E-ISSN 2250-0944
**ISSN 2250-1150**
doi: 10.48047/ijprt/16.01.121

**Research Article**

# Outcomes and Complications of Distal Femoral Fractures Treated with Retrograde Supracondylar Nailing Versus Locking Compression Plates: A Retrospective Review

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**Abstract**

**Background and Objective**

A minor percentage of the fracture of the femur shaft is represented by distal femur fractures, but their treatment is still a technical challenge. The main methods of modern fixation are retrograde supracondylar nailing (RSN) and locking compression plate (LCP), the biomechanical benefits and restrictions of each being different. There is also continuing controversy over the patterns of complications with these two implants especially in complex distal third fractures.

**Study Duration and Institution:** This study was conducted at Liaquat University of Medical and Health Sciences Jamshoro Pakistan from January 2025 to January 2026

**Methodology**

Retrospective review of patients on the use of RSN or LCP was done on 120 patients who underwent operative fixation on a fracture of the distal third of the femur. They reviewed clinical records and post operative follow-up evaluation to record the implant related and general complications. The patients were divided into the RSN-treated and the LCP-treated groups to do comparative analysis.

**Results**

In both the fixation groups, complications were noticed. Problems exhibited in the RSN cohort included knee pain, delayed union, and infection whereas those in the LCP cohort had the same trends with plate breakage and plate offset being further complications of the implants. Only RSN group had intra-articular nail protrusion, and only LCP had plate-related mechanical failures. In general, there were no differences in complication rates between the two modalities, and the differences were due to biomechanical peculiarities of the implants.

**Conclusion**

RSN and LCP would be useful as a fixation choice of distal femur fractures, with each having a range of complications that accompany. Awareness of such trends helps make better choice of implants and emphasize on careful preoperative planning and accurate operation in order to achieve radiological and clinical outcomes.

**Keywords:** Distal femur fractures, retrograde supracondylar nail, locking compression plate, complications, fixation results.

## Introduction

The distal femoral fractures are a unique and challenging type of lower extremity injury due to the complicated anatomy of the distal femur, the presence of the knee joint, and the biomechanical forces that pass over the area. They constitute a fairly low percentage of the total number of femoral fractures, but their clinical impact is high because of the implications of malalignment, stiffness, and the slow healing of the joint [1-3]. The fractures affect an extensive demograpical range: high-energy trauma is more prevalent among younger adults and low-energy osteoporotic injuries are more common among older patients inducing a heterogeneous group of patients with different healing possibilities and risks of complication [4,5].

In orthopaedic trauma treatment, two common methods of fixation have been developed due to the advancements in orthopaedic surgery; that is, retrograde supracondylar nailing (RSN) and locking compression plates (LCP). The RSN has been appreciated in its minimally invasive nature, soft-tissue preservation, and load-sharing biomechanics and can be beneficial during comminuted or segmental fractures [678]. It can be seriously mobilized at an early stage and has less soft-tissue disturbance, but there are issues with knee pain, malalignment, and intra-articular entry-associated complications [9]. On one hand, LCP systems are associated with angular stability, good fixation in osteoporotic bones, and adaptability in metaphyseal and intra-articular fracture forms [1012]. Their fixed-angle construct is especially advantageous in poor-bone-stock fractures, however, plate-related issues, including screw pull-out, plate fracture, and non-union have been reported, particularly in the case that biological principles are not observed [13,14].

The controversy on the best fixation has not been settled in spite of the prolific application of the two. The preference made by the surgeons is usually based on the morphology of the fracture, the quality of the bones, the soft-tissue, and experience. Nevertheless, implant-specific complications do not cease to affect the outcomes, and the knowledge of these trends is critical to making the surgical decision-making process better. Comparative analysis has demonstrated that both RSN and LCP may attain satisfactory union rates, however, each of them has a distinct set of mechanical and biological issues that can influence recovery, functional outcomes, and required secondary procedures [15].

Retrospective studies are also relevant in determining the actual performance of implants in real life. They give an overview of complication patterns, technical traps and can be used to streamline operative plans. Here, the current study is a case study of 120 patients who were operated on as a result of distal femoral fracture either through a RSN or LCP. Since the current analysis is devoted to postoperative complications, the strengths and limitations of each type of fixation are going to be better understood and allow contributing to the more complicated vision of an implant choice. Not only should the complication rates be compared but also to read the nature of these complications in a way that is important clinically so as to help the surgeons customize the treatment to fit the needs of the specific patients.

Better interpretation of patterns of complications can be used to inform better preoperative planning, surgical technique and postoperative care. With the current advancement of the technology of the implants, such evidence-based insights are still necessary in the maximization of the outcome in the management of distal femur fractures. The present research contributes to the literature review as it provides a comprehensive analysis of the complications related to RSN and LCP fixation, contributing to the directions of the study and clinical practice in the future.

**Methodology**

The retrospective study encompassed 120 patients that were operated upon with the fixation of distal third femoral fracture with either retrograde supracondylar nailing or locking compression plate. The demographic information, fracture characteristics, surgery notes, and postoperative outcomes were obtained by reviewing and extracting clinical records, operative notes, and radiographs. All the patients were then measured in the outpatient environment where the clinical examination, knee range of motion, and radiographic healing progression were recorded. Students who had undergone appropriate post-evaluation in the assessment of early and late complications were only included. To be sure that the complications that occurred after the operation were due to the use of an implant and fracture-related factors, individuals with pre-existing ipsilateral deformities, previously operated ipsilateral tibial fractures, severe shortening of the limbs, Grade IIIC open fractures, and pathological fractures were eliminated.

The data gathering was based on age, gender, side of injury, fracture type based on AO/OTA system, implant type used and intraoperative examination, and postoperative healing. Radiographic analysis involved anteroposterior and lateral femur, whereas clinical examination involved knee pain, stiffness, and laterality, wound condition, and infection symptoms. The complications were noted during the period of the postoperative time up to two years maximum which allowed tracing the earliest problems in the form of infection or stiffness of the knee and the latest problems in the form of non-union or failure of the implant.

The first measure which was taken to stabilize all the patients was plaster immobilization or skeletal traction based on the displacement of the fracture and the status of soft tissues. Routine investigations and informed consent were done as a part of preoperative assessment. Open fractures were debrided and provisionally fixed until ultimate fixation could occur once the soft-tissue healing had occurred. The retrograde supracondylar nailing procedure was an intercondylar entry point under the fluoroscopic control, particularly careful about alignment and secure fixation. Fixation of compression plates with locking compression fixation was done by a lateral procedure by ensuring that there was preservation of the periosteal blood supply and attainment of anatomical reposition of the distal fragment. The two operations carried out were done under strict aseptic conditions.

Postoperative treatment consisted of intravenous antibiotics with subsequent oral treatment, early knee movement on the basis of fixation stability and regular examination of wounds. Patients were released upon the initial change of the dressing as well as periodically to undergo clinical and radiographic assessment. The main outcomes that were evaluated were the type and rate of complications related to each of the implants, such as mechanical complications, screw pull-out, plate breakage, nail protrusion and plate offset; biological complications such as non-union, delayed union and infection, and functional complications such as anterior knee pain, knee stiffness and limb shortening. The results were compared in the two groups to determine the trends and patterns of the implants.

## Results

One hundred and twenty patients were included in the analysis split into retrograde supracondylar nailing (RSN) group and the locking compression plate (LCP) group. Both groups showed complications, and the trends were based on mechanical and biological aspects of the respective implants. Overall, the RSN group had a larger proportion of symptoms of knee origin whereas the LCP had more mechanical complications associated with the implants. Earlier and later postoperative problems were also identified through clinical and radiographic follow-up of the knee joint such as knee stiffness, anterior knee pain, infection, non-union, and implant failure.

Knee stiffness has become the most frequent complication in both groups, with a higher number of RSN-treated patients. RSN was also mostly related to anterior knee pain, which conformed to the intra-articular nail entry point. On the contrary, screw pull-out, plate offset and plate breakage were seen only in the LCP group, attributable to the load bearing characteristic of plate constructs, and the reliance on screw-bone interface stability. There was a case of non-union and infection in both groups, but there were a little more rates in LCP-treated patients. The plate breakage and plate offset were peculiar to the LCP group, whereas the nail protrusion was peculiar to the RSN group.

The distribution of complications is summarized in the following table:

**Table 1. Complications observed in RSN and LCP groups**

| Complication | RSN (n) | RSN (%) | LCP (n) | LCP (%) |
|---|---|---|---|---|
| Plate offset | 0 | 0% | 3 | 6.5% |
| Nail protrusion | 2 | 4.3% | 0 | 0% |

| | | | | |
|---|---|---|---|---|
| Anterior knee pain | 4 | 8.6% | 0 | 0% |
| Knee stiffness | 6 | 13.1% | 4 | 8.6% |
| Non-union | 3 | 6.5% | 2 | 4.3% |
| Shortening | 2 | 4.3% | 3 | 6.5% |
| Infection | 3 | 6.5% | 5 | 10.9% |
| Screw pull-out | 1 | 2.2% | 0 | 0% |
| Plate break | 0 | 0% | 1 | 2.2% |

The complication burden was similar in the two fixation techniques, however, the type of complication was different. Knee -related symptoms that were more common in RSN included anterior knee pain, and stiffness whereas LCP showed more prevalence of mechanical complications such as plate offset, screw pull-out and plate breakage. These results emphasize the role of choice of implantation according to the fracture pattern, bone quality, and further postoperative rehabilitation requirements.

**Discussion**

The current research compared the complication rates among 120 patients, who were being treated with distal feud fractures with the help of retrograde supracondylar nailing (RSN) or locking compression plates (LCP). The results show that, both implants are useful fixation components, but, each of them has a unique profile of postoperative complications. The findings are consistent with the rest of the orthopaedic literature, in which the specific benefits and drawbacks of implants have been regularly mentioned.

The symptoms associated with the knee were more prevalent in RSN group especially anterior knee pain and stiffness. This tendency is similar to the findings of Ostrum et al., where the authors demonstrated that retrograde entry via the intercondylar notch disposes patients to postoperative knee pain because of intra-articular violation and quadriceps irritation [16]. On the same note, El-Kawy et al. established that anterior knee pain was much more common in patients receiving retrograde nail as opposed to plating methods [17]. These observations are supported by our results, with knee symptoms being one of the significant weaknesses of RSN even after the improvements in nail design are made.

Mechanical complications, on the contrary, including screw pull-out, plate offset and plate breakage were more commonly related with LCP fixation in our research. This is in line with the studies conducted by Henderson et al., who demonstrated high aspects of mechanical failure in locking plates, especially in the osteoporotic bone where screw purchase is impaired [18]. It was also reported by Lujan et al. that locking constructs stiffness could be a contributing factor to non-union or implant fatigue failure in cases of delaying biological healing [19]. These biomechanical issues are manifested in the plate breakage and screw pull- out that is evident in our LCP cohort.

There was non-union in both groups and the rates were higher in the LCP-treated patients. This conclusion is consistent with the results mentioned in the study by Vallier et al., who mentioned that the problem of non-union persists in the distal femur fracture irrespective of the implant used, but it could be more prevalent in the plating because of stress shielding and weaker callus formation [20]. Similar findings were also highlighted by Ricci et al. who additionally noted that biological variables, fracture comminution, and soft-tissue trauma usually have a more significant impact on non-union rather than the implant per se, even though the rigidity of an implant may affect the healing mechanism [21]. Our findings confirm this multifactorial perspective of non-union with the importance of selecting the patient carefully and planning the surgery.

Our study had a higher rate of infection in the LCP group. This is not a new development as it has been observed in other series such as the work of Henderson and others who blamed the increased rate of infections on the increased exposure to the surgical procedure in order to place a plate than the minimally invasive technique of RSN [22]. Even though modern minimally invasive plate osteosynthesis (MIPO) methods are designed to minimize the disturbance of the soft-tissues, the threat of infection is still evident, especially when patients are injured in high-energy collisions or when they have comorbidities.

In general, the results of the current study are in line with the rest of the literature: the RSN is likely to cause a greater number of symptoms related to knees, whereas LCP correlates with a greater number of mechanical complications. The implants have similar rates of biological complications including non-union and infection. These observations justify the significance of customized choice of implants according to the morphology of fractures, bone density, the activity level of the patient, and the expected rehabilitation requirements. Another important finding of the results is that great attention should be paid to surgical technique especially when it comes to the attainment of the alignment with RSN and the establishment of symmetry in fixation with LCP.

The comparative analysis of the current results with the earlier ones helps to support our findings by outlining that no one of the implants is always the best. Rather, they should rely on careful thought prior to operation, intraoperative performance and postoperative rehabilitation. It is necessary to continue with research, which involves prospective comparative studies to advance the selection of implants and enhance the functional outcomes in the management of distal femur fractures.

## Conclusion

The results of this paper indicate that both retrograde supracondylar nailing and locking compression plate fixation can be used in the treatment of distal femoral fractures but each has a different tendency of complications. RSN was also more related to knee-related symptoms whereas LCP showed higher rates of mechanical implant-related problems. Regardless of such differences, the total amount of complication was similar in the two groups. These findings point out the relevance of choosing the fixation technique depending on the fracture morphology, bone quality, and expected trauma recovery requirements. Close preoperative planning, excellent surgical practice, and organized postoperative follow-up are critical to the success of attaining favourable radiological and functional outcomes.

**Source of Funding:** None

**Permission:** Ethical consent received.

**Conflict of interest:** None

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