

Functional Outcome of Distal Femur Fractures Managed with Plate and Nail Osteosynthesis

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Abstract: ***Study design:** Prospective study to deduce the functional outcome of distal femur fractures in 50 patients operated in our hospital with supracondylar nail and distal femur plate. **Objective:** To study the functional outcome and results of operative modalities for treatment of Distal femur fracture with Locking compression plates, Condylar buttress plate, Dynamic condylar screw with side plate and Retrograde intramedullary supracondylar nail. **Material and Methods:** This was a prospective study conducted with 50 patients with distal femur fractures managed surgically with both plate osteosynthesis as well as retrograde supracondylar nail. Patients were assessed in terms of intraoperative blood loss, operative time, early weight bearing and radiological union. **Results:** Decreased operative time, intraoperative blood loss was observed in a case of supracondylar nailing when assessed along with a case of distal femur plating. Early weight bearing and mobilisation could be started in a patient in whom supracondylar nailing was done. As far as radiological union was taken into account both had similar results with nailing showing union upto 4 weeks before plating. **Conclusion:** Retrograde supracondylar nail and distal femur plating had similar long-term outcome in extraarticular distal femur fractures. Patients managed with supracondylar nailing had less blood loss, decreased hospital stay, and early weight bearing since nail is a load sharing device. But these factors were not significant to affect the final functional outcome.*

Keywords: Distal femur fracture, locking compression plate, supracondylar nail

1. Introduction

The fast pace of modern industrialization and hectic lifestyle have contributed to a sharp increase in road traffic accidents as well as an aging population with a higher risk of osteoporotic fractures due to increased life expectancy. Distal femoral fractures are much less common than hip fractures and account for about 4-7% of all femoral fractures. If fractures of the hip are excluded, 31% of femoral fractures involve the distal portion.^[1]

Distal femur fractures occur typically due to two different mechanisms of injury in two different set of population. There is bimodal distribution in distal femur fractures. High energy distal femur fracture caused by road traffic accidents, sports injury occur mostly in young males (<40 years) while in women aged above 50 years with osteoporosis fracture happens as a result of trivial trauma.

Fractures of the distal femur are challenging to treat effectively as they tend to be complex, unstable, involve multiple joints, and result in significant damage to the surrounding soft tissues, including the quadriceps and knee ligaments.

Previously, most fractures of the distal femur were treated with conservative methods, such as traction, which could lead to satisfactory results, however, patients were also exposed to prolonged bedrest, as well as potential deformities, misalignment in the knee joint, and decreased knee mobility. The optimal method of treatment is still disputed. After the recent advances in techniques and implants, nonsurgical methods have largely fallen out of favour.^[2]

The optimal method of treatment is still disputed. Various treatment options are available for management of distal

femur fractures advocated by AO group includes plate osteosynthesis with condylar buttress plate, dynamic condylar screw with 95 degree side plate, locking compression plates and less invasive stabilisation system (LISS) and nail osteosynthesis using anterograde and retrograde nail.

Early surgical stabilization can facilitate care of the soft tissue, permit early mobility and reduces the complexity of nursing care.^[3]

Locking condylar plates, a minimally invasive technique, offer higher rates of union and stronger fixation in osteoporotic bones, leading to improved knee mobility. While they may be more expensive than other devices, locking plates are highly effective for treating fractures of the distal femur, especially in cases of osteoporosis and complex fractures. They have become a widely accepted treatment option in modern orthopaedics.

Intramedullary nails are load sharing devices and can be used for all extra articular distal femur fractures. Advantages of nailing is need of less soft tissue dissection and have been claimed to have high healing rates.⁴ Disadvantage of nailing is difficulty to achieve articular congruity in intra articular comminute fractures

This study is to analyse outcome and results of operative modalities of treatment for Distal femur fracture with Locking compression plates and Retrograde intramedullary supracondylar nail.

2. Materials and Methods

This study included 50 patients admitted and operated in our hospital during September 2020 to September 2022

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Inclusion Criteria

- 1) The fractures of the distal femoral metaphysis, metaphysis-diaphysial with or without intraarticular extension.
- 2) Closed fractures.
- 3) Gustilo grade 3 open fractures

Exclusion Criteria

- 1) Fracture in patients of age <18 years.
- 2) Any pathological fracture (except due to osteoporosis).

Classification**Type – A (Extra Articular):**

Fractures are divided into three subgroups of increasing severity:

- A1. Simple extraarticular fracture (two parts)
- A2. Metaphyseal wedge fractures
- A3. Metaphyseal complex fractures (comminuted)

Type –B (Partial Articular):

Fractures are further classified according to the plane of the fracture and the direction of the fracture line.

- B1. They are lateral sagittal fractures with the fracture line running upwards and outwards and detaching the lateral condyle.
- B2. They are the medial sagittal fractures with the fracture line running upwards and inwards and detaching the medial condyle.

B3. The fractures are in the frontal plane (coronal plane- *Hoffa's fracture*).

Type-C (Complete Articular):

They are further classified according to the pattern of articular and metaphyseal component.

C1. They are simple articular and simple metaphyseal fractures ('T' or 'Y' fracture pattern).

C2. They are simple articular and multi fragmentary metaphyseal fractures.

C3. They are multi fragmentary articular fractures.

Fractures were classified as per the Orthopaedic Trauma Association (AO/OTA) classification.^[5]

All patients were operated in the supine position. In plating, an incision of size 5 to 6 cm was made to the lateral part of the distal thigh, corresponding to the distal region of the fracture line. The locked distal femur plate was then slid submuscularly to the proximal part of the fracture line. The proximal plate was accessed through an incision of size 5 to 6 cm to the lateral part of the proximal thigh. The distal part of the plate was fixed to the bone with a Kirschner wire (K-wire). After adequate length and alignment was ensured by means of manual traction and manipulation, the fracture was reduced and the proximal part of the plate was fixed to the bone with an additional K-wire. Osteosynthesis was completed by locking the proximal and distal parts of the plate with locking screws after fluoroscopic confirmation of the reduction.



Figure 1: Instrumentation for locking compression plate



Figure 2 & 3: Radiographic images of locking compression plate

In the retrograde nailing, the joint was accessed using a medial parapatellar approach of approximately 3 to 4 cm in length. The fracture was reduced and length and alignment was obtained with manual traction. After radiological control of the reduction, awl was inserted in retrograde fashion in the centre of intercondylar notch in antero-

posterior view and anterior to blumensaat line in lateral view to avoid damage to posterior cruciate ligament. Reaming was done and nail inserted. Distal locking done with 6.5 mm cancellous bolts and proximal locking done with 4.9 mm cortical bolts.



Figure 4: Instrumentation for Retrograde femur nail

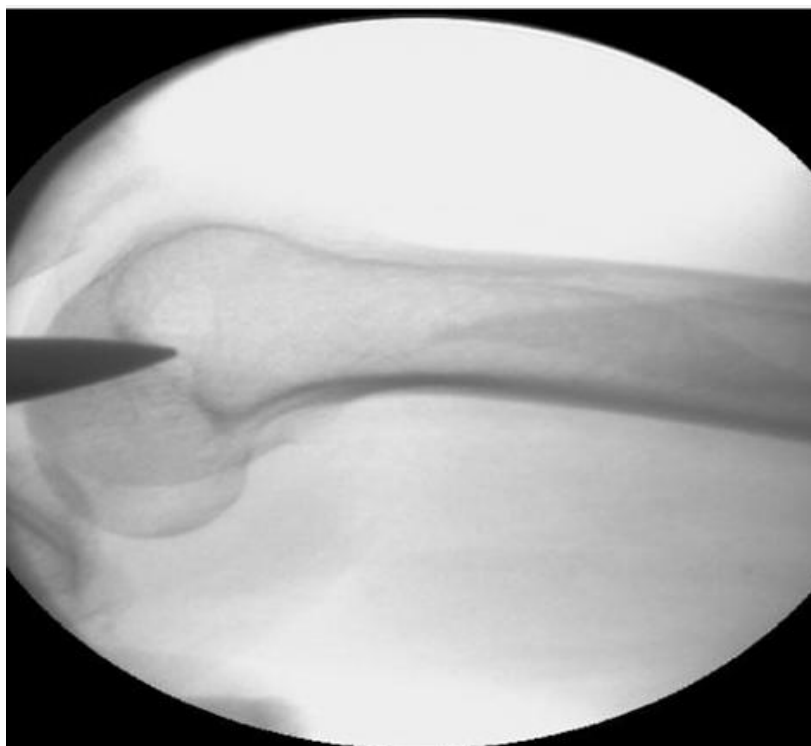


Figure 5: Entry point for retrograde femur nail



Figure 6 & 7: Radiographic images of postoperative retrograde femur nail

After surgery, antibiotics were given for 24 to 48 hours to prevent infection and low-molecular-weight heparin was given to prevent deep vein thrombosis until the patient was able to move around. The patient started doing isometric quadriceps exercises and knee-hip-ankle exercises at the end of the first day after surgery. On the second day, the patient was able to move around using double crutches without putting weight on the affected limb. The amount of weight allowed on the affected limb varied depending on the stability of the fracture, with partial weight-bearing allowed within 3 weeks for Type A1 fractures in the nail group and within 6 weeks for Type A2 and A3 fractures and all fractures in the plate group. Full weight-bearing was allowed once the fracture had healed, as shown by x-rays.

Follow up was done for 1, 3 and 6 months.

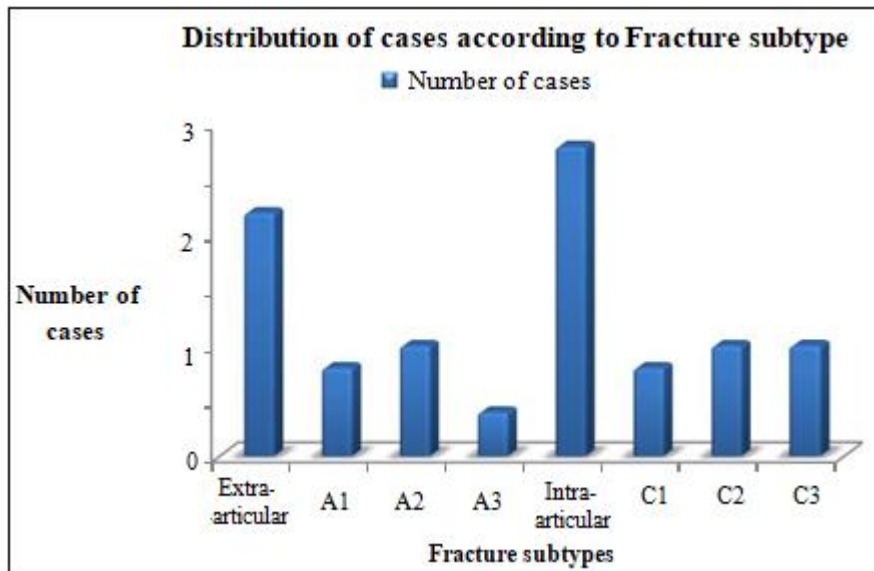
Data Analysis

The entire data was filled into excel sheet and was further analysed using SPSS software. Mean standard deviation were calculated along with required ranges for measured values.

3. Results

Table 1: Fracture subtypes–Patients distribution

Type of fracture	Numberofcases
Extra-articular	22(44%)
A1	8 (16%)
A2	10(20%)
A3	4 (8%)
Intra-articular	28(56%)
C1	8 (16%)
C2	10(20%)
C3	10(20%)
Total Cases	50(100)

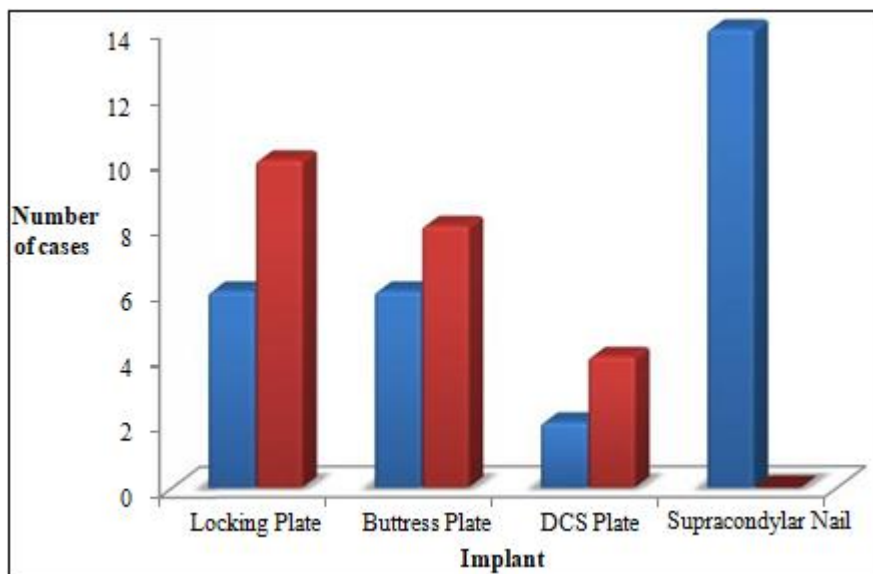


In this, majority of the fractures were Intra-articular (56%) out of which A O type C1, C2 & C3 were 16%, 20% and 20% respectively.

The others were Extra-articular (44%) out of which AO type A1, A2 & A3 were 16%, 20% and 8% respectively.

Table 2: Intra-Operative average blood loss–Patients distribution

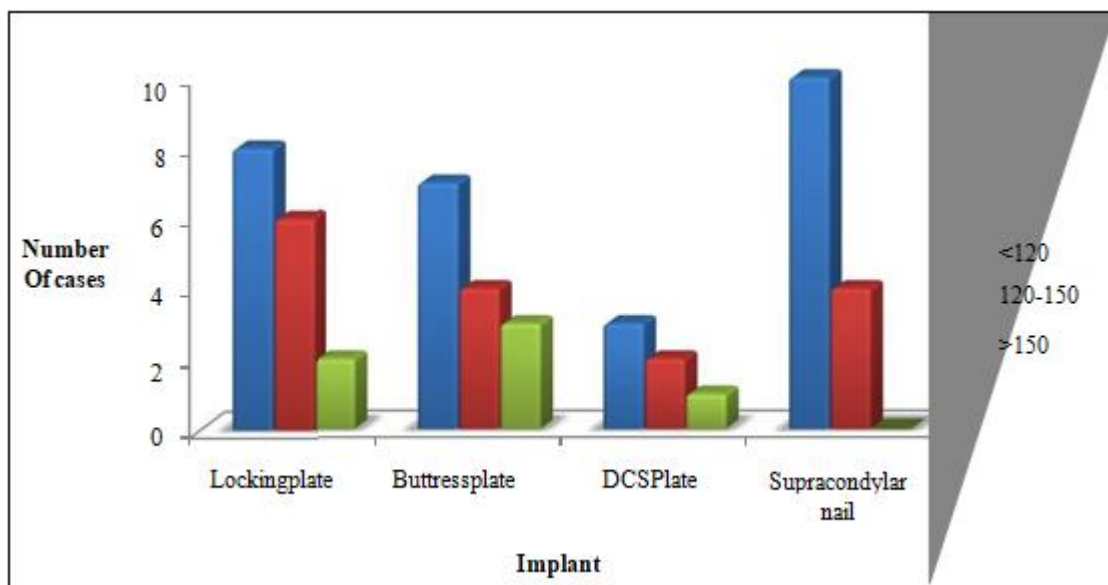
Blood loss in (ml)	Locking plate	Buttress plate	DCS plate	Supracondylar nail
<300ml	6(37.5%)	6(42.8%)	2(33.4%)	14(100%)
≥300ml	10(62.5%)	8(57.2%)	4(66.6%)	0
Average loss	284.38ml	282.14ml	291.66ml	142.85ml
Total cases	16(100%)	14(100%)	6(100%)	14(100%)



All the patients (100%) fixed with Retrograde nail had blood loss <300ml as compared to 37.5% of those operated with Locking compression plate, 42.8% those operated with Buttress plate and 33.4% of those operated with Dynamic compression screw with plate.

Table 3: Average duration of surgery–Patients distribution

Duration of surgery (minutes)	Locking plate	Buttress plate	DCS Plate	Supracondylar nail	Total
<120	8 (50%)	7 (50%)	3 (50%)	10 (71.42%)	28 (56%)
120-150	6 (37.5%)	4 (28.57%)	2 (33.33%)	4 (28.57%)	16 (32%)
>150	2 (12.5%)	3 (21.42)	1 (16.67%)	0	6 (12%)
Average duration	120 min	123.57 min	126.66 min	96.42 min	
Total	16	14	6	14	50



When plating was compared with retrograde nail, the difference in duration for surgery between plating and nailing was found to be statistically significant with duration of nailing far lesser than plating.

Table 4: Average hospital stay–Patients distribution

Hospital stay (Days)	Locking plate	Buttress plate	DCS	Retrograde nail	Total	Average Hospital stay (Days)
<15	2	1	0	9	12 (24%)	20.25
15-20	7	6	4	2	19 (38%)	
>20	7	7	2	3	19 (38%)	
Average stay	22	24	20	15		
Total	16	14	6	14	50 (100%)	

Average hospital stay with retrograde nail is 15 days which is less than Average Hospital stay for Locking plate 22 days, Buttress plate 24 days & DCS with side plate 20 days.

Table 5: Period of radiological union–Patients distribution

Period(wks)	Locking plate	Buttress plate	DCS	Supracondylar nail	No. of cases
10-15	13 (81.25%)	11 (78.58%)	5 (83.33%)	10 (71.42%)	39 (78%)
16-20	3 (18.75%)	2 (14.28%)	1 (16.67%)	4 (28.58%)	10 (20%)
>20	0	1 (7.14%)	0	0	1 (2%)
Average period of union	14.12	14.14	13.66	14.42	
Total	16 (100%)	14 (100%)	6 (100%)	14	50 (100%)

71.42% of the patients fixed with Supracondylar nail had union between 10-15weeks, 28.58% had union between 15-20 weeks. Average period of union radiologically for nailing was 14.42 weeks.

4. Discussion

Being an intramedullary load sharing device, Supracondylar nail extends a distinct assistance in early weight bearing and appears to be an alternative for distal femur fracture but persistent knee pain and later development of knee arthrosis and systemic complications remain a setback for nailing.^[6]

Despite a proven higher stiffness of plate systems compared with intramedullary nails, the latter devices provide the advantage of an indirect fracture reposition away from the almost always comminuted metaphyseal region.

In this study, earlier union rate was noticed in the nailing group with fractures uniting almost 4 weeks earlier on an

average than plating group but the difference was statistically insignificant. Studies comparing the supracondylar nailing and plating methods in distal femur fractures have reported similar complications in both groups^[7,8,9,10] Hierholzer et al.^[7] reported that the small supracondylar nail incision protects soft tissues and results in less blood loss. On the other hand, the authors reported no significant difference between both fixation methods in terms of nonunion or infection rates. In their prospective study of intra/extra-articular distal femur fractures, Markmiller et al. found no significant differences between the two groups in terms of infection, mal alignment or non union.^[8]

Conclusion

To conclude both plating and supracondylar nailing provided superior and similar results in view of fracture union in extra articular distal femur fractures. Patients managed with supracondylar nailing had less blood loss, decreased hospital stay, and early weigh bearing since nail is a load sharing

device. But these factors were not significant to affect the final functional outcome. In intra articular fractures plating provided a better joint congruity.

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