

Functional outcome of supracondylar fracture femur treated with plate fixation and retrograde intramedullary nailing – A comparative study

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Abstract—Fractures of distal femur reportedly account for less than 1% of all fractures and about 4% of all femur fractures. Aims of the treatment of extra-articular fractures are restoration of length, torsion, and frontal and sagittal plane alignment and stable fixation. The objective of the study is to compare the functional and radiological outcome of the patients who sustained the distal femoral fractures treated with plate fixation against retrograde intramedullary nail. Patients meeting the specified inclusion criteria were divided into two groups: one treated with retrograde intramedullary nailing and the other with plate fixation. Follow-up assessments were performed at 4, 12, and 24 weeks post-surgery, utilizing flexion scores and Modified Schatzker and Lambert criteria to evaluate functional and radiological outcomes. The functional outcomes and knee flexion scores at the 6-month mark showed no significant difference between the plating and nailing groups. However, the plating group demonstrated early recovery, with a significant improvement in range of motion observed at 4 weeks post-operation. Retrograde intramedullary nailing exhibited advantages in terms of shorter surgery duration and lower intraoperative blood loss, making it a preferred option for patients with anticipated major blood loss or polytraumatized individuals.

Keywords—Nailing, Plating, Distal femur, Fracture, Modified Schatzker and Lambert criteria

1 Introduction

Fractures occurring in the distal femur region present a complex challenge for orthopaedic surgeons. These fractures are relatively rare, accounting for less than 1% of all fractures and approximately 4% of femur fractures¹ with an incidence of 37 per 100,000 patients per year.

Supracondylar femur fractures typically occur due to two distinct mechanisms of injury, affecting different age groups. In young adults, these fractures are commonly caused by high-energy trauma, often due to accidents and sports-related injuries. On the other hand, in the elderly population, supracondylar femur fractures result from low-

energy events, predominantly in females over 60 years old, typically caused by falls or sprains. Moreover, these fractures are associated with polytrauma in approximately 30% of cases.² Open fractures account for 27% of cases, with 58% exhibiting intra-articular extensions.³

The optimal treatment approach for distal femur fractures remains a subject of ongoing debate. These fractures are challenging to manage due to their proximity to vital neurovascular structures. Moreover, severe comminution and bone loss, along with fragment displacement, further complicate the fixation process. The juxta-articular location of these fractures near the knee joint leads to early impairment of joint mobility, necessitating a comprehensive approach involving effective physiotherapy and gradual mobilization exercises for optimal recovery.

Recent advancements in surgical techniques and implant designs have resulted in a decline in non-surgical treatment approaches.⁴ Minimally invasive techniques, such as locking compression plates, have gained popularity as they allow for biologically friendly fixation with minimal soft tissue disruption, thus preserving the blood supply and fracture hematoma. Another significant breakthrough occurred in 1988 with the introduction of retrograde intramedullary nails by Green⁵ which offer similar advantages to locking plates and have shown high healing rates.⁶

Despite the widespread use of both plate fixation and retrograde intramedullary nails, there is a scarcity of studies directly comparing their outcomes. Successful management of supracondylar fractures necessitates a thorough understanding of fracture anatomy, classification systems, technical aspects of fixation, and post-operative care. The objective of this study is to compare the outcomes of distal femoral fractures treated with locking compression plates versus retrograde intramedullary nails, providing valuable insights into the effectiveness of these two fixation methods. By evaluating the functional and radiological outcomes, this study aims to contribute to the existing knowledge and guide orthopaedic surgeons in making treatment decisions for these challenging fractures.

2 Materials and Methods

After approval from Institutional Ethics Committee, this prospective study was conducted from June 2021 to December 2022 in the Department of Orthopaedics in a tertiary care centre in South India. Patients were classified according to AO CLASSIFICATION⁷ and GUSTILLO ANDERSON CLASSIFICATION⁸ in case of open fractures and were divided into two groups.

Inclusion criteria –

1. All patients above 18 years with closed fractures of supracondylar & distal femur fractures extending up to 15 cm from distal articular surface.

2. Open fractures type 1,2,3A,3B.

3. Patients who will give consent to take part in this study

Exclusion criteria –

1. Patients with open fractures type 3C

2. Patients with intra articular fracture extension

3. Children with distal femoral fractures in whom the growth plate is still open or less than 18 years of age
4. Pathological fractures
5. Patients lost in follow up
6. Patient refusal for study participation.

After emergency management and stabilization, diagnosis was made with the help of good quality AP and lateral radiographs of the knee and distal femur. X-rays of the pelvis, ipsilateral hip and femoral shaft were also taken in order to rule out associated injuries. CT scans with axial, coronal and sagittal reconstruction of the distal femur are an important adjunct to plain radiograph. If there is doubt regarding vascular injury a doppler ultrasound study was done. Valid informed and written consent was obtained from all the patients. All essential pre-operative investigations were done and all cases were posted for surgery after obtaining anesthetic fitness.

The first 20 patients were treated by retrograde intramedullary nailing using an infrapatellar incision and the next 20 by distal femoral plate fixation by standard lateral approach. Appropriate antibiotic therapy was given according to the nature of injury and the patient was started on DVT prophylaxis. Touch down weight bearing was allowed initially and is progressed as callus formation increased over next 4-6 weeks. This is a prospective study where patients were followed up at 4th week, then monthly for first 3 months, then at 6th month and 1 year. During each visit functional outcomes using Modified Schatzker and Lambert criteria⁹ and radiological union were assessed. Flexion score (at 24 weeks) was assessed at 6th month. Range of movements of knee, pain at fracture site, other symptoms were also assessed.

STATISTICAL ANALYSIS -

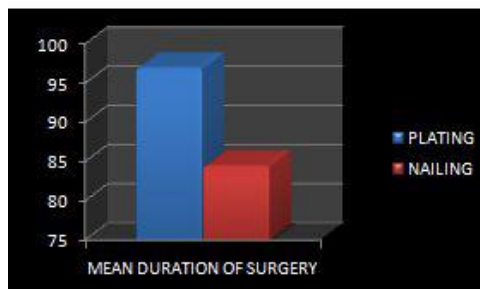
Data was analyzed postoperatively with the knee flexion scores and Modified Schatzker and Lambert Criteria. The values were entered in Microsoft Excel and analyzed using SPSS version 29 software. Statistical tests like Paired T-test and Chi-Square test were used. All statistical analyses were considered significant at p value <0.05.

3 Results

Most of the cases in our study population were AO type 33-A1. Majority of the cases of our study population were closed type of fractures.

The mean duration of surgery in the Plating group was 97 minutes as compared to 84.5 minutes in the nailing group and this difference was statistically significant with a p value of 0.034.

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Graph 1. Mean duration of surgery

The mean intra-operative blood loss was 362.50ml in the plating group and 245ml in the nailing group. This was statistically significant with a p value of <0.001.



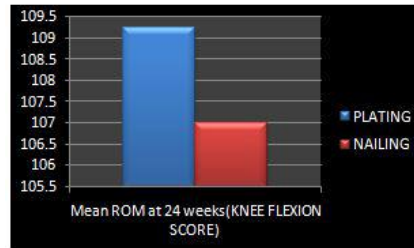
Graph 2. Mean intra-operative blood loss

On follow up at 4 weeks there was a significant difference between the knee ROM of the plating and the nailing group with a p value of 0.001. At 12 weeks and 24 weeks, there was no significant difference between the plating and the nailing groups. The Knee Flexion ROM was the KNEE FLEXION SCORE of the two groups.

Table 1. ROM at 4, 12 and 24 weeks

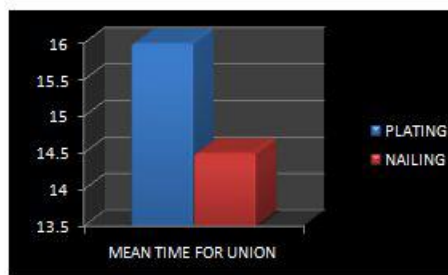
GROUPS	N	ROM at 4 weeks		Mean Difference	p Value
		Mean	SD		
Plating	20	94.50	4.261	5.250	0.001
Nailing	20	89.25	5.200		
GROUPS	N	ROM at 12 weeks		Mean Difference	p Value
		Mean	SD		
Plating	20	105.75	6.935	4.750	0.053
Nailing	20	101.00	8.046		
GROUPS	N	ROM at 24 weeks (FLEXION SCORE)		Mean Difference	p Value
		Mean	SD		
Plating	20	109.25	7.656	2.250	0.354
Nailing	20	107.00	7.504		

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Graph 3. Knee Flexion score

The mean time taken for union was 16 weeks in the plating group and 14.5 weeks in the nailing group and the difference was not statistically significant with a p value of 0.083.



Graph 4. Mean time for union

At 24 weeks post-op, using the clinical and radiological parameters, cases were classified according to the Modified Schatzker and Lambert Criteria. It was found that there was no significant difference in the outcome between the plating and the nailing group with a p-value of 0.876. 55% (11 cases), 25%, 25% and 5% (1 case) among the plating group and 60% (12 cases), 15%, 20% and 5% (1 case) had Excellent, Good, Fair and Failure outcomes. Failure in the plating group was due to loss of flexion and that in the nailing group was due to varus deformity of 15 degrees.

Table 2. Modified Schatzker and Lambert Criteria

Modified Schatzker and Lambert Criteria	Groups				p Value
	Plating		Nailing		
	n=20	%	n=20	%	
Excellent	11	55.0	12	60.0	0.876
Good	5	25.0	3	15.0	
Fair	3	15.0	4	20.0	
Failure	1	5.0	1	5.0	

3 cases(15%) of the Nailing group complained of anterior knee pain.
1 case (5%) of the plating group developed infection.
1 case (5%) of the plating group had nonunion for which secondary bone grafting had to be done.

4 Discussion

Distal femur fracture occurs following a high-energy impact in the young patients often resulting in severely comminuted and open fractures, whereas a low-energy injury is sufficient to cause distal femoral fractures in the elderly patients with osteopenic or osteoporotic bones. The fracture type, bone quality and the associated soft tissue injuries play an important role in the outcome of the treatment of these fractures.

For the operative management of distal femoral fractures, two major therapeutic principles have been employed: locking plate osteosynthesis and retrograde IM nailing. Both the operative stabilizing systems follow the principle of biological osteosynthesis. Protection of the soft-tissue envelope due to the minimally invasive approach and closed reduction techniques is better advocated using IM nailing.

We did a prospective comparative study of 40 patients with distal femur fractures admitted in our department satisfying the inclusion and exclusion criteria treated with distal femur locking compression plate system and retrograde distal femoral nail. In the management of extra articular fractures of distal femur, since the articular congruity is maintained and the articular cartilage is not involved, surgical fixation, early mobilization and rehabilitation can lead to excellent outcome for the patients. Though the distal femur fractures are managed recently by locking compression plate, as far as the extra articular fractures of distal femur is concerned, retrograde intramedullary nailing can also be considered as an option. In case of retrograde intra medullary nailing, as it is load sharing device and by applying in closed means without disturbing the fracture hematoma, biological fixation is a major advantage.

Generally, the functional outcomes have been shown to correlate with the patient's age and the severity of the initial injury.¹⁰ In our study, functional outcome came out to be similar in both the groups. Numerous rating scales have been used to determine the functional outcomes after surgical treatment of supracondylar fractures of femur.

SPS Gill et al, in 2017, compared the outcome of LCP vs retrograde nailing in the treatment of extra articular supracondylar femur fractures. At 18 months, no statistically significant differences were found in the mean duration for union and functional outcome.^[11] We also found out that there was no statistically significant difference in the outcome (according to Modified Schatzker and Lambert criteria) between the plating and nailing groups with 55% of the cases [11 cases] in the plating and 60% [12 cases] among the nailing group showing excellent outcomes and 5% [1 case] in each group was a failure.

In present study, the mean time taken for union for plating was around 16 weeks, which was comparable to Virk J S et al¹² and Pascarella R et al¹³ who observed the

mean union time to be 19 and 16.3 weeks respectively. In our study, the mean time for union for nailing group was 14.5 weeks and Jillala S R et al¹⁴ showed healing at 13.4 weeks.

Lawrence and Kenneth Johnson in their series on early versus delayed surgical fixation in polytrauma patients pointed out that early fixation resulted in very less or nil pulmonary complications, decreased hospital stay and a minimal need for intensive care. They also advocated that the incidence of ARDS, fat embolism & pneumonia were higher in multiple injured patients, when the fracture stabilization was delayed.¹⁵ All of our 40 cases had undergone early surgical fixation and none of them developed pulmonary complications and only a few of them needed an intensive care.

Leggon et al¹⁶ found a trend of more knee pain with retrograde distal femoral nailing in patients of distal femur fracture. We had 3 cases in the nailing group who had anterior knee pain.

In our study, the mean duration of surgery and intra operative blood loss was significantly higher in the plating group than in the nailing group. In a study by Kanda Gao et al, the mean intra operative blood loss was significantly higher in the retrograde nailing group¹⁷ than in the locking plate group. But, there was no statistically significant difference in the mean duration of surgery between the two groups ($p = 0.106$, statistical power: 37.3%).

5 Conclusion

Retrograde intramedullary nail is a good implant choice for distal femur fractures giving comparable results to distal femoral locking plate. In our study, the Modified Schatzker and Lambert criteria showed no significant difference in the overall functional outcome among the plating and nailing groups and the knee flexion score were also comparable among the two groups, even though the plating group showed an early recovery from the surgery with a significant difference in the range of motion at 4 weeks post-op. There was no significant difference in the meantime taken for union among the two groups. However, the mean duration of surgery and the mean intraoperative blood loss were significantly higher in the plating group when compared to the nailing group.

Retrograde nailing is advantageous over plating in terms of mean duration of surgery and mean intraoperative blood loss; hence, nailing may be preferred in those with anticipated major blood loss and in polytraumatized patients. Both the procedures require adequate preoperative planning and surgical experience so as to avoid complications and revision surgery. The prognosis, though, seems to be more dependant on the type of fracture than the implant used.

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