

Original Research Article

Comparing the outcome of fixation of supracondylar femur fractures using retrograde intramedullary nailing and distal femur locking compression plate

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ABSTRACT

Background: Supracondylar femur fractures typically occur as a result high energy trauma in young and in elderly after low energy trauma. Retrograde intramedullary nailing (RIMN) and distal femur locking compression plate (DFLCP) are widely used for fixation distal femur fractures. This study was done to compare the clinicoradiological outcome of fixation of supracondylar femur fractures using RIMN and DFLCP.

Methods: In our study with 26 patients fulfilling the criteria were enrolled and one group treated with RIMN while the other group treated with DFLCP and corresponding Functional and radiological assessment done on basis of Neer's score.

Results: Fractures occurred primarily as a result of RTA in young and self-fall in elderly. Fracture type AO33-A1 was seen more commonly in both groups. The mean duration of surgery, blood loss and bone union time in the RIMN group minutes was less than that the DFLCP group. All fractures in the RIMN group united while three cases of non-union in DFLCP group, with one case of delayed union, one case of periprosthetic implant fracture, and one case of knee joint arthrosis. Local soft tissue complications were more common among DFLCP group. Functional and radiological assessment on basis of Neer's score was found to be better in RIMN group than the DFLCP group.

Conclusions: RIMN is a better option in the operative treatment of supracondylar femur fractures found to be correct in terms of less soft tissue complications, shorter duration of surgery, less intraoperative blood loss, shorter duration of hospital stays, and fracture union.

Keywords: Supracondylar femur fracture, Nailing, Plating, DFLCP, DFN/RIMN, Distal femur

INTRODUCTION

Fracture of the distal femur accounts for 7% of all femoral fractures, excluding hip fractures, accounts for 30% of femoral fractures.¹ Supracondylar femur fractures typically occur as a result of distinct mechanisms of injury and in two distinct populations, in young after high energy trauma and in elderly after low energy trauma.²

There is a considerable amount of literature on supracondylar femur fracture and their treatment. However, the best management approach is yet to be

determined. Prior to 1970, most supracondylar fractures were treated non-operatively; however, angular deformities, knee joint incongruity, loss of knee motion, as well as complications associated with recumbency, led to the development of better treatment methods.³⁻⁵ During the past 40 years, operative techniques and implants have dramatically improved, and internal fixation is recommended for most displaced distal femoral fractures in adults. Internal fixation of the distal femur can be challenging for a variety of reasons, including thin cortices, a wide medullary canal, compromised bone stock, and fracture comminution, all of which make stable

internal fixation difficult to achieve. The goals of treatment are, restoration of limb alignment, length, and rotation, and stable fixation that allows for early mobilization.⁶ Union and infection problems encountered with open reduction and plating methods in the treatment of distal femur fractures have encouraged the fixation of distal femur with nails.⁷

Retrograde nailing is probably preferred for distal femoral fractures with extensive shaft extension and is inserted through the intercondylar notch. It has become a popular method of treating supracondylar fractures and is preferred over antegrade nailing in the vast majority of situations.⁸ DFLCP has gained popularity in recent years because it allows for limited fracture movement against physiological loading while also providing good fixation, particularly in osteoporotic and comminuted metaphyseal fractures. Because this technique provides fixation from the lateral side, it reduces the risk of knee problems and embolism, but weight-bearing may be delayed.⁷

Retrograde intramedullary nailing (RIMN) and distal femoral locking compression plating (DFLCP) are frequently applied implants for fixation distal femur. Several studies have been conducted to describe the clinical outcomes of RIMN and DFLCP. However, few studies have compared the outcomes of RIMN and DFLCP procedures for operative fixation of supracondylar femur fractures. According to one study, the clinical outcomes of supracondylar femur fractures treated by open reduction with DFLCP and minimally invasive approach with RIMN are comparable. The minimally invasive approach, on the other hand, has a significantly lower incidence of wound complications and secondary intervention.⁹

This study was done to compare the outcome of fixation of supracondylar femur fractures using RIMN and DFLCP.

METHODS

This hospital-based prospective study was conducted in Assam Medical College, Dibrugarh, after clearance from the Ethical Committee of the institute, and informed consent was taken. From all patients who met the inclusion criteria of the study.

Inclusion criteria include adult patients aged 18 to 60 years with closed supracondylar femur fractures AO (33-A1, 33-A2, 33-A3), fresh fractures less than 3 years old. Excluded patients were Compound fractures, Fractures with intra-articular extensions AO (33-B, 33-C), associated knee ligament tears, neurovascular injuries, pre-existing arthritis, pathological fractures, and periprosthetic fractures.

In a period of 1 year (June 2020 to May 2021), 26 patients (age 18-60 years) with Supracondylar femur fractures AO (33-A1, 33-A2, 33-A3), less than three weeks old, were enrolled for the study.¹⁰ Patient selection for surgical procedure was done based on opaque envelope method and one group treated with minimally invasive approach for

RIMN while the other group treated with lateral approach for DFLCP.

Procedure

Minimally invasive approach for RIMN

Position-supine with tourniquet not applied. The leg was draped freely, and the knee flexed to 45 degrees. Fracture was reduced with a tibial traction pin or with manual traction applied by gripping the gastrocnemius muscle at the level of the proximal tibial border. Radiolucent table – fracture visualized in AP and lateral views. An infra patellar incision 3 to 4 cm long was made directly over the medial edge of the patellar tendon. The patellar tendon was correspondingly retracted laterally. Direct visualization of the entry point in the intercondylar notch can be accomplished by excision of the fat pad and arthrotomy performed. The entry point was 5 mm anterior to the attachment of the posterior cruciate ligament and it lies slightly medial to the center of the distal femoral condyles. Inserted a 3.2 mm guide into the intercondylar notch and passed into the distal fragment, the fracture was reduced by manual traction and the guide wire was passed into the proximal canal to the level of lesser trochanter and position of the guide wire was checked on anteroposterior imaging.

Medullary canal was prepared by introducing cannulated reamers over the guide wire to a diameter 1.0 to 1.5 mm longer than the nail used, and position of guide wire was rechecked to confirm its position at the lesser trochanter. The entry portal was removed, and the nail was inserted attached to the targeting guide (jig), seating it to the level of the lesser trochanter. A lateral image was taken to ensure that the nail was properly inserted, and that the distal end of the nail was at least 1 mm deep to subchondral bone. If the nail was at the proper level, the guide wire was removed, and the distal locking of the nail was performed using the guide. To dimple the skin, the drill sleeve and trocar was placed into the targeting guide. The drill guide was inserted to the bone and the drill was advanced until the far cortex was encountered and the measurement for drill bit calibrations were read for length approximation. At least two 6.5 mm screws were placed to secure bi cortical purchase in the distal fragment. The screw was inserted by hand until fully seated. The length and position of the screws were checked with anteroposterior and lateral imaging. When the final reduction and length were accepted, we moved to the proximal static and dynamic locking with 4.9 mm, interlocking bolts, which was placed in the antero-posterior plane. Insertion guide was removed and the surgical site was irrigated with normal saline. Wound was closed in a standard layered fashion and dressing was applied.

Lateral approach for DFLCP

The patient was placed in the supine on a radiolucent table, allowing both AP and lateral views. A well-padded bump was placed under the ipsilateral hip, surgical draping was done, and the affected limb was allowed 30-45° flexion to

relax the gastrocnemius muscle. A 10-15 cm long skin incision was made. The subcutaneous tissue, the Tensor fascia lata, and the vastus lateralis muscle were all incised. The tensor fascia lata and vastus lateralis muscles were elevated anteriorly from the intramuscular septum, which was readily accomplished with an elevator. The overlapped fracture ends were displaced into varus to allow a direct view of the medullary canal, then we debrided the fracture ends of frayed soft tissue that was impaled on sharp bone edges, and then irrigated. Holding the bones in place using bone holding forceps, the medial edge of the main fragment was brought into contact with the fracture, which was still in varus, and the fracture was reduced by levering on the medial edge. The plate was applied to the flat posterior lateral surface. Reduction was held temporarily with a K-wire, after aligning the plate along the shaft. After confirming the reduction and plate position parallel to the condyles, the second K-wire was passed into the sleeve, plate, and condyle. Drill bits of size 4 mm, 4.5 mm, and 5 mm were used. Two 6.5 mm CC screw and remaining 5 mm CC screws were applied in distal fragment and non-locking cortical 4.5 mm screw applied in most proximal screw hole. Remaining screw holes cortical screws were placed (5 mm), length and positions of the screws were checked with Anteroposterior and lateral imaging. The surgical site was irrigated with normal saline. Vastus lateralis was not repaired and kept in place over suction drains, and fascia lata was repaired with an absorbable suture. Subcutaneous and skin closure was done, and a dressing was applied.

Postoperatively, patients received antibiotics, I.V for 1 day's f/b oral antibiotics for next 7 days. Analgesics were given accordingly. Check X-ray was taken immediately after the surgery on 2nd post-operative day. Physiotherapy with active knee bending and static quadriceps exercise was started on 2nd post-operative day. The wound was inspected on the 3rd post-operative day. Suture was removed on 10th post-operative day non-weight bearing crutch aided ambulation was done as per patient's pain tolerance.

Full non-assisted weight bearing was allowed once clinico-radiological fracture union was achieved.¹¹

All patients were followed up at 6th week, 3rd month, and 6th months. X-rays of the involved thigh with hip and knee was done at every visit to assess fracture union. Radiographs of the femur i.e., anteroposterior and lateral views, were obtained for functional and radiological assessment, which was done on basis of Neer's score.¹²

Statistical analysis

The statistical analysis of data was performed using the computer program, statistical package for social sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010. Results on continuous measurements are presented as mean standard deviations are compared using student t test. Discrete data are expressed as numbers (%) and are analysed using Chi

square test and Fischer's exact test (where the cell counts were <5 or 0). The statistical significance was fixed at a 5% level (p value <0.05) for all analyses.

RESULTS

The majority of the patients were adults between the ages of 26–55 years, with a mean age of around 40 years in both groups. The majority of the patients were male, with a male-to-female ratio of 4.2:1. The supracondylar femur fractures occurred primarily as a result of RTA or self-fall, with RTA being more common than self-fall, and right-sided predominance was seen for supracondylar femur fractures. Fracture type AO33-A1 (53.85%) was seen more commonly in both groups. This difference, however, was not statistically significant. The mean duration of surgery in the RIMN group (64.85, 4.86) minutes was significantly less than that in the DFLCP group (79.85, 7.19) minutes, and the mean intraoperative blood loss in the RIMN group (212.31±4.33) ml was also significantly less than that in the DFLCP group (336.92±28.83) ml. The mean hospital stay in the RIMN group was (8.77±4.15) days was also significantly less than that in DFLCP group (16.69±5.12) days, and the mean bone union time was (15.42±4.94) weeks in the RIMN group and (19.60±9.04) weeks in the DFLCP group. This demonstrates a significant difference in mean bone union time between the two groups.

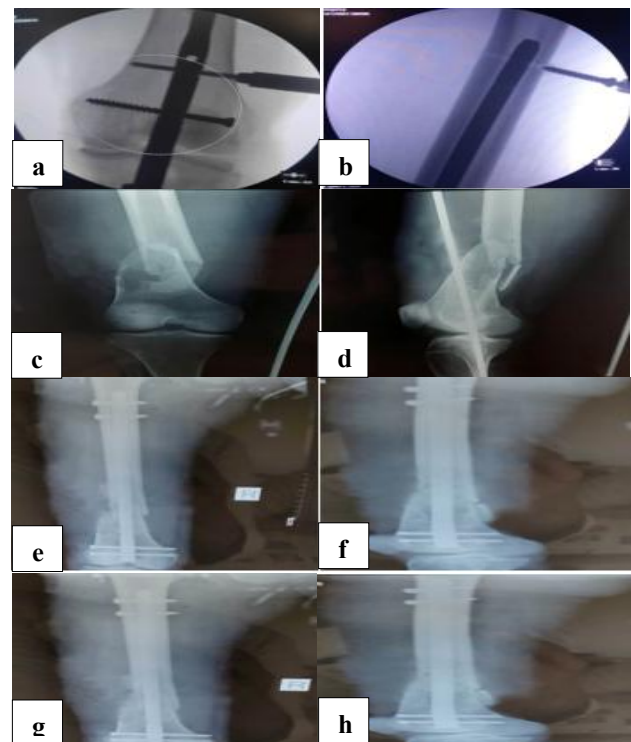


Figure 1: (a and b) 40-year-old male patient treated with RIMN, (c and d) pre-op X-rays, (e and f) immediate post-op, and (g and h) at 6-weeks.

All fractures in the RIMN group were united (100% union rate), with one case of delayed union, one case of

periprosthetic implant fracture, and one case of knee joint arthrosis. There were three cases of non-union in the DFLCP group. In the RIMN group, the mean Neer's score at the sixth week, third month, and sixth month was (73.54 ± 10.94), (79.08 ± 23.98), (86.58 ± 26.26), while in the DFLCP group, the mean Neer's score at the sixth week, third month, and sixth month was (62.54 ± 13.55), (70.0 ± 10.02), (76.92 ± 11.09). Until the final follow-up, this is statistically significant in both groups.

Table 1: Age distribution.

Age (years)	Group-A (RIMN)		Group-B (DFLCP)		P value*
	N	%	N	%	
18-30	0	0	4	30.77	0.1290
31-40	6	46.15	6	46.15	
41-50	4	30.77	2	15.38	
51-60	3	23.08	1	7.69	
Total	13	100	13	100	

*Statistically significant.

Table 2: Gender distribution.

Age (years)	Group-A (RIMN)		Group-B (DFLCP)		P value*
	N	%	N	%	
Male	12	92.31	9	69.23	0.1354
Female	1	7.69	4	30.77	
Total	13	100	13	100	

*Statistically significant.

Local soft tissue complications, such as deep infections, were more common in the DFLCP group ($n=2$, 15.38%). These patients were given thorough wound debridement as well as empirical intravenous antibiotic therapy. Anterior knee pain ($n=3$, 23.08%), on the other hand, was more common in the RIMN group. In our study, the differences

in the rates of complications between RIMN and DFLCP were not found to be statistically significant ($p>0.05$). Neither procedure was associated with systemic complications.

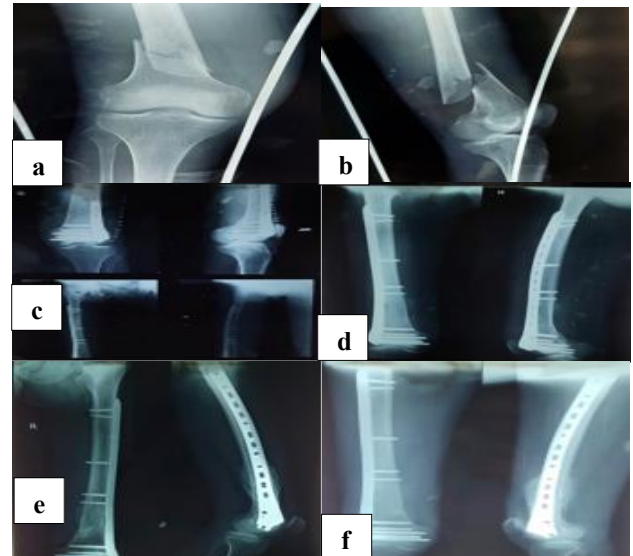


Figure 2: 55-year-old male patient treated with DFLCP, (a and b) pre-op X-rays, (c) at immediate post-op, (d) at 6-weeks, (e) at 3-months, and (f) at 6-months.

Table 3: Time of union.

Parameter	Group-A (RIMN) (mean $\pm$ SD)	Group-B (DFLCP) (mean $\pm$ SD)	P value*
Time of union (weeks)	15.42 $\pm$ 4.94	19.60 $\pm$ 9.04	0.003

*Statistically significant.

Table 4: Radiographic and functional outcome on basis of Neer score.

Radiographic and functional outcome	Group-A (RIMN)		Group-B (DFLCP)		P value*
	Number	Percentage	Number	Percentage	
At 6 th week					
Excellent (90–100)	0	0.00	0	0.00	0.0937
Good (80–89)	4	30.77	0	0.00	
Fair (70–79)	4	30.77	6	46.15	
Poor (<70)	5	38.46	7	53.85	
Mean±SD*	73.54	10.94	62.54	13.55	0.0320
At 3 rd months					
Excellent (90–100)	1	8.33	0	0.00	0.01346
Good (80–89)	6	50.00	0	0.00	
Fair (70–79)	4	33.33	9	69.23	
Poor (<70)	1	8.33	4	30.77	
Mean±SD*	79.08	23.98	70.00	10.02	0.0341
At 6 months					
Excellent (90–100)	5	41.67	0	0.00	0.0409
Good (80–89)	6	50.00	8	61.54	
Fair (70–79)	0	0.00	2	15.38	
Poor (<70)	1	8.33	3	23.08	
Mean±SD*	86.58	26.26	76.92	11.09	0.0402

*Statistically significant.



Figure 3 (a-c): Functional outcome at 6-months of follow-up in patient treated with DFLCP.

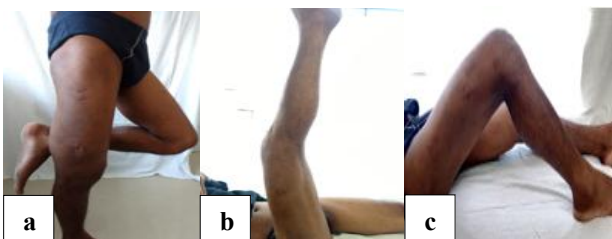


Figure 4 (a-c): Functional outcome at 6-months of follow-up in patient treated with RIMN.

DISCUSSION

In our study, the mean NEER score at the sixth week, third month, and sixth month was 73.54 ± 10.94 , 79.08 ± 23.98 , 86.58 ± 26.26 in the RIMN group, and 62.54 ± 13.55 , 70.0 ± 10.02 , 76.92 ± 11.09 in the DFLCP group. This is statistically significant in both groups till the final follow up ($p < 0.05$). Singh et al, in their study found that the functional outcome according to the NEER scoring system between the two groups RIMN and DFLCP was statistically insignificant ($p = 0.134$), and the mean NEER score was higher in the LCP group, but it was statistically insignificant.¹³

Kumar et al, according to their study, the clinical and radiological outcomes in terms of the Neer scoring system were excellent in 45% of the DFLCP group and 40% of the retrograde nailing group in their study. Satisfactory results were obtained in 35% of DFLCP patients and 45% of retrograde nailing patients.¹⁴ The treatment of choice for comminuted distal femoral fractures, particularly type A fractures with a higher Neer score, is a distal femoral locking plate.

Limitations

This study's limitations include a single-center design, a small sample size, and a shorter follow-up period. A study with more randomised observational studies on a larger sample size and over a longer period is suggested to determine the outcome conclusively.

CONCLUSION

We observed that both the approaches are equally effective and comparable in treating distal femur fracture AO (33-A1, 33-A2, 33-A3) in terms of final radiological and functional outcome on basis of Neer's score. Despite this, we found that RIMN using a minimally invasive approach has significantly less soft tissue complications (superficial and deep infections), a shorter duration of surgery, and less duration of hospital stay, less intraoperative blood loss. In terms of fracture healing, RIMN performs significantly better than DFLCP in the treatment of supracondylar femur fractures even though RIMN had a higher incidence of anterior knee pain. As a result, we conclude that RIMN is a better option in the operative treatment of supracondylar femur fractures AO (33-A1, 33-A2, 33-A3) in terms of less soft tissue complications, shorter duration of surgery, and less intraoperative blood loss, shorter duration of hospital stays, and time of fracture union.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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