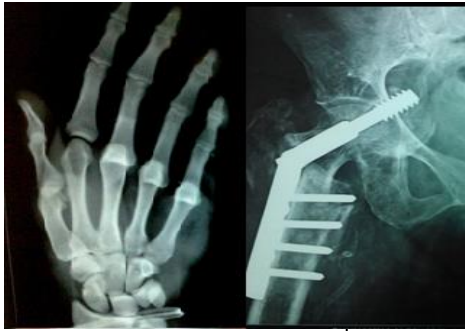




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A comparative study of functional outcome of extra articular distal femur fractures treated, with retrograde nailing versus locking compression plate

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Abstract

Aim: To compare the functional outcome of supracondylar fractures of distal femur managed by Supracondylar nailing (retrograde) and locking femoral compression plate.

Introduction: Before 1980, supracondylar fractures of the femur were treated with nonlocking plates. Plaster immobilization and traction were modes of treatment for non-operative patients. Nowadays, the knowledge of internal fixation has evolved as to treat complex fractures by cancellous screws, 95-degree blade plates, dynamic condylar screw and plate, condylar buttress plates, locking femoral compression plates and supracondylar nailing (retrograde). Trending procedures for supracondylar fractures of the femur are supracondylar nail (retrograde) and locking femoral compression plate.

Materials and Methods: Totally 30 patients of extra-articular distal femur fractures treated in Rajah Mathai Medical College from May 2019 to June 2021. Patients were treated by random allocation as 15 patients by retrograde nailing and the other 15 patients by distal femur locking compression plate. Functional outcome was compared between them according to Neer's Scoring System at 24 weeks.

Results: In our study, the patients were screened up to 1 year. The assessment was based on both radiologically and clinical scoring. Neer's score was higher in nailing (54%) compared to plating (46%).

Conclusion: From our study, nailing proved to have a good functional outcome in terms of early weight-bearing, knee flexion and less union time. Both nailing and plating have excellent results with proper preoperative planning.

Keywords: Distal femur fractures, supracondylar nailing, distal locking femoral plates

Introduction

Fractures of the distal third femur are defined as- "Fractures within 15cm from the articular surface of the distal femur. Before 1980, supracondylar fractures of the femur were treated with nonlocking plates. Plaster immobilization and traction were the mode of treatment for non-operative patients. Nowadays, the knowledge of internal fixation has evolved as to treat complex fractures by cancellous screws, 95 degree blade plates, dynamic condylar screw and plate, condylar buttress plates, locking femoral compression plates and supracondylar nailing (retrograde). Trending procedures for supracondylar femur fractures are supracondylar nail (retrograde) [1, 2] and distal locking femoral compression plate.

Extra and intraarticular fractures, particularly in osteoporotic bones [2, 6] were treated meticulously with a distal locking compression plate. Supracondylar nailing has the advantage of being less invasive over the plate and early knee mobilisation and weight bearing to prevent stiffness [3, 4] and arthritis.

In this study, we compared and evaluated the clinical, radiological and functional outcome of Supracondylar fracture of the distal femur [5], stabilization using supracondylar nailing (retrograde) and distal locking femoral compression plate.

Materials and Methods

This was a prospective randomized study conducted in patients aged >18 years having Supracondylar fractures of distal femur reporting to Orthopaedic OPD and Orthopaedic Emergency unit of Rajah Muthiah Medical College, Annamalai University Chidambaram

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during the study period from May 2019 to October 2021. Following were the inclusion and exclusion criteria for the selection of patients in study groups.

Inclusion Criteria

1. Age >18years
2. Type A distal femur fractures
3. Closed or Gustilo type I, II, IIIa & IIIb open fracture
4. Patient able to walk without assistance before the injury

Exclusion Criteria

1. Pathological fractures
2. Type B and C distal femur fractures
3. Gustilo type III C open fractures
4. Patients with bleeding manifestations.

Table 1: Demographic and Fracture Pattern in Two Groups

Parameters	Group I (SRN)	Group II (LCP)
Mean Age (years)	45.75	44
Gender		
Male	9	8
Female	6	7
Side		
Right	10	9
Left	5	6
Mode of Trauma		
RTA	13	11
Self-fall	2	4
Type of fracture		
Closed fracture	8	5
Open fracture		
Grade 1	2	4
Grade 2	3	4
Grade 3a	2	2
Classification (AO/OTA)		
33-A1	4	5
33-A2	7	7
33-A3	4	3

Informed consent was taken from all the subjects or guardians. A thorough history and clinical examination was done, including the status of vascular or neurological injury. The patients were immobilized temporarily by using a Plaster of Paris slab or by using upper tibial skeletal traction in elevation with a Bohler Braun splint. Intraarticular anterior approach was used for retrograde nailing. A lateral approach was used for locking compression plating. All patients were operated on at elective or emergency operation theatres of the Department of Orthopaedic Surgery, Rajah Muthiah Medical College, who had no preference for nailing or plating. The patients were followed up until union was achieved or was categorized as delayed union (>20 weeks). Each case was reviewed clinically and radiologically during the follow-up period every month. If there was no clinical or radiological union by the end of 20 weeks, it was categorized as a delayed union. Neer's scoring was used to functionally assess the patient. This was done after the fracture had united clinically and radiologically or at the end of 24 weeks whichever was earlier. Haemogram, blood glucose, blood urea, serum creatinine, liver function tests, blood group and Rh typing, bleeding time and clotting time, Chest X-ray, electrocardiography and X-rays of the fracture site were done. Computed tomography scans, Doppler study and angiography were done wherever required. Fractures were classified with the help of radiographs according to the AO-ASIF classification. The preoperative calculation was done on

radiographs to ascertain the length of the supracondylar nail, maximum possible diameter and lengths of interlocking bolts after subs traction of the magnification factor.

AO/Muller Classification



Fig 1: Diagrammatic representation of AO Muller classification

Operative Procedure: Pre-op assessment was done. The preference of spinal/epidural or general anaesthesia was decided.

Supracondylar retrograde nail: Patients undersupine position with access to fluoroscopy. The affected limb was placed in 30-degree flexion of the knee with a bolster. Through the midline patellar tendon splitting approach, a 5 cm longitudinal midline infra-patellar skin incision was centered over the patellar tendon and the tendon split longitudinally in its middle. The protection sleeve was inserted. In AP and lateral views, Blumensaats' line was drawn and the entry point was confirmed radiologically. Entry was taken with a bone awl 1 cm anterior to the insertion of PCL. A guidewire was inserted and reduction was achieved, with respect to the normal 7 degree valgus angle of the knee to the horizontal plane. Serial reaming in 1 mm increments was done until the cortical chatter was appreciated. A nail of size 1 mm less than the last reamer used was inserted and advanced with a distal end buried well below the subchondral bone established under fluoroscopy. The distal locking bolts and proximally two interlocking bolts were inserted under fluoroscopy.

Appropriate IV antibiotics were given for 3 to 5 days once the surgery was completed and converted to oral, till suture removal. On the 5th-14th day after surgery, the patient status was evaluated discharged from the hospital. Isometric quadriceps exercises and knee -hip -ankle exercises were initiated in first postoperative day. Non weight bearing mobilization with a walker was done from the 2nd day onwards. Patients were called for follow-up at two weeks, four weeks and then monthly till six months and three monthly after that.

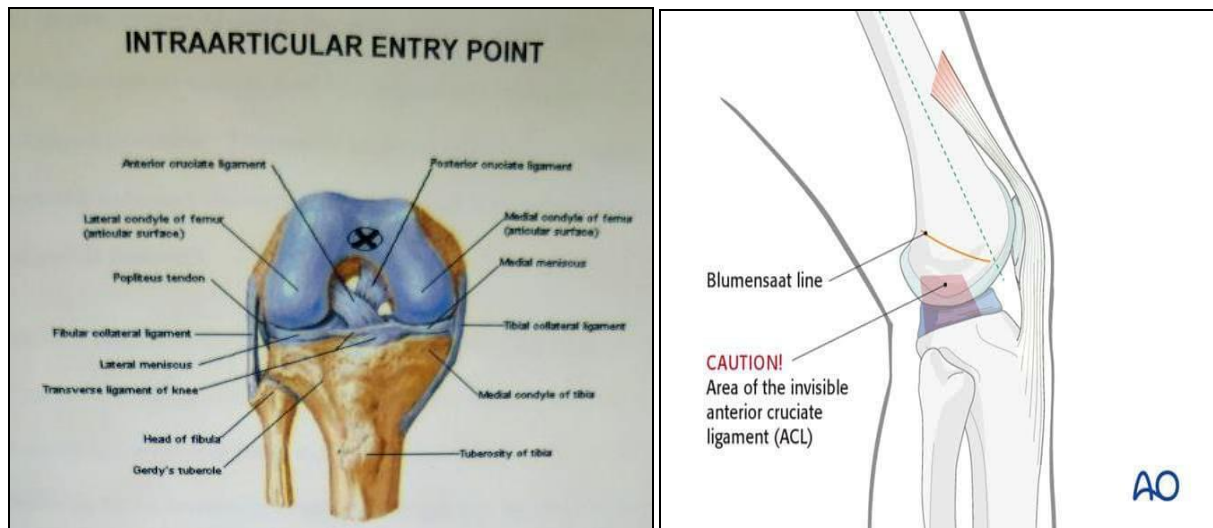


Fig 2: Pictorial representation of entry point and instrumentations in retrograde nailing

Locking compression plate group: The patient was positioned supine on a radiolucent OT table under fluoroscopy imaging with a bolster under the knee to acquire flexion of 20-40 degree in order to relax the deforming force of gastrocnemius; thereby avoiding the typical hyperextension of the distal fragment. Principally, through lateral approach, a 6 cm skin incision was made starting from Gerdy's tubercle and extended proximally in a curvilinear fashion in line with the shaft of the femur. The vastus lateralis muscle was split

and LCP was glided under the muscle, K wires were applied for holding the plate in position. The reduction achieved by manipulation. Essential instruments needed were, femoral distractor, Lowmans' forceps, percutaneous clamps etc., and utilized wherever necessary. Locking screws were applied and checked under fluoroscopy to prevent intra articular penetration. Proximally nonlocking screws can be inserted by stab incisions wherever necessary using an image intensifier. ROM of the knee joint was checked after complete fixation.



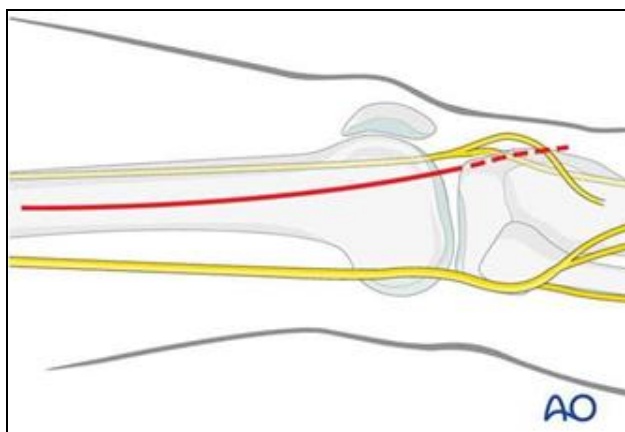


Fig 3: Instrumentation in LCP and AO lateral approach to the distal femur.

Postoperative care was given as routine. Partial weight bearing for A1 type fractures were started by 3 weeks, early knee mobilization was advised as prior. Patients with type A3, weight bearing was started after 6 weeks. Full weight bearing was delayed in LCP patients and allowed once satisfied with radiological and clinical stability. Serial follow-ups were aimed with, Anteroposterior & lateral views of the affected limb. Pain scores calculated under the Visual Analogue Scale (VAS). Clinical evaluation of patients were comprised of checking wound healing, stability of the knee, alignment of fixation, range of motion, infection and rest of the complications.

lateral radiographs were taken to visualise the osseous union by the presence of bridging callus in three or four cortices. Good clinical healing comprises minimal /no pain and no tenderness near the fracture site. Functional outcomes were graded using Neer's Score.

Table 2: Neer's Score

Excellent	>85
Good	70-85
Fair	56-69
Poor	<55

Table 3: Components in Neer's scoring

Functional (70 points)		Anatomical (30 points)	
a) Pain (20 points)		a) Gross Anatomy (15 points)	
• No pain		• Thickening only	15
• Intermittent	16	• 5 degrees angulation or 0.5 cm shortening	12
• With fatigue	12	• 10 degrees angulation or rotation, 2 cm shortening	9
• Limits function	8	• 15 degrees angulation or rotation, 3 cm shortening	6
• Constant or at exertion	4-	• Healed with considerable deformity	3
b) Walking Capacity (20 points)		• Nonunion or chronic infection	0
• Same as before accident	20	b) Roentgenogram (15 points)	
• Mild restriction	16	• Near normal	15
• Restricted stair side ways	12	• 5 degrees angulation or 0.5 cm displacement	12
• Use crutches or other walking aids	4-0	• 10 degrees angulation or 1 cm displacement	9
c) Joint Movement (20 points)		• 15 degrees angulation or 2 cm displacement	6
• Normal or 135 degrees	20	• Union, but with greater deformity, spreading of condyles and osteoarthritis	3
• Up to 100 degrees	16	• Nonunion or chronic infection	0
• Up to 80 degrees	12		
• Up to 60 degrees	8		
• Up to 40 degrees	4		
• Up to 20 degrees	0		
d) Work Capacity (10 points)			
• Same as before accident	10		
• Regular, but with handicap	8		
• Alter work	6		
• Light work	4		
• No work	2-		

Results

Total of 30 patients of extra-articular distal femoral fractures were divided into two groups (Supracondylar retrograde nailing SRN-15 patients, locking compression plate LCP - 15 patients). The mean age of SRN was 45.75 years, while the mean age of LCP was 44 years. In both groups cause of injury was a road traffic accident (RTA) which was found to be 82.2% cases in the SRN group and was 81.6% for group II. The left and right side of the fracture in both was found to be approximately in same proportion.

Both group1 and group 2 patients were screened for a period of 1 year. In the Flexion Score comparison among the groups, the SRN group showed a marginal good flexion score than the plating group. In the comparison of pain Scores among the groups, the SRN patients had a higher score.

We have done closed nailing in 14 patients, 1 patient needed open reduction and ss wire cerclage. Our patients didn't need bone grafting.

The functional score was not comparable and resulted found to be similar. The patients with supracondylar retrograde

nailing had early full weight-bearing at around 6 weeks, which was longer in the plating group. The meantime of union in group I (SRN) was 14 weeks & in group II (LCP) was 16 weeks. Bone union was seen earlier in group I (SRN). According to Neer's functional outcome scoring system, the mean functional score was more in the SRN group. In our study, limb shortening was present in 1 patient with SRN and

2 patients in LCP. One patient had implant failure, breakage of the plate (3.3%) after the union. In spite of taking extra precautions to prevent injury to the patella and femoral cartilage throughout the retrograde nailing as well as confirming the distal extent of the nail under image, knee pain was present in 3 patients.

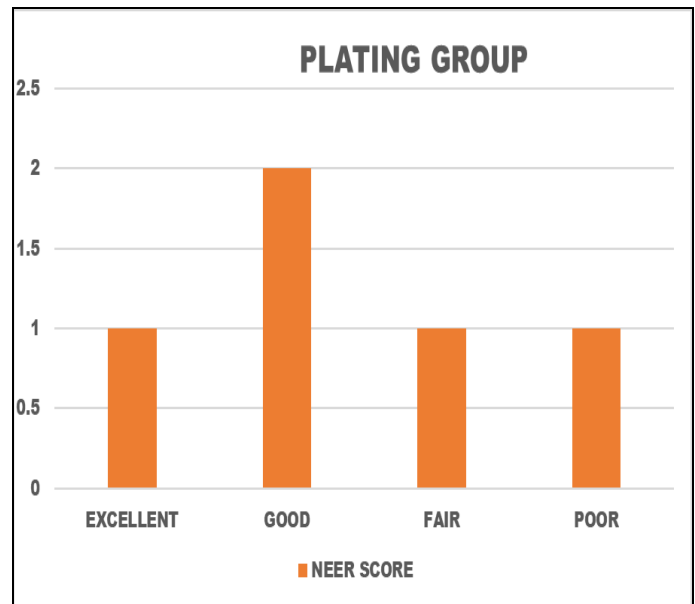
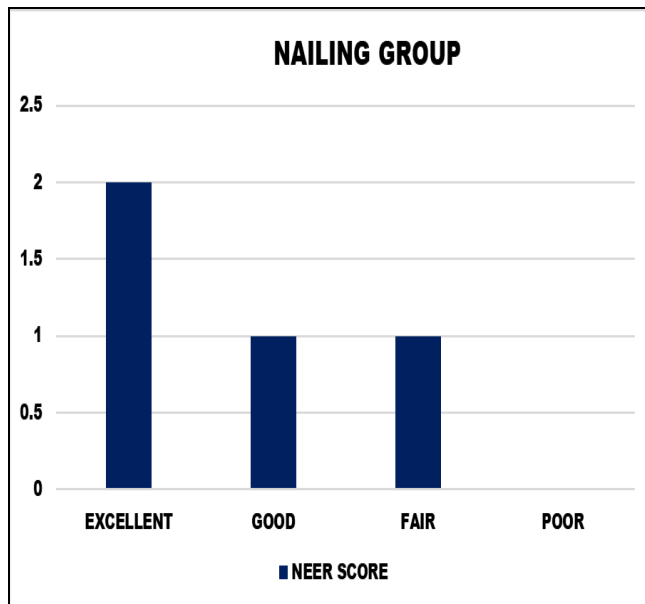


Fig 4: Bar diagram showing functional outcome in nailing and plating group

Table 4: Percentage of functional score in both the groups

		Group 1 SRN	Group 2 LCP	Total
Excellent	Count	7	4	11
	% in groups	46.6%	26.7%	35.6%
Good	Count	4	8	12
	% in groups	26.7%	53.3%	40%
Fair	Count	4	2	6
	% in groups	26.7%	13.3%	2%
Poor	Count	0	1	1
	% in groups	0%	0.07%	3.4%
Total	Count	15	15	30
	% in groups	100%	100%	100%

Discussion

Fractures of the distal femur were severe and complex injuries, where there was an equal distribution^[7] of males and females.

The use of a locked compression plate has shown reduced callus formation around the plate and found to be stiff. This trends the plating towards primary healing and early union by Lujan *et al.*^[8] & Shailendra singh^[9]. In spite of the increased healing rate, there was a disturbance in union with the locking compression plate group.

Zlowodzki^[10] & Markmiller *et al.*^[11], in their study, shows no difference between nailing and plating on union rate. Individual studies of Demirates A^[12] also has arrived at outcomes with excellent to poor results in both nailing and plating groups.

Various scoring systems have been used, which has its own fallacies. Our study emphasis on Neer's Scoring System (NSS)^[13]. Shailendra singh has derived functional outcomes with NSS and describes the importance of NSS over other

scoring system as it covers both clinical and radiological outcomes of patient.

In our study, the SRN group have a higher mean Neer's score and previous studies also has cocordant results which were comparable. In the past, studies of Gao K *et al.*^[14], with Hospital for Special Surgery Score (HSS) and Ashwin Shetty^[15] with Hammer score supported the functional scoring to be higher in the SRN group.

Technically, the SRN has more advantages of minimal percutaneous procedure, avoiding disruption of blood vessels and early knee mobilization. Earlier studies have proved no significant difference in final results of plating & nailing except for the presence of anterior knee pain, described by Leggon *et al.*^[16] and knee arthrosis with nailing. Hartin *et al.*^[17] also found the presence of knee pain in the SRN group and found it resolved after 4 weeks. These complications can be avoided by taking precautions in reaming by using a protection sleeve, and draining out the debris in the knee joint. Biological fixation of fractures with proper surgical technique seems to be an ideal way to prevent the infection and nonunion rates.

According to Hoskin *et al.*^[18], the SRN has proved to be a superior technique to LCP and this supports the outcome of our study.

To be precise, the choice of the implant would be decided based on the fracture pattern, wound status and comorbidities of the patient. It's appropriate that surgeon's prefer the choice with respect to the patient's condition.

Case illustration

Case 1: Plating

53 years old female

H/o RTA to the right thigh



Pre-Op X-Ray

Immediate Post Op



1 Month

6 Months

Intra Op



Follow Up



Case 2: Nailing
35 years old female
H/o RTA to right thigh



Pre-Op



Immediate Post Op



1 Month



6 Months

Intra Op



Follow Up



Conclusion

In our study functional results trended toward better in nails than plates in terms of mean union time and range of motion at the knee joint. A locking compression plate is a good implant for fractures of the distal femur giving comparable results to supracondylar retrograde nailing. The overall functional outcomes of supracondylar retrograde nailing and locking compression plating done for extra-articular distal femoral fractures remains unaltered despite the range of motion was more in the case of the supracondylar retrograde nail group. One of our patients had implant failure (breakage of the plate). Since our follow-up period was short and a number of cases were less, the choice of the implant was difficult to conclude. Both nailing and plating have good outcomes with proper preoperative planning.

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