1. Gross anatomy** | |
| • Thickening only | 15 |
| • 5° angulation/0.5 cm shortening | 12 |
| • 10° angulation or rotation/2 cm shortening | 9 |
| • 15° angulation or rotation/3 cm shortening | 6 |
| • Healed with considerable deformity | 3 |
| • Non union/Chronic infection | 0 |
| **2. Roentgenogram** | |
| • Near normal | 15 |
| • 5° angulation/0.5 cm displacement | 12 |
| • 10° angulation/1.0 cm displacement | 9 |
| • 15° angulation/2.0 cm displacement | 6 |
| • Union but with greater deformity; spreading of condyles; osteoarthritis | 3 |
| • Non union/Chronic infection | 0 |
| Excellent | Above 85 |
| Satisfactory | 70-85 |
| Unsatisfactory | 55-69 |
| Failure | Below 55 |

**[Table/Fig-9]:** NEER score.

Inc., Chicago, IL, USA). The data were summarised as mean and standard deviation for numerical variables and count and percentages for categorical variables. Unpaired t-tests and Chi-square tests were used, and a p-value of ≤0.05 was considered statistically significant.

## RESULTS

In the present study, in the distal femoral locking plate group, the mean age was 55.5 years, while in the distal femoral nail group, the mean age was 53.2 years [Table/Fig-10]. There were a total of 40 participants, among whom 70% were male and 30% were female [Table/Fig-11]. Among the 40 patients, the most common mode of injury was a road traffic accident with 21 (52.5%) participants, followed by a fall from height with 7 (17.5%) participants [Table/Fig-12].

| Age (in years) | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) |
|---|---|---|
| Mean | 55.5 | 53.2 |
| Median | 55.0 | 54.0 |
| Range | 31-78 | 35-72 |

**[Table/Fig-10]:** Comparison of both groups according to age of the patients.

| Gender | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | Total (N=40) |
|---|---|---|---|
| Male | 13 (65.0%) | 15 (75.0%) | 28 (70.0%) |
| Female | 7 (35.0%) | 5 (25.0%) | 12 (30.0%) |
| Total | 20 (100.0%) | 20 (100.0%) | 40 (100.0%) |

**[Table/Fig-11]:** Comparison of both groups according to sex of the patients.

| Mode of Injury | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | Total (N=40) |
|---|---|---|---|
| Fall from height | 4 (20.0%) | 3 (15.0%) | 7 (17.5%) |
| Fall from vehicle | 2 (10.0%) | 3 (15.0%) | 5 (12.5%) |
| Physical assault | 2 (10.0%) | 0 | 2 (5.0%) |
| Road traffic accident | 9 (45.0%) | 12 (60.0%) | 21 (52.5%) |
| Slip and fall | 3 (15.0%) | 2 (10.0%) | 5 (12.5%) |
| Total | 20 (100.0%) | 20 (100.0%) | 40 (100.0%) |

**[Table/Fig-12]:** Comparison of both groups according to mode of injury.

In present study, it was found that in the distal femoral locking plate group, the mean postoperative duration of hospital stay was 4.35 days with a median duration of four days, while in the distal femoral nail group, the mean postoperative duration of hospital stay was 4.60 days with a median duration of 4.5 days [Table/Fig-13].

| Post-operative duration of hospital stay (in days) | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) |
|---|---|---|
| Mean | 4.35 | 4.60 |
| Median | 4.0 | 4.5 |
| Range | 3-9 | 3-9 |

**[Table/Fig-13]:** Comparison of both groups according to postoperative duration of hospital stay.

In present study, it was found that in the distal femoral locking plate group, the mean partial weight-bearing time was 6.0 weeks with a median of six weeks, and in the distal femoral nail group, the mean partial weight-bearing time was 4.6 weeks with a median of five weeks [Table/Fig-14]. There was a statistically significant difference between the mean times for partial weight bearing among the groups, as the p-value was <0.05. Partial weight bearing is defined as assisted weight bearing with crutches [2,3].

| Partial weight bearing (in weeks) | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | p-value |
|---|---|---|---|
| Mean | 6.0 | 4.6 | 0.009 |
| Median | 6.0 | 5.0 | |
| Range | 2-8 | 2-6 | |

**[Table/Fig-14]:** Comparison of both groups according to time for partial weight bearing.
Test applied- Student's unpaired t-test test and level of significance- p-value ≤0.05

In the distal femoral locking plate group, the mean time for radiological union was 16.0 weeks with a median of 16 weeks, while in the distal femoral nail group, the mean time for radiological union was 14.05 weeks with a median of 14 weeks [Table/Fig-15]. There was a statistically significant difference between the mean times for radiological union among the groups, as the p-value was <0.05.

In the distal femoral locking plate group, the mean degrees of knee flexion were 114.50 with a median of 1200, and in the distal femoral nail group, the mean degrees of knee flexion were 111.00 with a

median of 1150. There was no statistically significant difference between the mean degrees of knee flexion among the groups, as the p-value was >0.05 [Table/Fig-16].

In the distal femoral locking plate group, the mean NEER score was 84.10 with a median of 87.5, and in the distal femoral nail group, the mean NEER score was 83.30 with a median of 86.5. There was no statistically significant difference between the mean NEER scores among the groups, as the p-value was >0.05 [Table/Fig-17].

| Radiological union (in weeks) | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | p-value |
|---|---|---|---|
| Mean | 16.0 | 14.05 | 0.041 |
| Median | 16.0 | 14.0 | |
| Range | 8-20 | 8-18 | |

**[Table/Fig-15]:** Comparison of both groups according to radiological union and full weight-bearing.

| Knee flexion (in degree) | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | p-value |
|---|---|---|---|
| Mean | 114.50 | 111.00 | 0.452 |
| Median | 120.0 | 115.0 | |
| Range | 80-130 | 80-130 | |

**[Table/Fig-16]:** Comparison of both groups according to degree of knee flexion.
Test applied- Student's Unpaired t-test test and level of significance- p-value ≤0.05

| NEER score | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | p-value |
|---|---|---|---|
| Mean | 84.10 | 83.30 | 0.835 |
| Median | 87.5 | 86.5 | |
| Range | 48-100 | 56-100 | |

**[Table/Fig-17]:** Comparison of both groups according to NEER Score tested with student unpaired t-test.
Test applied- Student's unpaired t-test test and level of significance- p-value ≤0.05

In the distal femoral locking plate group, 55% had an excellent NEER score, 35% had a satisfactory NEER score, while in the distal femoral nail group, 55% had an excellent NEER score, and 30% had a satisfactory NEER score. There was no statistically significant difference between the groups, as the p-value was >0.05 [Table/Fig-18].

| NEER score rating | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | p-value |
|---|---|---|---|
| Excellent | 11 (55.0%) | 11 (55.0%) | 0.665 |
| Satisfactory | 7 (35.0%) | 6 (30.0%) | |
| Unsatisfactory | 1 (5.0%) | 3 (15.0%) | |
| Failure | 1 (5.0%) | 0 | |
| Total | 20 (100.0%) | 20 (100.0%) | |

**[Table/Fig-18]:** Comparison of both groups according to NEER score rating.
Test applied- Chi-square test and level of significance- p-value ≤0.05

In the distal femoral locking plate group, superficial infection was present in 30%, while in the distal femoral nail group, superficial infection was present in 5%. Superficial infections were significantly higher in the distal femoral locking plate group, as the p-value is <0.05 [Table/Fig-19]. Patients who presented with superficial infection had to undergo debridement under anaesthesia followed by intravenous antibiotics for seven days. They responded well to this treatment.

| Complications | Distal femoral plate group (n=20) | Distal femoral nail group (n=20) | p-value |
|---|---|---|---|
| Superficial infection | 6 (30.0%) | 1 (5.0%) | 0.037 |
| Nil | 14 (70.0%) | 19 (95.0%) | |
| Total | 20 (100.0%) | 20 (100.0%) | |

**[Table/Fig-19]:** Comparison of both groups according to complications.
Test applied- Chi-square test and level of significance p-value ≤0.05

## DISCUSSION

The management of distal femoral fractures has been a topic of debate for the past decade [10-13]. While non surgical treatment was advocated in the 1970s, nowadays operative intervention is the treatment of choice for anatomical reduction. This approach helps in early mobilisation and weight-bearing.

Open reduction with internal fixation can be achieved with the help of many implants available nowadays, such as angled blade plates, Enders nails, dynamic condylar screw, condylar buttress plates, interlocking nails, and condylar locking compression plates.

Retrograde nailing for the treatment of distal femur fractures has been developed to address some of the previous problems associated with this injury. Henry SL reported that due to its intramedullary position, retrograde nails have an advantage over conventional laterally placed devices as the intramedullary position reduces the lever arm, thereby reducing varus and valgus angulation [14].

On the other hand, distal femoral locking plates increase the rigidity of fixation in osteoporotic bones and provide a more stable fixation for periarticular and juxta-articular comminutions [15]. Distal femoral locking plates provide multiple points of fixed plate-to-screw contact, creating a more stable construct that prevents varus collapse [16]. The locking plate decreases the screw-plate toggle motion at the bone-screw interface, thereby providing a more rigid fixation [15,17-19].

In the current study, it was found that 70% of the patients were male, with average ages of 55.5 years and 53.2 years for the distal femoral plating and distal femoral nailing groups, respectively, resulting in a total average age of 54.35. Similar results were reported in a study by Gellman RE et al., [20], where the average age was 50 years with a range from 26 to 84 years.

According to the study by Gellman RE et al., trauma accounted for 63% of the cases, while a study by Schatzker J et al., reported that 58% of cases were due to trauma. In the current study, road traffic accidents accounted for 52.5% of cases, and falls from height accounted for 17.5% of cases [20,21].

In present study, the average time for union was 16 weeks for plating and 14.05 weeks for nailing. Radiological union is defined as bridging callus in three cortices [1]. In a study by Shroff AS et al., the average time for union was 15 weeks for plating and 13 weeks for nailing [1]. In studies by Henderson CE et al., and Markmiller M et al., the average time for union in cases of distal femoral plating was 12 and 14 weeks, respectively [22,23]. In studies by Gellman RE et al., Kumar A et al., and Ingman AM, the average time for radiological union after nailing was 12, 14, and 12 weeks, respectively [20,24,25].

In a study by Shroff AS et al., knee range of motion was found to be 112° of flexion following management by distal femoral nailing and 107° following distal femoral plating [1]. In studies by Collinge CA and Wiss DA, Gellman RE et al., and Kumar A et al., knee flexion was reported as 104°, 106°, and 100°, respectively, after nailing [2,20,24]. Kregor PJ et al., Schütz M et al., and Markmiller M et al., reported knee flexion as 103°, 107°, and 110° following the plating procedure [23,26,27]. In present study, it was found that the average knee flexion was 114.5° in the plating group and 111.0° for the nailing group. The difference was not statistically significant.

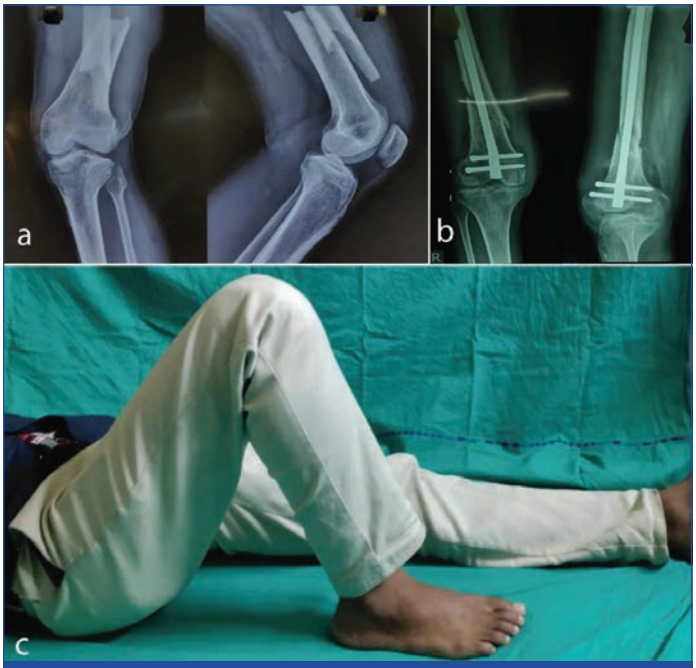
In present study, the NEER score was used to evaluate the outcome of the operative technique. An excellent result was obtained in 55% of cases for both groups, with a satisfactory result obtained in 35% of cases for the plating group and 30% for the nailing group in NEER Scoring. In a study by Jillala SR et al., they obtained a satisfactory outcome in 46.4% of cases and 34.6% of cases for the nailing and plating groups, respectively, according to the NEER Score [9].

The clinical outcomes of the treatment protocols in present study were presented in the following four cases. A 25-year-old female suffered a distal femur fracture due to a road traffic accident. The preoperative radiograph showed an AO C1 type fracture

[Table/Fig-20a]. She was treated with a distal femur locking plate. Postoperative check radiograph and radiograph obtained after six months of follow-up [Table/Fig-20b] were satisfactory. The knee range of motion was satisfactory [Table/Fig-20c].


**[Table/Fig-20]:** a) Preoperative radiograph showing AO C1 type distal femur fracture. b) Radiograph after six months follow-up. c) Knee range of motion after six months follow was found satisfactory.

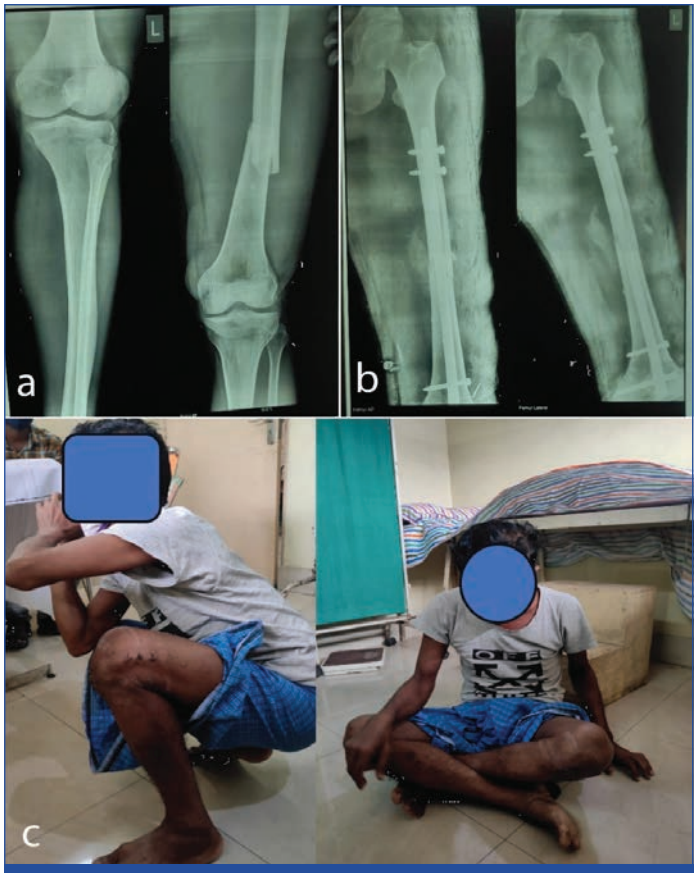
The second case involved a 22-year-old male who suffered a distal femur fracture due to a road traffic accident. The preoperative radiograph showed an AO A1 type fracture [Table/Fig-21a]. He was treated with a distal femur nail. Postoperative check radiograph and radiograph obtained after six months of follow-up [Table/Fig-21b] were satisfactory. The knee range of motion was satisfactory [Table/Fig-21c].




**[Table/Fig-21]:** a) Preoperative radiograph showing AO A1 type distal femur fracture. b) Check radiograph after 6 months follow-up. c) Satisfactory knee range of motion obtained after 6 months follow-up.

Another case was a 42-year-old male who suffered a distal femur fracture due to a fall. The preoperative radiograph showed an AO A1 type fracture [Table/Fig-22a]. He was treated with a distal femur nail. Postoperative check radiograph and radiograph obtained after six months of follow-up [Table/Fig-22b] were satisfactory. The knee range of motion was satisfactory [Table/Fig-22c].

Additionally, a 51-year-old female who suffered a distal femur fracture due to a fall was treated, and the preoperative radiograph showed an AO A1 type fracture [Table/Fig-23a]. She was treated with a distal femur locking plate. Postoperative check radiograph




**[Table/Fig-22]:** a) Preoperative radiograph showing AO A1 type distal femur fracture. b) Radiograph after 6 months follow-up. c) Satisfactory knee range of motion obtained after 6 months follow-up.

and radiograph obtained after six months of follow-up [Table/Fig-23b] were satisfactory. The knee range of motion was satisfactory [Table/Fig-23c].


**[Table/Fig-23]:** a) Preoperative radiograph showing AO A1 type distal femur fracture. b) Radiograph after 6 months follow-up. c) Satisfactory knee range of motion obtained after 6 months follow-up.

Implant failure was noted in 3.4% of cases by Ogbemudia AO and Umebese PFA in the nailing group, while in the plating group, Kregor PJ et al., observed a failure in 1.5% of cases [26,28]. In present study, according to the NEER Score, a 5% failure rate was noted in the plating group, while no failures were noted in the nailing group.

Distal femur fractures are complicated fractures that are the subject of debate. While conservative management was advocated in the past, surgical intervention is now the treatment of choice, and both distal femur locking plates and retrograde nailing techniques may be used. Good surgical planning, accurate articular reduction, and stable fixation are necessary for a good outcome. Postoperative rehabilitation plays an important role in the patient's recovery.

### Limitation(s)

The sample size of the study was small, and it was a single hospital-based study, so generalisation of the results was not possible. The delay in the availability of implants due to the COVID-19 situation resulted in delayed surgeries, affecting the outcome of the study. The present study helps us understand each mode of treatment in greater depth and thus helps us select the appropriate treatment for patients and fracture patterns. Furthermore, present study provides a baseline that will help compare future implants with existing ones.

## CONCLUSION(S)

Distal femur fractures are complex fractures resulting from high-velocity injuries commonly occurring in middle-aged people. Both retrograde intramedullary nailing and the use of locking compression plates may be considered as adequate treatment options. Early weight-bearing may be started with retrograde nailing. No significant difference was noted in terms of outcomes, fracture healing, or NEER score. The time taken for radiological union of the fracture for both techniques was comparable. Both operative techniques require correct operative planning and surgical expertise to avoid re-surgery. Postoperative rehabilitation and exercise play an important role in the return of proper joint functioning. Thus, it can be concluded that both techniques may be used for the treatment of distal femoral fractures if correct operative methods and postoperative protocols are followed. Satisfactory results with good knee range of motion may be obtained by either method.

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