

Comparison of Functional Outcome of Intra-Articular Distal Femur Fracture Management with Retrograde Nail with That of Locking Compression Plate - A Clinical Interventional Study

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ABSTRACT

BACKGROUND

Intraarticular distal femur fracture has always been difficult to treat and the choice of fixation device often leads to confusion. Retrograde nailing with distal femur nail in a closed manner and open reduction and internal fixation with locking compression plate are the two most widely accepted methods of fixation. We wanted to compare the efficacy and functional outcome of these two methods.

METHODS

This is a prospective interventional study of 20 patients with closed intra-articular distal femoral fracture treated either with retrograde nailing or locking compression plate. They were divided into two groups of 10 patients each. In one group retrograde nailing was done while in the other group locking plate was used for fixation. The patients were followed up monthly for six months thereafter in 12 & 18 months. Every time, radiological signs of healing, range of movement of knee, onset of complications like knee pain, and infection were noted and functional assessment scoring was done as per Neer's score.

RESULTS

The mean duration of surgery in nailing group was 68 ± 12.2 minutes while it was 81 ± 11.6 minutes in plating group which was statistically significant (p -value = 0.025). Average fracture union time was better in nailing (15.2 ± 1.2 weeks) than plating group (18 ± 1.4 weeks) as assessed both clinically & radiologically (p -value = 0.0001). The average knee flexion was better in nailing (104.8 ± 9.4) than plating (91.4 ± 8.9) (p -value = 0.0042). Post-operative Neer's score was higher in nailing (86.2 ± 10.6) than the plating group (63.8 ± 9.4) which was statistically significant.

CONCLUSIONS

In our study, retrograde nailing with distal femoral nail was found to be a better fixation system for both extra- as well as intra-articular fractures (AO type C1 & C2) of distal femur with better outcome in terms of range of movements, mobilization, time to union, operative time and blood loss.

KEYWORDS

Intra-Articular Fractures, Fracture Fixation, Intramedullary, Bone Plates, Femoral Fractures

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BACKGROUND

The incidence of distal femoral fractures is approximately 37 per 1,00,000 persons per year.¹ Distal femur fractures are defined as "Fractures up to 15 cm from distal femoral articular surface." It accounts for 6 - 7 % of the fractures of femur. In the older osteoporotic population, it occurs predominately after low-energy trauma like falls & have complications associated with comorbidities.² In younger patients, high-energy trauma leads to complex injury with comminuted and open fracture pattern. Internal fixation has advantage of early ambulation and early knee range of motion exercises which reduces chances of knee stiffness.^{3,4} Currently with evolution of implants and fixation, the modes of treatment have been focused on Locked plating, Intramedullary nailing or Total knee replacement with angled blade plates.

A retrograde intramedullary nail aligns the femoral shaft with condyles, reducing the tendency for varus movement at the fracture site and has the advantages like preservation of fracture haematoma, less blood loss, minimal soft tissue dissection, less operative time and reduced rate of infection and is often termed as the "biologic" mode of fixation. Distal femoral locking plates has shown promising results in both intra and extra articular fractures of distal femur especially in osteoporotic bones.⁵ The locked compression plate is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness or pullout resistance as seen in unlocked plates.

While the controversy in the management of these fractures has always been there, the choice of implant in a fracture with intraarticular component is still not very conclusive. There is little literature evidence comparing the nailing and plating in these groups of injury (AO type C1 & C2) as most of the surgeons are preoccupied with doing a locked plating in these injuries.

In this prospective study, we evaluated and compared the clinical, radiological and functional outcome of intraarticular type of distal femur fracture stabilization using retrograde nailing and locking compression plate.

METHODS

This prospective, single center, clinical interventional study was conducted from August 2017 to November 2019 in the Department of Orthopaedics, Sri Ram Chandra Bhanja Medical College & Hospital, Cuttack, in patients of intra-articular distal femoral fracture who were treated either by retrograde intramedullary nailing or with locking compression plate. This was approved by the institutional ethics committee. Before enrolling any patient for the study informed written consent was obtained. Conventionally all these group of fractures were treated with open reduction and internal fixation with locking compression plate. We aim to compare its results with closed reduction and fixation with distal femoral nail.

A total of 20 patients with distal femur fracture were treated. They were divided into two groups of 10 patients each. There was no preoperative randomization. The procedure to be done was decided by the two senior surgeons who was familiar with both the methods of fixation but had no preference for one particular method of fixation. Selection bias was avoided by allocation concealment. Group one underwent treatment with locking compression plating while Group two underwent retrograde nailing.

Inclusion Criteria

1. Age group 18 to 70 years of either sexes.
2. AO type C1, and type C2 distal femur fracture or fracture with intercondylar extension.
3. All cases of distal femur fracture medically fit for surgery.
4. Patients with compound grade-1 injuries.

Exclusion Criteria

1. AO type A, type B and type C3.
2. Patients less than 18 years of age & more than 70 yrs.
3. Patients unfit for surgery.
4. Associated comorbid conditions history of suffering from Myocardial Infarction (MI) less than one year, psychiatric illness, and head injury.
5. Uncontrolled diabetes mellitus (DM), hypertension, patients with clinically detectable focus of active infection.
6. Pathological fracture.
7. Fracture involving patellar fracture and neuro vascular injury.

Soon after admission, a detailed history was taken, relating to the age, sex and occupation, mode of injury, past and associated medical illness and then they were immediately kept in a proximal tibial skeletal traction over a Böhler Braun splint till surgery which was after 3 days. Antero posterior and lateral radiographs of distal femur including knee were studied to classify the fractures. A routine radiograph of pelvis done to rule out any hip injury. Group one (10 patients) were treated by distal femoral locking plate while group two (10 patients) were treated by distal femoral nailing. After obtaining informed consent, the patient was kept for surgery. Epidural anesthesia was given and the patient was positioned as per the desired surgery. A single dose of intravenous antibiotic (cefuroxime) was given on the table just before starting surgery.

In group one the patient was kept in supine position & the standard lateral approach to distal femur was carried out. The articular fragments were temporarily secured with pointed reduction forceps and Kirschner wires. The condyles were secured with 6.5 mm cancellous screws. Using anatomic landmarks and C-arm imaging, the locking compression plate (OrthoMax™, Cuttack, India) was mounted on the reconstructed condyle beneath the vastus lateralis muscle.

In group 2 patients a bolster was kept underneath the knee so that the knee was in 50 to 60 degree flexion. The condyles were reduced with Kirschner-wires being used as

joystick which was guided by fluoroscopy & it was maintained with the help of pointed reduction clamp. Two cancellous cannulated screws were inserted in both the condyles from lateral to medial direction, one anterior and other posterior in such a way that the nail can be passed between those screws. A 5 cm incision was made starting from lower pole of patella and just medial to the patellar tendon. The inter condylar notch was palpated and guide pin was placed just above and medial to the femoral attachment of posterior cruciate ligament and confirmed by means of anterior-posterior and lateral fluoroscopy. The medullary canal was reamed and the supra condylar nail (OrthoMax™, Cuttack, India) of appropriate size was inserted. All the cases were locked in static mode with at least two distal locking screws and nail was buried 3 mm deep to the distal articular cartilage of femur.

The Patients were followed up every month till six months thereafter 12 & 18 months and passive knee movement was allowed gradually as per the patient comfort level. In every follow up radiographs were done of the involved limb to assess the bony union. Other assessments include knee flexion range, signs of infection like purulent discharge and any knee pain during full tolerable range of motion and finally Neer's score.

The sample size was calculated before the initiation of the study on the basis of literature data and previous experience. The expected proportion of excellent result was 80 % in the nailing group and 20 % in the plating group. Type I error was set at 0.05 and type II error at 0.2 (80 % power). Using the ClinCalc.com software, the needed total sample size was calculated to be 20 patients (10 patients per group).

The Fisher exact test was used for categorical variables between the two groups, such as gender, injured side, fracture characteristics, diabetes, heavy smoker, infection and knee pain. A Student's t test was used for continuous variables, such as age, operating time, intraoperative blood loss, Neer's score and knee range of movement. The level of significance was set at $p < 0.05$.

RESULTS

In this present study, 20 cases of intraarticular distal femur fracture were treated at our institute. All cases were treated either with distal femoral nailing or by locking compression plating. The age of the patients varied from 18 to 70 years with mean age (45.95 ± 15.39). The age distribution showed a bimodal peak. Out of 20 patients, 12 (60 %) were male and 8 (40 %) were female. The male to female ratio was 3:2. The most common cause was RTA with 11 (55 %) patients. 13 (65 %) patients had fractures of right side while 7 (35 %) patients had fractures of left side. The fractures were classified according to the AO classification. Type A, type B and type C3 fractures were not included in our study. Out of 20 cases 13 (65 %) cases were type C1 and 7 (35 %) cases were type C2.

Parameters	Group 1 (LP) (n = 10)	Group 2 (DFN) (n = 10)	P Value
Gender			0.649
Male	7	5	
Female	3	5	
Mean Age (in yrs.)	48.89 ± 16.3	46.62 ± 16.1	0.757
Side			1.000
Right	7	6	
Left	3	4	
Mode of injury			1.000
RTA	6	5	
Fall from height	4	5	
Classification			0.349
C1	8	5	
C2	2	5	
Diabetes Mellitus	3	2	1.000
Smoker	5	3	0.649

Table 1. Demographics, Medical History & Fracture Pattern in the Two Groups

The mean duration of surgery was 68 ± 12.2 (range 44 - 92 min) minutes in nailing group comparing to 81 ± 11.6 (range 58 - 104 min) minutes in plating group which was statistically significant. The average blood loss in nailing group was only 65 ± 10.8 ml (range 43 - 87 ml) while it was 141 ± 10.3 ml (range 120 - 162 ml). Difficulty in reduction was faced in 3 cases of nailing and 2 cases of plating. Difficulty in locking was problem in both nailing (proximal screw) and plating. (Table 2).

Parameters	Group 1 (LP)	Group 2 (DFN)	P Value
Duration of Surgery (min)	81 ± 11.6	68 ± 12.2	0.025
Blood Loss (ml)	141 ± 10.3	65 ± 10.8	0.0001
Difficult Reduction	2	3	1.000

Table 2. Intraoperative Parameters

Average healing time was better in case of nailing (15.2 ± 1.2 weeks) than plating (18 ± 1.4 weeks) (p -value = 0.0001). All fractures were united by 5 month except 2 cases which took 7 months. The mean knee flexion achieved was higher in case of nailing than plating and it was found to be statistically significant. Neer's Score was 86.2 ± 10.6 (range 65 - 100) in nailing group while it was 63.8 ± 9.4 (range 45 - 83) in plating group. (Table 3).

Parameters	Group 1 (LP)	Group 2 (DFN)	P Value
Healing time (weeks)	18 ± 1.4	15.2 ± 1.2	0.0001
Knee flexion (degree)	91.4 ± 8.9	104.8 ± 9.4	0.0042
Neer's Score	63.8 ± 9.4	86.2 ± 10.6	0.0001

Table 3. Measures of Outcome

The common post-operative complications are knee stiffness and infection which were more in case of plating (50 % cases). Anterior knee pain was frequently associated with nailing. Other complications are non-union, malunion, delayed union, shortening, angulations etc. (Table 4)

Parameters	Group 1 (LP)	Group 2 (DFN)	P Value
Anterior Knee Pain	0	1	1.000
Infection	2	0	0.473
Knee Stiffness	3	0	0.210

Table 4. Post-Operative Complications

Functional outcome according to Neer's scoring system between two groups, group I (LCP) and group II (DFN) was statistically insignificant for AO Type C2 fractures (p -value = 0.659) while it was significant for type C1 fractures (p -value = 0.002).



Figure 1. Fixation with Locking Compression Plate. (A) Pre-Operative Radiograph (B) Immediate Post-Operative Radiograph (C) Follow-Up after 14 Weeks



Figure 2. Fixation with Retrograde Nailing (A) Pre-Operative Radiograph (B) Immediate Post-Operative Radiograph (C) Follow-Up after 14 Weeks

DISCUSSION

We found that distal femoral nailing for intra-articular distal femoral fractures (Type C1 & Type C2) is the optimal tool as it provides rigid fixation, is a reproducible technique, and requires attention initially to details of technique to reduce complications.

Luzan TJ et al concluded in his study that locking plates used to bridge fractures of the distal femur results in average to less callus (Figure 1 & 2) formation than nailing which is consistent with our study as evident by early union in nailing group.⁶ Though none of our cases went for nonunion Herrera DA et al found 5.3 % nonunion rates with Locking Plates as opposed to 1.5 % in nailing in a systematic review of 29 case series with 415 patients.⁷ Gao K. et al study showed union disturbance rate in the Locking Plate group was higher than in the Retrograde Nailing group.⁸ In present study, average time taken for union for Plating was around 18 weeks, which was comparable to Henderson et al and Markmiller et al who observed it to be 12 and 14 weeks respectively.^{9,10} Radiological union was defined as bridging callus across three cortices. In cases of nailing average healing time was 15 weeks which was comparable to Kumar et al 14 weeks and Ingman et al 12 weeks.^{11,12} When comparing non-union rates, there is no much difference between nailing and plating series. Leggon et al found a trend of more knee pain with retrograde distal femoral nailing in patients of distal femur fracture which is consistent with our study.¹³ Functional outcome according to Neer's¹⁴ scoring system between two groups, group I (plating) and group II (nailing) was statistically insignificant for AO Type C2 fracture while it was significant for type C1 fractures in our study. Hoskins et al concluded nailing may be a superior treatment compared with anatomical locking plates for fractures of the distal femur which holds true in our study for fractures with intraarticular extension.¹⁵ Distal femur nail has many advantages as locking plates such as percutaneous placement without disruption of blood supply and direct fracture reduction and being an intramedullary load sharing device allows early load bearing

and should be preferred in these fracture patterns. However being a study of small sample size further research with larger sample size may guide the treatment plan further.

CONCLUSIONS

In both extra and intraarticular fractures of distal femur (AO type C1 & C2), retrograde reamed intramedullary nailing using distal femoral nail gives better result than locked compression plating in terms of range of movements, mobilization, time to union, operative time, and blood loss.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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