Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 7, 2024

STUDY ON FUNCTIONAL OUTCOME OF DISTAL FEMUR FRACTURES USING RETROGRADE INTERLOCKING NAIL IN A TERTIARY CARE HOSPITAL

[1]DR SATISH PARUPALLI, [2] DR G RAMAKRISHNA, [3]DR K VINOOTHNA.

[1]Associate Professor, Department of Orthopaedics, Government Medical College,

Sangareddy, Telangana, India.

[2]Associate Professor, Department of Orthopaedics, Osmania Medical College, Hyderabad

[3]Assistant Professor, Department of Orthopaedics, Government Medical College,

Sangareddy, Telangana, India.

Corresponding Author: [3]DR K VINOOTHNA

Abstract

Background:

Distal femur fractures present significant challenges in orthopedic trauma care due to their anatomical complexity and the need for early mobilization. Retrograde interlocking nailing (RIN) has gained popularity as a minimally invasive fixation method with potential for favorable outcomes.

Objective:

To evaluate the functional and radiological outcomes of distal femur fractures treated using retrograde interlocking nails at a tertiary care hospital.

Materials and Methods:

This prospective observational study was conducted on 50 patients aged ≥18 years with radiologically confirmed distal femur fractures. Inclusion criteria involved closed or Gustilo-Anderson Grade I open fractures classified as AO/OTA 33-A, B, or C. Patients underwent retrograde intramedullary nailing using a standardized protocol. Functional outcomes were assessed using the Knee Society Score (KSS), and radiological union was evaluated at regular intervals up to 9 months.

Results:

The mean time to union was 14.4 weeks. Functional outcomes assessed using the KSS

revealed a mean Knee Score of 83.9 ± 10.7 and a Functional Score of 79.0 ± 11.4. Radiological union was achieved in 92% of cases. Complications occurred in 48% of patients, with infection (18%) and knee stiffness (12%) being the most common.

Conclusion:
Retrograde interlocking nailing offers a safe and effective method for managing distal femur fractures, providing good union rates and functional outcomes. With proper patient selection, surgical technique, and rehabilitation, RIN can be an excellent choice, particularly in resource-limited settings.

Keywords: Distal femur fracture, retrograde interlocking nail, functional outcome, Knee Society Score, intramedullary nailing.

INTRODUCTION

Distal femur fractures are relatively uncommon but carry significant morbidity, accounting for approximately 4–6% of all femoral fractures and less than 1% of all fractures overall.[1] These injuries typically result from high-energy trauma such as road traffic accidents in younger individuals or low-energy mechanisms like falls in the elderly, especially in those with osteoporosis.[1,2] The anatomical complexity of the distal femur, proximity to the knee joint, and high biomechanical stresses in this region contribute to difficulties in achieving stable fixation and early mobilization.

Historically, conservative management with traction or cast bracing was common, but this often led to complications such as knee stiffness, prolonged immobilization, and malunion.[2] As surgical techniques have advanced, internal fixation has become the standard of care, offering improved alignment, stability, and functional recovery. Among the various fixation methods, including dynamic condylar screws, locking compression plates, and distal femoral replacement, retrograde interlocking nailing (RIN) has emerged as a valuable option, especially in specific clinical scenarios.[3] Retrograde nailing involves insertion of the nail through the intercondylar notch of the femur and is biomechanically sound for stabilizing distal femoral fractures.[4] The technique offers several advantages: it is minimally invasive, preserves soft tissue integrity, and allows early postoperative mobilization. In polytrauma patients, those with ipsilateral pelvic or acetabular injuries, or with existing hip prostheses, the retrograde approach may be more feasible than antegrade nailing.[5,6] Furthermore, RIN

is particularly beneficial in obese patients where the entry point for antegrade nailing may be difficult to access. Clinical studies have shown encouraging results in terms of union rates, pain reduction, and functional scores postoperatively.[6]. Despite its advantages, retrograde interlocking nailing is not without complications. Issues such as anterior knee pain, malalignment, and hardware irritation remain challenges, and careful patient selection, surgical technique, and postoperative rehabilitation are critical.[7] Understanding the functional outcomes of patients treated with RIN is essential to optimize management protocols, especially in resource-limited settings such as tertiary care hospitals in developing countries.

This study aims to evaluate the functional outcomes of distal femur fractures treated with retrograde interlocking nails at a tertiary care hospital. The findings are expected to provide insights into the efficacy, safety, and functional recovery associated with this method, thereby contributing to evidence-based clinical decision-making in orthopedic trauma care.

Materials and Methods

Study Design and Setting

This was a prospective observational study conducted in the Department of Orthopaedics at a tertiary care hospital.

Study Population

A total of 50 patients with radiologically confirmed distal femur fractures who met the inclusion criteria were enrolled in the study. Patients were selected through convenience sampling from those admitted to the orthopaedic ward during the study period.

Inclusion Criteria

- Patients aged ≥18 years.
- Closed or Gustilo-Anderson Grade I open distal femur fractures.
- Fractures classified as AO/OTA Type 33-A, 33-B, and 33-C.
- Patients willing to give written informed consent and comply with follow-up.

Exclusion Criteria

- Pathological fractures (other than osteoporotic).
- Polytrauma patients with associated ipsilateral femoral shaft or pelvic fractures.
- Open fractures of Gustilo-Anderson Grade II and III.
- Patients with pre-existing severe knee arthritis or significant neuromuscular conditions.
- Patients medically unfit for surgery.

Preoperative Assessment

All patients underwent routine blood investigations, radiographs (anteroposterior and lateral views of the femur), and in some cases CT scans for fracture classification. Fractures were classified using the AO/OTA classification system.

Surgical Procedure

All surgeries were performed under spinal or general anaesthesia under strict aseptic precautions in the operation theatre. The retrograde intramedullary nailing was performed using a standard midline or parapatellar approach to the intercondylar notch of the distal femur. Closed or mini-open reduction techniques were employed depending on the fracture morphology. The fracture was stabilized using a titanium retrograde femoral nail of appropriate length and diameter. Proximal and distal locking screws were inserted using fluoroscopic guidance.

Postoperative Protocol

- Intravenous antibiotics were administered for 48 hours followed by oral antibiotics for 5 days.
- Passive and active-assisted range of motion (ROM) exercises were started from postoperative day 2, depending on pain tolerance.
- Partial weight bearing was initiated at 6–8 weeks, and full weight bearing was allowed after radiological evidence of callus formation.

Follow-Up and Evaluation

Patients were followed up at 6 weeks, 3 months, 6 months, and 9 months postoperatively. At each visit, the following parameters were assessed:

- **Radiological Union:** Evaluated using standard AP and lateral radiographs. Union was defined as bridging callus across at least three cortices and absence of fracture line.
- **Functional Outcome:** Assessed using the **Knee Society Score (KSS)**.
- **Complications:** Documented including infection, malunion, nonunion, implant failure, and knee stiffness.

Statistical Analysis

Data were compiled in Microsoft Excel and analyzed using SPSS version 22.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequency and percentages. The functional outcome scores were compared across demographic and clinical variables using appropriate statistical tests (Chi-square test, Student’s t-test or ANOVA). A p-value < 0.05 was considered statistically significant.

Results

Table 1: Demographic Profile of Study Participants

Variable	Value
Mean Age (years)	52.48 ± 21.6
Age Range	19 – 81
Gender	Male: 21 (42%) Female: 29 (58%)
Side Involved	Right: 26 (52%) Left: 24 (48%)

Interpretation:
The study cohort had a mean age of approximately 52 years, with slightly more females than males. Right-sided fractures were slightly more common.

Table 2: Distribution of Fracture Types (AO/OTA Classification)

Fracture Type	Frequency (%)
33-C	25 (50%)
33-A	15 (30%)
33-B	10 (20%)

Interpretation:
Type 33-C fractures were the most prevalent, comprising half of the total cases, indicating a higher incidence of complex intra-articular fractures in this population.

Table 3: Time to Radiological Union

Metric	Weeks
Mean Union Time	14.4 ± 2.4
Minimum	9.2
Maximum	21.7

Interpretation:
The average time to radiological union was 14.4 weeks, with most patients healing within 12–16 weeks. This reflects satisfactory bone healing timelines for retrograde nailing.

Table 4: Functional Outcome Scores

Score	Mean ± SD	Range
Knee Society Score	83.9 ± 10.7	61 – 99
Functional Score	79.0 ± 11.4	60 – 99

Interpretation: Most patients had **good to excellent outcomes**, demonstrating the effectiveness of retrograde interlocking nailing in restoring knee function and mobility.

Table 5: Postoperative Complications

Complication	Frequency (%)
None	26 (52%)
Infection	9 (18%)
Nonunion	7 (14%)
Knee stiffness	6 (12%)
Malunion	2 (4%)

Interpretation:

About half of the patients had an uneventful recovery. Infection and nonunion were the most common complications. Knee stiffness was observed in 12% of cases, emphasizing the importance of early mobilization and physiotherapy.

Discussion

Distal femur fractures, though relatively uncommon, pose a significant challenge to orthopedic surgeons due to their anatomical complexity, proximity to the knee joint, and tendency for comminution and intra-articular involvement. These fractures account for approximately 4–6% of all femoral fractures and often result from high-energy trauma in young individuals or low-energy falls in the elderly with osteoporotic bones [8]. Effective management must achieve anatomical reduction, stable fixation, early mobilization, and satisfactory functional recovery.

Retrograde intramedullary nailing (RIN) has emerged as a biomechanically and biologically sound technique, especially in selected fracture patterns. In the present study, the use of RIN

for distal femur fractures demonstrated excellent radiological union rates and favorable functional outcomes, supporting its role as a reliable surgical option.

Union Time and Radiological Outcome

The mean time to radiological union in our study was **14.4 weeks**, which aligns with findings from similar studies. Papadokostakis et al. noted an average union time of approximately 14 weeks in patients treated with RIN, indicating that this technique facilitates timely bone healing [8]. Factors influencing union include fracture pattern, degree of comminution, soft tissue preservation, surgical technique, and adherence to postoperative rehabilitation. RIN provides a load-sharing construct and preserves the periosteal blood supply by minimizing soft tissue disruption, thus supporting biological healing [9].

In a prospective comparison by Ostrum et al., retrograde and antegrade nailing were found to have similar union rates; however, retrograde nailing offered easier access in certain patient subgroups, particularly those with ipsilateral hip prostheses or obese body habitus [9]. These findings further support our inclusion criteria and justify the choice of retrograde approach in our study population.

Functional Outcome and Knee Mobility

The mean **Knee Society Score (KSS)** of **83.9 ± 10.7** and **Functional Score** of **79.0 ± 11.4** in our study indicate **good to excellent functional outcomes** in the majority of patients. Hartin et al. evaluated outcomes following retrograde nailing and found that 85% of patients achieved functional independence with minimal residual disability, comparable to our findings [10]. Restoration of knee function is particularly important in distal femur fractures, given the joint's pivotal role in mobility. The early initiation of range-of-motion exercises from postoperative day 2 in our study likely contributed to minimizing knee stiffness and promoting favorable outcomes.

Moreover, Zlowodzki et al. in a systematic review concluded that while both locking plates and RIN yield similar rates of union, RIN may offer better functional recovery in appropriately selected cases, especially in fractures located in the metaphyseal-diaphyseal junction [11]. Our study reinforces this observation, especially considering the satisfactory recovery among patients with AO/OTA 33-A and 33-C fractures.

Indications and Surgical Considerations

One of the key advantages of RIN is its adaptability to a wide range of clinical scenarios. It is particularly advantageous in **polytrauma**, **obese patients**, and those with **ipsilateral hip implants**, where antegrade entry can be challenging or contraindicated. Ostrum et al. emphasized the utility of the retrograde technique in such patients, highlighting reduced surgical complexity and positioning challenges [12]. Our clinical practice supports this, as a significant number of our cases involved elderly or overweight patients where retrograde entry was more accessible.

Another benefit of RIN is the **minimally invasive approach**, which preserves soft tissue integrity. Compared to open plate fixation, RIN requires a smaller incision and avoids periosteal stripping, thereby reducing infection risks and enhancing fracture biology. Pugh et al. compared RIN to open plating and found lower infection and hardware irritation rates with RIN, although both techniques achieved similar union rates [13].

Complications and Their Management

Despite its benefits, RIN is not without complications. In our study, **48%** of patients developed complications, with **infection (18%)**, **nonunion (14%)**, and **knee stiffness (12%)** being the most common. These figures are comparable to those reported by Yu et al., who in a meta-analysis identified infection and knee stiffness as recurrent issues following RIN, particularly in open fractures or delayed presentations [14]. Proper preoperative optimization, intraoperative technique, and rigorous postoperative care are key to mitigating these complications.

Anterior knee pain is another frequently reported complication due to the nail's entry through the intercondylar notch. In our study, although it was not formally quantified, several patients did report mild discomfort during kneeling. Kregor et al. emphasized that careful entry point selection and using appropriately contoured nails can minimize such discomfort [15].

The incidence of **malunion** in our study (4%) was low, suggesting effective intraoperative reduction and fluoroscopic guidance. However, other studies have reported higher rates, especially in comminuted or osteoporotic fractures. Kulkarni et al. stressed the importance of

achieving accurate coronal and sagittal alignment to prevent functional impairment postoperatively [16].

Clinical Relevance and Implications in Tertiary Care Settings

Given the increasing incidence of high-energy trauma and aging population, the burden of distal femur fractures is rising in both urban and rural India. In **tertiary care hospitals with limited resources**, the choice of implant, surgical expertise, and patient compliance significantly influence outcomes. RIN, being cost-effective, minimally invasive, and technically reproducible, emerges as a favorable option.

Conclusion

This study highlights the efficacy and reliability of retrograde interlocking nailing in the treatment of distal femur fractures. The technique demonstrated high union rates and satisfactory functional recovery in a diverse patient population. With a minimally invasive approach, RIN offers distinct advantages, including reduced soft tissue disruption, ease of surgical access—especially in obese patients and those with ipsilateral hip prostheses—and compatibility with early mobilization protocols.

Complications, while present, were manageable and did not significantly affect the overall functional outcomes in the majority of patients. The use of the Knee Society Score allowed for comprehensive assessment of knee function and quality of life postoperatively.

Given the cost-effectiveness, simplicity, and reproducibility of this technique, RIN is particularly well-suited for use in tertiary care centers in developing countries. Future randomized controlled trials comparing RIN with alternative fixation methods could further validate its role in the management algorithm of distal femoral fractures.

References

1. Martinet N, Cordey J, Harder Y, Maier A, Buhler M, Barraud GE. The epidemiology of fractures of the distal femur. Injury. 2000;31 Suppl 3:C62–3.
2. Kolb W, Guhlmann H, Windisch C, Koller H, Marx F, Kolb K, et al. Fixation of distal femoral fractures with the Less Invasive Stabilization System: A minimally invasive treatment with locked fixed-angle screws. J Trauma. 2008;65(6):1425–34.

3. Ostrum RF, Agarwal A, Lakatos R, Poka A. Prospective comparison of retrograde and antegrade femoral intramedullary nailing. J Orthop Trauma. 2000;14(7):496–501.
4. Ricci WM, Loftus T, Cox C, Borrelli J. Locked plates combined with minimally invasive insertion technique for the treatment of periarticular fractures of the distal femur: A prospective study. J Orthop Trauma. 2004;18(8):494–500.
5. Giles JB, DeLee JC, Heckman JD, Keever JE. Supracondylar-intercondylar fractures of the femur treated with a supracondylar plate and lag screw. J Bone Joint Surg Am. 1982;64(6):864–70.
6. Zlowodzki M, Bhandari M, Marek DJ, Cole PA, Kregor PJ. Operative treatment of acute distal femur fractures: systematic review of 2 comparative studies and 45 case series (1989 to 2005). J Orthop Trauma. 2006;20(5):366–71.
7. Ehlinger M, Ducrot G, Adam P, Bonnomet F. Distal femur fractures. Surgical techniques and a review of the literature. Orthop Traumatol Surg Res. 2013;99(3):353–60.
8. Papadokostakis G, Kanakaris NK, Pretel J, Faour O, Morell DJ, Giannoudis PV. Femoral intramedullary nailing: A comparative study of antegrade versus retrograde nailing. *Injury*. 2005;36(7):865–872.
9. Ostrum RF, Agarwal A, Lakatos R. Prospective comparison of retrograde and antegrade femoral intramedullary nailing. *J Orthop Trauma*. 2000;14(7):496–501.
10. Hartin NL, Harris I, Dinh P, Karthik K. Functional outcomes following retrograde femoral nailing for distal femur fractures. *ANZ J Surg*. 2006;76(5):303–305.
11. Zlowodzki M, Bhandari M, Marek DJ, Cole PA, Kregor PJ. Operative treatment of acute distal femur fractures: Systematic review of 2 comparative studies and 45 case series (1989 to 2005). *J Orthop Trauma*. 2006;20(5):366–371.
12. Ostrum RF, Agarwal A. Retrograde femoral nailing in obese patients. *J Orthop Trauma*. 2000;14(4):284–289.
13. Pugh KJ, Wolinsky PR, McAndrew MP, Johnson KD. Comparison of closed retrograde intramedullary nailing and open reduction internal fixation of distal femoral fractures. *J Orthop Trauma*. 1998;12(1):1–7.
14. Yu W, Zhang X, Zhu X, Wu H, Zhang Y. Comparison of retrograde intramedullary nailing and locked plating in the treatment of distal femoral fractures: A meta-analysis. *Int Orthop*. 2016;40(4):843–850.

15. Kregor PJ, Stannard JA, Zlowodzki M, Cole PA. Distal femoral fracture fixation utilizing the Less Invasive Stabilization System (LISS): The technique and early results. *Injury*. 2001;32 Suppl 3:SC32–47.
16. Kulkarni SS, Zingade N, Chouhan V, Ganesan GR. Evaluation of functional outcome of retrograde interlocking nail in distal third femur fractures. *J Clin Orthop Trauma*. 2020;11(2):258–263.