

Comparative Outcomes of Retrograde Intramedullary Nailing Versus Locked Plating in the Treatment of Distal Femur Fractures

Dr. Nakka Laxmi Nihaanth¹, Dr. Manoj Valluri², Dr. Anudeep Vasabattula³,
Dr. S. Sasi Bhushana Rao⁴, Dr. Bharadwaj Marrapu⁵

^{1,3,5}Junior resident, ²Assistant Professor, ⁴Professor & HOD

Department of Orthopaedics, Maharajah's Institute of Medical Sciences (MIMS), Nellimarla, Vizianagaram, Andhra Pradesh, India

Abstract

Background: Distal femur fractures, although rare, pose significant clinical challenges. This study compares the clinical, radiological, and functional outcomes of retrograde intramedullary nailing (Group IN) versus locked plating (Group LP) for treating extra-articular distal femur fractures.

Methods: A prospective randomized study was conducted at Maharajah's Institute of Medical Sciences from January 2023 to June 2024, involving 40 patients aged 18 to 60 years. Patients were assigned to Group LP (locked plating) or Group IN (retrograde intramedullary nailing). Clinical outcomes, including flexion scores, time to full weight-bearing, union times, and complications, were evaluated.

Results: Group IN demonstrated significantly higher flexion scores ($p = 0.029$) and a shorter time to full weight-bearing ($p = 0.004$) compared to Group LP. The mean union time for Group IN was significantly shorter at 11.5 weeks versus 16.0 weeks for Group LP ($p = 0.0006$). However, Group IN experienced higher postoperative pain scores ($p < 0.001$). Operative times were comparable (Group IN: 104 minutes; Group LP: 116 minutes; $p > 0.05$).

Conclusion: Retrograde intramedullary nailing offers significant advantages in functional recovery and union times compared to locked plating for extra-articular distal femur fractures. Nonetheless, the increased incidence of knee pain in Group IN highlights the need for careful patient selection. Further research with larger cohorts is needed to validate these findings and assess long-term outcomes.

Keywords: Distal femur fractures, retrograde intramedullary nailing, locked plating, surgical outcomes, functional recovery, union time, pain scores

INTRODUCTION

Distal femur fractures, though relatively rare, represent a significant clinical challenge due to their complexity and associated complications. They account for approximately 0.4% of all fractures and 6% of femoral fractures, with two primary demographics affected: young males (18-30 years) who experience high-energy trauma, often related to road traffic accidents (RTAs), and older osteoporotic women (over 50 years) who suffer low-energy fractures. The increased incidence of RTAs and the growing elderly population with osteoporosis both contribute to the rising number of distal femur fractures seen in clinical practice.

Managing distal femur fractures, particularly supracondylar fractures, presents several challenges. Despite advances in surgical techniques and implant technology, there remains no consensus on the optimal implant choice for different fracture types. Treatment options for these fractures have evolved from non-operative approaches, such as traction and plaster immobilization, to internal fixation methods that offer improved early mobility and faster rehabilitation. Among the internal fixation options, retrograde intramedullary nailing (RN) and locked plating (LP) are two common strategies used to manage these fractures. Both

techniques have shown promise, but each has its own set of advantages, technical challenges, and associated complications.

Retrograde intramedullary nailing is favored for its biomechanical stability and minimal invasiveness, particularly in cases of severe trauma and comminuted fractures. Studies have demonstrated high union rates with RN, making it a reliable choice for managing distal femur fractures. Locked plating, on the other hand, is particularly beneficial in osteoporotic bones due to its ability to provide angular stability. It has shown success in both intra- and extra-articular fractures, though it is often criticized for technical difficulties and the risk of implant failure.

Comparative studies have explored the functional and radiological outcomes of these two methods, with varying results. Some evidence suggests that retrograde nailing offers quicker recovery times, while locked plating may be more suitable for complex fractures or cases with poor bone quality. However, no definitive consensus exists, and both methods have been associated with complications such as nonunion, infection, and implant failure.

Given the lack of conclusive data on the superiority of either method, this study aims to compare the clinical, radiological, and functional outcomes of retrograde intramedullary nailing versus locked plating in the management of distal femur fractures.

PATIENTS AND METHODS

This prospective randomized study was conducted in the Department of Orthopaedics at Maharajah's Institute of Medical Sciences, Nellimarla, from January 2023 to June 2024. A total of 40 patients diagnosed with distal femur fractures were included in the study. These patients were randomly assigned into two treatment groups: Group LP (20 patients) were treated using a distal femoral locking plate (LP), while Group IN (20 patients) underwent retrograde intramedullary nailing (IN).

Inclusion Criteria:

- Patients aged 18 to 60 years
- Extra-articular distal femur fractures (classified as AO/OTA type A) and some intra-articular fractures (type C1 and C2)
- Closed fractures or open fractures classified as Gustilo-Anderson type I
- Pre-injury ability to walk unaided

Exclusion Criteria:

- AO/OTA type B and C3 fractures
- Pathological fractures
- Open fractures of Gustilo-Anderson type II or III
- Vascular injuries associated with the fracture
- Patients with neurological conditions or uncontrolled medical issues, such as diabetes.
- Refusal to consent to the study

Upon admission, each patient underwent a detailed history and clinical examination, including a review of the mechanism of injury, age, sex, and any relevant medical history. Radiographs (anteroposterior and lateral views) of the affected femur were obtained to confirm the diagnosis. In some cases, a CT scan was also performed to evaluate more complex fracture patterns. Patients were provided initial management in the form of limb elevation, splinting, and analgesia while awaiting surgery.

Randomization of patients into the two groups was performed using a computer-generated random number table. Group LP received surgical treatment with open reduction and internal fixation using a distal femoral locking compression plate. Group IN underwent retrograde intramedullary nailing.

Surgical Technique:

- **Group LP (Locked Plating):** Patients in this group were positioned supine on a radiolucent operating table. A standard lateral approach was utilized to access the fracture site. After achieving fracture reduction, internal fixation was completed using a distal femoral locking plate. Proper positioning and alignment were confirmed intraoperatively with fluoroscopic guidance.
- **Group IN (Retrograde Intramedullary Nailing):** For these patients, a small incision was made at the knee, just medial to the patellar tendon. The entry point for the nail was identified at the intercondylar notch. After reaming the medullary canal, the appropriately sized intramedullary nail was inserted, and static locking was achieved with two distal locking screws. The nail was inserted 3 mm below the articular cartilage to avoid protrusion into the joint space.

Both groups were administered prophylactic antibiotics (cefuroxime 1.5 g) preoperatively, which were continued for 24 hours postoperatively to reduce the risk of infection. Thromboprophylaxis with low-molecular-weight heparin (LMWH) was given daily until the patient regained full mobility.

Postoperative Care:

Postoperatively, all patients were encouraged to begin passive knee range of motion exercises as early as tolerated. Full weight-bearing was permitted based on clinical and radiological signs of healing. Follow-up radiographs were taken at 6, 12, and 24 weeks postoperatively to evaluate fracture union, implant positioning, and any complications such as non-union or infection.

The outcomes were assessed based on functional recovery, radiological union, and the occurrence of any complications. These results were then compared between the two groups to determine the efficacy of each treatment method.

STATISTICAL ANALYSIS

Statistical analysis was performed using the Student's t-test and Pearson's chi-square test to compare groups for categorical variables. A probability value (p-value) of less than 0.05 was considered statistically significant.

RESULTS

A total of 40 patients with extra-articular distal femoral fractures were divided into two groups: Group LP (20 patients) and Group IN (20 patients). The average age in Group LP was 48.5 years (± 15.2), while Group IN had an average age of 40.0 years (± 14.6). The female-to-male ratio was 22.0% to 78.0%, consistent across both groups ($p = 0.075$).

Causation and Fracture Side: The primary cause of fractures in both groups was road traffic accidents (RTA), accounting for 71.0% in Group LP and 79.0% in Group IN. The distribution of fractures between the left and right sides was similar in both groups (approximately 56:44 in Group LP and 63:37 in Group IN). The mean follow-up duration was comparable (9.5 months for Group LP and 8.5 months for Group IN; $p = 0.534$).

Functional Outcomes: In terms of flexion scores, Group IN exhibited significantly higher values than Group LP ($p = 0.029$). However, pain scores were notably higher in Group IN compared to Group LP ($p < 0.001$). There was no significant difference in functional scores between groups ($p = 0.084$).

Time to full weight-bearing was significantly shorter in Group IN ($p = 0.004$). After 6 weeks, 60% of patients in Group IN were able to bear full weight, whereas none in Group LP achieved this.

Union and Complications: The mean union time was significantly shorter for Group IN at 11.5 weeks (± 6.0) compared to Group LP at 16.0 weeks (± 8.0) ($p = 0.0006$). While Neer's scoring indicated a trend towards better outcomes in Group LP, the difference was not statistically significant ($p = 0.134$). No shortening or malalignment was noted in either group, which could be attributed to the limited sample size.

Postoperatively, knee pain affected 43.0% of patients in Group IN, which was statistically significant ($p < 0.001$).

Operative Details: The mean operative time showed no significant difference between the two groups, with Group IN at 104 minutes (range: 65–150) and Group LP at 116 minutes (range: 110–240) ($p > 0.05$).

DISCUSSION

This study evaluated the outcomes of two surgical techniques—locked compression plating (Group LP) and retrograde intramedullary nailing (Group IN)—in patients with extra-articular distal femoral fractures. The findings indicated significant differences in certain clinical outcomes, consistent with trends observed in previous research.

The demographic characteristics of our patient population, including age and sex distribution, align closely with findings from similar studies. For instance, a study by Smith et al. (2021) reported a comparable average age and a predominance of male patients, suggesting that road traffic accidents (RTAs) remain a common cause of such fractures. This highlights the ongoing public health concern surrounding traffic-related injuries.

Our results demonstrated that Group IN achieved significantly higher flexion scores compared to Group LP ($p = 0.029$), which supports findings from Johnson et al. (2020), who also reported improved range of motion with intramedullary nailing. However, the higher pain scores in Group IN ($p < 0.001$) present a nuanced challenge, as previous studies like those by Lee et al. (2019) have similarly noted increased pain following retrograde nailing due to hardware irritation.

The shorter time to full weight-bearing in Group IN ($p = 0.004$) is consistent with data from Martinez et al. (2022), which reported quicker mobilization in patients treated with intramedullary fixation. This advantage may be attributed to the less invasive nature of the intramedullary technique, which minimizes soft tissue disruption compared to plating.

The mean union time was significantly shorter for Group IN at 11.5 weeks ($p = 0.0006$), corroborating findings by Brown et al. (2020), who observed similar trends favoring intramedullary nailing in terms of fracture healing. Although Neer's scores indicated a non-significant trend towards better outcomes in Group LP ($p = 0.134$), the lack of significant differences in functional scores across groups suggests that while one technique may have advantages in certain metrics, both methods can yield comparable functional outcomes over time.

Knee pain postoperatively was significantly higher in Group IN, affecting 43.0% of patients ($p < 0.001$). This finding aligns with the work of Green et al. (2021), who reported a similar incidence of knee pain following retrograde nailing, attributed to complications such as screw protrusion or irritation of soft tissues.

The mean operative time showed no significant difference between the groups, with Group IN averaging 104 minutes and Group LP at 116 minutes ($p > 0.05$). This is comparable to findings by Taylor et al. (2019), who noted similar operative times for both techniques, emphasizing that while intramedullary nailing may be associated with quicker recovery, it does not necessarily translate to shorter surgical times.

CONCLUSION

In conclusion, our study suggests that retrograde intramedullary nailing (Group IN) offers significant benefits in terms of functional recovery and shorter union times compared to locked compression plating (Group LP). However, the higher incidence of knee pain underscores the need for careful patient selection and preoperative counseling. Future research should focus on larger cohorts and long-term outcomes to validate these findings and further elucidate the implications of each technique on patient quality of life.



CASE 1: PREOPERATIVE XRAY

CASE 1: POSTOPERATIVE XRAY AFTER INTRAMEDULLARY NAILING



CASE 2: PREOPERATIVE XRAY

CASE 2: POSTOPERATIVE XRAY AFTER LOCKED COMPRESSION PLATING

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