

# Comparative Evaluation of Retrograde Intramedullary Nailing and Locked Compression Plating in Distal Third Femur Fractures: A Prospective Study

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## Abstract

**Background:** Distal third femur fractures are complex injuries with significant functional implications. Surgical fixation is the standard approach, with retrograde intramedullary nailing and locked compression plating being the most widely used techniques. This study compared clinical, radiological, and functional outcomes between the two methods. **Material and Methods:** A prospective comparative study was conducted on 30 patients (18–80 years) with distal third femur fractures admitted to Government medical college and General Hospital, Mancherial, from June 2022 to July 2025. Patients were randomized into two groups: retrograde nailing (n=15) and locked compression plating (n=15). Demographic details, comorbidities, and lifestyle factors were documented. Clinical and radiological outcomes were assessed preoperatively and postoperatively, with follow-up at 3, 6, and 9 months. Complications including infection, non-union, mal-union, stiffness, and arthritis were also recorded. Statistical analysis was performed using SPSS v21, with  $p < 0.05$  considered significant. **Results:** Both groups were comparable in baseline demographics and comorbidities. Postoperative clinical and radiological scores showed no significant difference initially. At 3 and 6 months, plating achieved significantly higher clinical outcome scores ( $p < 0.05$ ), whereas retrograde nailing yielded superior radiological scores at the same intervals ( $p < 0.05$ ). By the 9th month, outcomes were comparable in both groups. Complications were minimal, though slightly higher in the plating group. Retrograde nailing demonstrated fewer infections and better union trends. **Conclusion:** Retrograde nailing offers superior radiological healing and fewer complications, while locked plating provides better short-term clinical function. Both are effective and reliable modalities for distal third femur fracture management.

**Keywords:** Distal femur fracture; Retrograde intramedullary nailing; Locked compression plating; Clinical outcomes; Radiological outcomes; Complications.

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## INTRODUCTION

Fractures involving the distal third of the femur constitute nearly 7% of all femoral fractures and remain among the most difficult injuries to manage in orthopaedic trauma care.<sup>[1]</sup> Their complex anatomy, close relation to the knee joint, and frequent occurrence with comminution or osteoporotic bone make anatomical reduction and stable fixation particularly challenging. These fractures often affect two distinct populations: young adults, where high-energy trauma such as road traffic accidents is the predominant cause, and elderly individuals, where low-energy falls in the context of reduced bone quality are more common.<sup>[2]</sup> Regardless of the etiology, failure to provide timely and appropriate treatment may result in complications such as malunion, joint stiffness, delayed union, and post-traumatic arthritis, which significantly compromise functional recovery and quality of life.<sup>[3]</sup>

Over the years, operative fixation has become the gold standard for distal femur fractures, replacing conservative methods due to its superior ability to restore alignment, allow early mobilization, and reduce morbidity.<sup>[4]</sup> Several fixation techniques have been described, but two remain most widely

practiced: retrograde intramedullary nailing (RIN) and locked compression plating (LCP). RIN provides a minimally invasive, load-sharing construct that preserves the periosteal blood supply and facilitates earlier rehabilitation, whereas LCP offers rigid fixation, superior angular stability, and greater control in osteoporotic bone or highly comminuted fractures.<sup>[5]</sup>

Despite these theoretical advantages, the clinical and radiological outcomes reported in the literature are variable, and both techniques have demonstrated distinct benefits and limitations across different patient populations and fracture patterns. Union rates have generally been found to be comparable, yet differences in complication rates, functional outcomes, and radiological

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healing continue to generate debate in orthopaedic practice.<sup>[6]</sup> In light of these uncertainties, this prospective comparative study was undertaken to assess and directly compare the clinical, radiological, and functional outcomes, along with the complication profile, of patients with distal third femur fractures managed using retrograde intramedullary nailing versus locked compression plating.

**MATERIALS AND METHODS**

**Study Design and Setting:** This prospective comparative study was conducted in the Department of Orthopaedics, Government Medical College and General Hospital, Mancherla, Telangana. The study period was from June 2022 to July 2025. Ethical clearance was obtained from the Institutional Ethics Committee prior to initiation of the study, and informed consent was obtained from all participants.

**Study Population:** A total of 30 patients aged between 18 and 80 years with distal third femur fractures were enrolled. Patients were randomly allocated into two groups:

Group A (n=15): Managed with retrograde intramedullary nailing

Group B (n=15): Managed with locked compression plating

**Inclusion Criteria:**

- Patients aged ≥18 years with closed distal third femur fractures
- Fractures classified as extra-articular or partial articular (AO/OTA classification)
- Willingness to participate and provide follow-up data

**Exclusion Criteria:**

- Pathological fractures
- Periprosthetic distal femur fractures
- Patients with severe comorbidities precluding surgery
- Open grade III fractures with gross contamination

**Preoperative Evaluation:** Baseline demographic data, history of smoking, alcohol intake, diabetes mellitus, and hypertension were recorded. Standard investigations included complete blood picture, bleeding and clotting time, random blood sugar, and renal function tests. Radiographic evaluation was performed in anteroposterior and lateral views to classify fractures.

**Surgical Technique:** Retrograde nailing: A midline incision below the patella was used, with entry through the intercondylar notch under fluoroscopic guidance. Nails were inserted after canal preparation and locked proximally and distally.

Locked compression plating: A lateral approach to the distal femur was performed, with anatomical reduction of fragments followed by fixation using precontoured plates and locking screws.

**Postoperative Care and Follow-up:** Patients received intravenous antibiotics, analgesics, and physiotherapy. Knee mobilization and quadriceps strengthening exercises were initiated within 48 hours postoperatively. Partial weight bearing was advised after 6 weeks, and full weight bearing after 12 weeks, depending on radiological evidence of union.

**Outcome Assessment:** Clinical evaluation: Functional outcomes were assessed using standardized clinical scores (Knee Society Score, ROM).

**Radiological evaluation:** Union was assessed by cortical continuity and disappearance of fracture lines.

**Follow-up:** Outcomes were measured at 4 weeks, 3 months, 6 months, and 9 months.

**Statistical Analysis:** Data were entered in Microsoft Excel and analyzed using SPSS version 21.0. Continuous variables were expressed as mean ± standard deviation and compared using Student’s t-test. Categorical variables were analyzed using Chi-square test. A p-value <0.05 was considered statistically significant.

**RESULTS**

A total of 30 patients with distal third femur fractures were enrolled in this comparative prospective study and were randomized into two equal groups: retrograde nailing (n=15) and locked compression plating (n=15).

**Demographic and Baseline Characteristics:** The mean age of patients in both groups was 58.38 ± 8.98 years, with a male predominance (66.7%). The distribution of gender, smoking habits, alcohol consumption, diabetes, and hypertension did not show statistically significant differences between the two groups (p > 0.05) [Table 1].

**Table 1: Demographic Characteristics**

Variable	Retrograde Nailing (n=15)	Locked Compression Plating (n=15)	p-value
Mean Age (years)	58.38 ± 8.98	58.38 ± 8.98	NS
Gender (Male/Female)	10 / 5	10 / 5	NS
Smoking history (%)	Comparable	Comparable	>0.05
Alcohol history (%)	Comparable	Comparable	>0.05
Diabetes (%)	Comparable	Comparable	>0.05
Hypertension (%)	Comparable	Comparable	>0.05

**Clinical and Radiological Scores at Baseline and Post-operation:** Preoperative and postoperative clinical and radiological scores were comparable between the retrograde

nailing and locked plating groups. No significant difference was observed in either clinical or radiological scores immediately after surgery [Table 2, Figure 1].

**Table 2: Pre- and Post-operative Clinical & Radiological Scores**

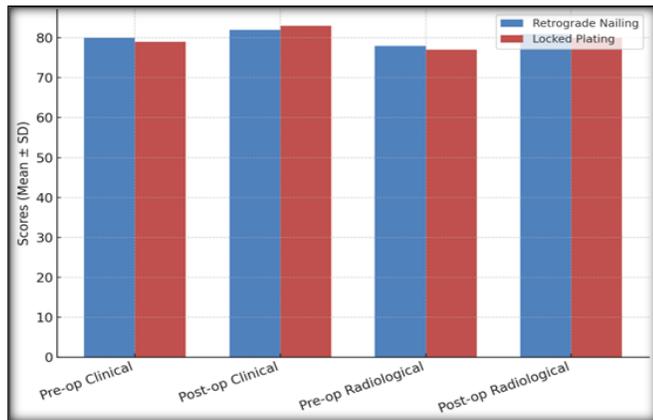
Outcome	Retrograde Nailing	Locked Plating	p-value
Pre-op Clinical Score	Comparable	Comparable	NS
Post-op Clinical Score	Comparable	Comparable	NS
Pre-op Radiological Score	Comparable	Comparable	NS
Post-op Radiological Score	Comparable	Comparable	NS

**Clinical Outcomes During Follow-up:** At the 3rd and 6th months of follow-up, patients treated with locked compression plating demonstrated significantly higher clinical outcome scores compared with those treated with

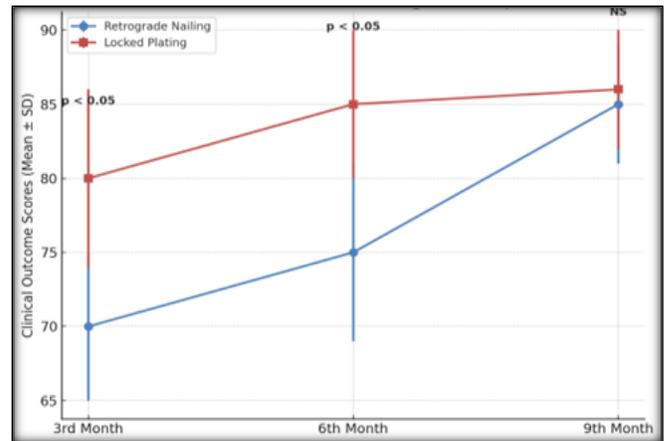
retrograde nailing ( $p < 0.05$ ). However, by the 9th month, both groups showed comparable clinical outcomes, with no significant differences [Table 3, Figure 2].

**Table 3: Clinical Outcomes During Follow-up**

Follow-up Interval	Retrograde Nailing	Locked Plating	p-value
3rd Month Clinical Score	Lower	Higher	<0.05
6th Month Clinical Score	Lower	Higher	<0.05
9th Month Clinical Score	Comparable	Comparable	NS



**Figure 1: Pre and Post operative Clinical and Radiological Scores**



**Figure 2: Clinical Outcomes During Follow-up**

**Table 4: Radiological Outcomes During Follow-up**

Follow-up Interval	Retrograde Nailing (Mean Score)	Locked Plating (Mean Score)	Significance
3rd Month	Higher	Lower	Significant
6th Month	Higher	Lower	Significant
9th Month	Comparable	Comparable	NS

**Radiological Outcomes During Follow-up:** Radiological assessment revealed that retrograde nailing was associated with significantly higher mean radiological scores at the 3rd

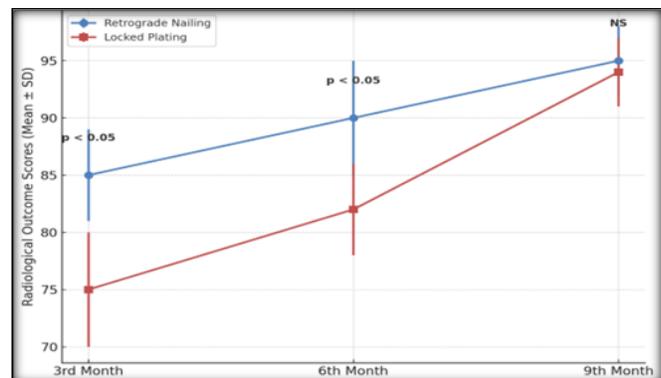
and 6th months compared to locked plating ( $p < 0.05$ ). At the 9th month, both groups achieved comparable radiological outcomes [Table 4].

**Table 5. Complications**

Complication	Retrograde Nailing (%)	Locked Plating (%)
Infection	Minimal	Slightly higher
Non-union	Rare	Rare
Mal-union	Low	Slightly higher
Knee stiffness	Comparable	Comparable
Arthritis	Minimal	Comparable

**Complications:** Complications were minimal in both groups. The incidence of infection, mal-union, and arthritis was slightly higher in the plating group, whereas retrograde nailing showed fewer adverse events. Non-union and knee stiffness were rare and comparable across groups [Table 5].

**Overall Outcomes:** Overall, retrograde nailing demonstrated superior radiological outcomes and fewer complications, whereas locked compression plating yielded better mid-term clinical scores. Both techniques, however, achieved satisfactory union and functional recovery at the final follow-up.



**Figure 3: Radiological Outcomes During Follow-up**

## DISCUSSION

Distal third femur fractures continue to present therapeutic challenges due to their anatomical complexity, association with osteoporosis, and high risk of functional disability. In the present study, retrograde intramedullary nailing and locked compression plating were compared with respect to clinical, radiological, and complication outcomes.

Our findings demonstrated that both groups had comparable baseline characteristics, ensuring minimal confounding. Early postoperative outcomes were similar, but locked compression plating showed superior clinical scores at 3 and 6 months. However, by the ninth month, both groups achieved equivalent functional recovery. These results are in line with the meta-analysis by Neradi et al., who reported no significant long-term differences between locked plating and retrograde nailing, though early outcomes varied.<sup>[7]</sup> Similarly, Shah et al. observed that plating provided improved early functional recovery, whereas intramedullary nails were advantageous for radiological union.<sup>[8]</sup>

Radiological outcomes in our study favored retrograde nailing at 3 and 6 months, likely due to its load-sharing biomechanics that enhance callus formation. This observation is consistent with the multicenter work of De Mauro et al., who found that construct selection influences alignment and radiological healing, with combined constructs often showing improved union.<sup>[9]</sup> Biomechanical reviews have further highlighted that nail-plate constructs offer synergistic benefits, balancing stability and biological healing.<sup>[10]</sup>

Complications in our cohort were low overall, but infection and malunion were slightly higher in the plating group. Garala et al. reported similar findings, noting that combined constructs reduced nonunion compared to plating alone.<sup>[11]</sup> Liporace et al. also emphasized the role of linked nail-plate constructs in enhancing stability and reducing complications, particularly in osteoporotic bone.<sup>[12]</sup> Saraglis et al. extended these findings to elderly patients, showing that nail-plate constructs achieved superior functional outcomes and quality of life measures.<sup>[13]</sup> Moreover, Kong et al. highlighted that fracture pattern whether native or periprosthetic further influences complication rates and should guide the choice of fixation.<sup>[14]</sup>

Taken together, these studies and our present findings suggest that while locked plating ensures short-term functional stability, retrograde nailing offers better radiological healing and fewer complications. Emerging evidence on hybrid nail-plate constructs indicates that combined strategies may further optimize outcomes, particularly in complex or osteoporotic fractures.

Limitations: The study was limited by a relatively small sample size and short follow-up duration. Larger multicentric randomized trials with long-term outcomes are needed to strengthen these observations.

## CONCLUSION

This prospective comparative study demonstrated that both retrograde intramedullary nailing and locked compression plating are effective methods for managing distal third femur

fractures, with each technique offering distinct advantages. Retrograde nailing provided superior radiological outcomes, earlier signs of union, and fewer complications such as infection and malunion, owing to its load-sharing biomechanics and minimally invasive approach. Conversely, locked compression plating yielded better short-term clinical scores during the early follow-up period, particularly at three and six months, reflecting enhanced initial functional stability. By the ninth month, both groups achieved comparable clinical and radiological outcomes, supporting either method as a reliable fixation strategy.

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## Conflicts of interest

There are no conflicts of interest.

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