

Study of Functional and Clinical Outcome of Retrograde Intramedullary Interlocking Nailing in the Management of Extra-Articular Supracondylar Femoral Fracture

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Abstract:

Aim: The aim of our study is to evaluate the functional and clinical outcome of retrograde intramedullary interlocking nailing in the management of extra-articular supracondylar femoral fracture.

Introduction: Fractures of the Distal femur are complex injuries that pose a challenge to orthopedic surgeon. Closed femoral nailing minimizes soft tissue damage and minimizes the blood loss. The anatomical alignment, stable internal fixation, rapid mobilization, and early functional rehabilitation of the knee are the effective ways of management of distal femoral fractures which can be achieved by Intramedullary interlocking nail.

Method: 25 Patients were studied during study period sept 2020 to march 2022. Data collected by verbal history taking, diagnosis was made on clinical and radiological basis. Fractures were classified according to Muller's classification. patients were taken for surgery (retrograde intramedullary nailing) and evaluated for pain, function, range of motion, deformity, time of radiological union as per NEER'S RATING SCORE .

Result: Age was ranging 18-75 years. 48% were Type A1, 44% were Type A2, 8% were A3 type as per mullers classification. There were 4 open and 21 closed type of fracture. radiological union was seen within 3 to 6 months in 22 patients, within 6 to 8 months in 2 cases and one patient had delayed union. Average knee flexion was 110 degree in 17 patients and 8 patients had flexion more than 110 degree. There were 5 patients with knee pain, 1 with shortening, 1 with implant failure, 1 with delayed union, 2 with superficial infection, and 1 patient had mild restriction. Using Neer's scoring system there were 72% patients with good to excellent results.

Conclusion: Retrograde intramedullary supracondylar nail is a good fixation system for distal third femoral fractures, particularly extra-articular type. It has benefits of less periosteal stripping, reduced blood loss, decreased hospital stay and less surgery duration. Early surgery, closed reduction, at least two screws in each fragment and early post-operative knee mobilization are essential for good union and good knee range of motion.

Keywords: AO-ASIF

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Introduction

Fractures of the Distal femur are complex injuries that pose a challenge to the orthopaedic surgeon. It constitutes about 6% of all femoral fractures. It usually occurs during high energy trauma in younger patients and frequently are associated with concomitant injuries. In contrast, elderly patients with severe osteopenia might sustain solitary distal femoral fractures from minor trauma such as a simple fall.

The supracondylar region because of its complex anatomy, proximity to the knee joint, a major weight bearing joint, difficulty in control over distal fragment always possess a challenge to treat. To add to this, are the associated ligamentous injuries, intra

articular involvement and difficulty in anatomical alignment, which further complicated the treatment[1].

Non operative treatment of any form was always confounded with anatomical mal-alignment and knee stiffness.[2] The conventional treatment for supracondylar fracture of the femur is open reduction with plates and screws. Considerable dissection of the thigh is required with resultant devascularization of the distal fragment leading to a high rate of complications including delayed union, nonunion, failure of the implant and infection.[3]

Intramedullary interlocking nailing is one of the

standard procedures used to stabilize fractures of distal femur as it is a biologic method of fixation and load-sharing device allowing early weight bearing.[4] Intramedullary nailing can be introduced either in an antegrade or a retrograde fashion for treatment of these fractures. Antegrade intramedullary nailing (AIMN) may lead to complications such as Trendelenburg gait or implant-related pain. Retrograde intramedullary nailing (RIMN) may cause complications including cartilage damage around the intercondylar notch or patella and impaired knee function. This study were conducted to analysed the outcome of the Retrograde Supracondylar Nail in fractures of distal femur and supracondylar area.

Aim

The aim of our study is to evaluate the functional and clinical outcome of retrograde intramedullary interlocking nailing in the management of extra-articular supracondylar femoral fracture.

Material and Methods

This prospective study was hospital based and conducted on 25 patients who underwent the surgery with retrograde intramedullary interlocking nail management of extra-articular supracondylar femoral fracture between Sept 2020 to March 2022 in Department of Orthopedics at Jhalawar Medical College ,Jhalawar (Rajasthan) were included the study group.

Inclusion criteria:-

1. All the patients attending orthopaedic OPD and emergency with supracondylar femur fracture.
2. Fracture case reported with in one week of injury.
3. 18-75 years of age in both genders.
4. All supracondylar femur fracture according to AO-ASIF classification type A1, A2 & A3 fracture.
5. Include both close and open fractures of extra-articular supracondylar femur grade I and II.

Exclusion criteria:-

1. All supracondylar femur fracture according to AO-ASIF classification type B1, B2 & B3 and C1, C2 and C3 fracture having intracondylar extension.
2. Grade III open fracture
3. Severe systemic illness like active cancer elsewhere in body, chemotherapy, insulin dependent diabetes mellitus, renal failure and other medical contraindication for surgery.
4. Skeletally immature patients
5. Associated with vascular injury that requires amputation.
6. Who did not give consent.
7. Pregnancy.

8. Patient age < 18 year & > 75 year of age.
9. Patient unfit for surgery.

Demographic data of patients were recorded on admission and through history and clinical examination. The fracture was assessed for radiological assessment of fracture with AO-ASIF classification system. After admission of patient, a careful history was elicited from the patient and or attendants to reveal mechanism of injury and the severity of trauma .

The patient were then assessed clinically to evaluate their general condition and the local injury. In general condition of the patient, the vital signs were recorded .

Methodological examination was done to rule out fracture another sites. Palpation reveal abnormal mobility ,crepitus and shortening of the affected limb. Distal vascularity was assessed by dorsalis pedis and posterior tibial arterial pulsations and capillary refilling.

Radiograph of the knee with the distal half of the femur AP, lateral, right and left oblique views were obtained , pelvis with both hips AP view and tibia fulllength AP and lateral to rule out other fractures. The limb was then immobilized in Thomas splint. The patient was then taken up for surgery after investigations and making patient medically fitness for surgery .The investigation done were,

1. Hemoglobin percentage, Packed cell volume(PCV)
2. Complete blood count, erythrocyte sedimentation rate,bleedingtime,clotting time ,prothrombin time
3. HIV ,HBsAG
4. Random blood sugar, bloodurea, serumcreatinine, serum uric acid blood grouping and cross matching.
5. Urine for macroscopy, sugar, albumin and microscopy
6. 2Decho if patients age is >60yr

Various instrument required are:

1. Radiolucent arm board.
2. Image intensifier (C-arm)
3. Supracondylar intermedullary femur nail.
4. Power pin driver

Special Instruments

The instruments set for supracondylar intramedullary nailing consist of:

1. Drill guide
2. Guide bar
3. Guide bar bolt
4. Wrench
5. Drill sleeve
6. 300 mm length drill bit
7. Measuring gauge



Figure 1: Pre-Operative Planning

All patients before surgery were assessed radiographically to note anatomical location of fracture, geometry of fracture, degree of comminution, intraarticular involvement and to classify the fracture pattern.

According to the fracture pattern and study of anteroposterior and lateral radiographs of the knee and thigh, supracondylar nailing was planned in our study. Supracondylar nail of 316 L steel having three interlocking holes proximally as well as distally each was used. Multiple holes nail may be used and nail length of 15, 20, 25cm was chosen.

Operative Procedure

Position: After spinal or general anaesthesia the patients were positioned on a simple operating table in the supine position.

The leg draped free and knee flexed 30-50 degree with a leg roll. Knee flexion allowed proper access to the entry portal, as well as reduction and fixation of intercondylar fractures.

Incision: modified percutaneous incision of size 4-5 cm from the lower pole of the patella to the superior border of the tibial tubercle.

After that patellar tendon was split longitudinally and the posterior cruciate ligament was visualized.

Reduction: It was achieved by manual traction and application of correctional forces that vary depending on the fracture pattern.

If difficulty was encountered with the reduction, the drill sleeve passed over the guide wire may be used as a joystick to achieve a reduction.

Entry Portal: The entry portal was made with the help of sharp awl, 1 cm anterior to the posterior cruciate ligament in the intercondylar notch.

Reaming: Reamer was passed over the guide wire and the distal fragment was reamed with adequate

size reamers. Reaming was done incrementally to 1-2 mm wider than the anticipated nail size.

Nail Insertion: The nail that was selected was fit into the introducer/target device and was pushed in by hand and the position was verified by the use of image intensifier to confirm that the tip of the nail lies centrally the distal third of the femur and the distal articular end of the nail showed be buried 2-3 mm subchondrally so as to prevent articular impingement.

Locking: Proximal and distal interlocking was done with jig and atleast two interlocking bolts of 4.5 mm were inserted. Both the cortices were drilled and the interlocking bolt of adequate size was inserted in. This was done using one screws and the position was confirmed by the sounding technique or under C-Arm image intensifier.

Wound Closure: Incisions were closed in layers after a thorough wash and achievement of complete haemostasis.

Immobilization: When fracture reduction is stable, limb was immobilized in above knee cast or above knee slab.

Post-Operative Care

- All patients were started intravenous antibiotics immediately and these was continued for three days followed by oral antibiotics for seven days and continued for more days in cases of compound fractures or in cases of infection.
- Analgesics were added according to need.
- All the patients were followed up till the evidence of healing or declaration of the non-union for an average of ten months.

Post-Operative Complications:

1. knee pain
2. knee stiffness
3. Peroneal nerve damage
4. Soft tissue infection
5. Thrombophlebitis or embolism

6. Implant complications

Long Term Complications:

1. Limitation of knee movements
2. Angular deformity
3. Instability
4. Arthritis

Follow Up

The patients were assessed on all follow ups and all findings recorded and maintained. Our scheduled follow ups were:

1. First week of surgery (dressing)
2. Two weeks of surgery (stitch removal)
3. One month of surgery
4. Two month of surgery
5. Three month of surgery
6. Six month of surgery
7. Eighth month of surgery
8. Tenth month of surgery
9. One year of surgery

On follow up axial alignment was assessed and functional analysis was quantified using Neer's rating system. Radiographs was analyzed for correction, maintenance of position or loss of reduction.

The following parameters were noted in the proforma:

1. Time taken for fracture union defined by radiography showing bridging callus on at least 3 cortices(AP and LATERAL VIEW)
2. Any Secondary procedures performed
3. Angular deformity as on anteroposterior and lateral radiographs, rotational deformity and leg-length discrepancies as measured clinically,
4. Knee function as measured by Neer's rating system.

Observation and Results**Table 1: Age Distribution**

Age (yrs)	No. of patients	Percentage
18-30	9	36
31-40	5	20
41-50	1	4
51-60	5	20
61-70	4	16
71-75	1	4
Total	25	100

Age of patient range from 18 to 75 yrs with an average of 43.7 yrs , majority of patient is from age 18-30yrs.

Sex Distribution

Of the total 25 patients operated with retrograde nailing , there were 17 male patients accounting 68 % of total patients and female were 8 patients accounting 32 % of total patients.

Table 2:

Sex	No. of patients	Percentage
Male	17	68
Female	8	32
Total	25	100

Type of Fracture

Out of 25 fractures 21 were closed accounting 84% and 4 were open grade accounting 16 % of total fractures.

Table 3:

Type of fracture	No. of patients	Percentage
Closed	21	84
Open	4	16
Total	25	100

Type Based on AO Classification

Under this study we classify the type of fracture on the basis of AO classification. out of 25 patients 12 were type A1 i.e supracondylar femur fracture extra articular diaphyseal simple. 11 were A2 i.e A2 extra articular fracture metaphyseal wedge and 2 were A3 i.e extra articular fracture metaphyseal complex. No patients were B2 i.e partial articular fracture, lateral condyle, sagittal and B3 i.e Partial articular fracture, frontal in our study.

Table 4:

TBOAOC	No. of patients	Percentage
A1	12	48
A2	11	44
A3	2	8
Total	25	100

Functional Rating As Per Neer's Rating Score

Long term final result were rated using NEER'S RATING SCORE , which gives point for pain ,function ,working , joint movement ,gross and radiological appearance . NEER'S score assigned for each patient after 24 weeks of follow up . After accessing this score out of total 25 patients , 12 have excellent score , 6 have good score , 4 have fair score and next 3 have poor score.

Table 5:

Functional Outcome	No. of patients	Percentage (%)
Excellent	12	48
Good	6	24
Fair	4	16
Poor	3	12
Total	25	100

Neer's R.S. criteria with Type Based on AO Classification

Table 6:

Type Best On AO Classification	Poor		Fair		Good		Excellent		Total	
	N	%	N	%	N	%	N	%	N	%
A1	1	4	2	8	2	8	7	28	12	48
A2	2	8	2	8	2	8	5	20	11	44
A3	0	0	0	0	2	8	0	0	2	8
Total	3	12	4	16	6	24	12	48	25	100

Complications

The complications encountered in post operated patients were mainly anterior knee pain in 5 patients ,followed by shorting in 1 patient ,infection in 2 patients and delayed union in 1 patients , mild restriction of knee in 1 patient and implant failure in 1 patient.

Table 7:

Complications	No. of patients	Percentage (%)
Delayed union	1	4
Implant Failure	1	4
Knee pain	5	20
Mild Restriction Knee	1	4
Shorting <2cm	1	4
Superficial Infection	2	8
No Complication	14	56
Total	25	100

Discussion

Fractures of distal femur are complex injuries that can be difficult to manage and have the potential to produce significant long term morbidity. Operative treatment is the treatment of choice in these injuries now a days, resulting in anatomic reduction and early mobilization combined with early weight bearing. Comparing our study with that of the previous reported series, the demographic profile :

Table 8:

Series	Age Group (Years)	Average Age	Male (No.)	Female (No.)
Seifert J Et Al(5)	17-92	44	29 17-75yrs (Avg34.3yrs)	18 19-92yrs (Avg53.8yrs)
Wisniewski T Et Al(6)	58-89	67	23	09
Bel Jc Et Al ⁷	16-96	61	12	17
Janzing Hmj EtAl(8)	65-96	82	02	22
Gellman Re Et Al(9)	24-84	50	10 29-61yrs (Avg39yrs)	12 26-84yrs (Avg60yrs)
Lucas Sm Et Al(10)	15-69	39	13	11
Our Study	18-75	43.7	17	8

The numbers and percentage of AO types of fractures are:

Table 9:

Series	A1	A2	A3	C1	C2	C3
Gellman RE et al	3(12%)	3(12%)	5(21%)	4(17%)	3(12%)	6(26%)
Lucas SM et al	0(0%)	4(16%)	2(8%)	4(16%)	10(40%)	5(20%)
Our study	12(48%)	11(44%)	2(8%)	0(0%)	0(0%)	0(0%)

All the fractures in the present study healed in an average of 20.24 weeks. Previous studies with lateral fixation device reported similar rates of union and time to union.

Table 10:

Series	Functional results	Complications
Gellman RE et al	Sanders Score: 4 excellent, 15 good, 2 fair, 2 poor A: 3 excellent, 16 good, 1 poor C: 1 excellent, 9 good, 2 fair, 1 poor Average flexion 106 degree (55-150)	1 malunion, 6 shortening, 3 nail impingement, 1 missed locking bolt, 2 required arthrolysis
Lucas SM et al	Average ROM 100 degree Average flexion 104 degree Average extensor lag 4 degree A: ROM 92° lag 6° flexion 98° C: ROM 103° lag 3° flexion 106°	4 knee pain, 1 malunion, 1 shortening, 1 bent nail, 1 broken nail, 1 infection, 6 required arthrolysis, 7 irritation at screw site, 2 post traumatic arthritis
Bel JC et al	Average ROM 110 degree (range 60-120)	3 malunion, 1 shortening
Our study	Neer's score 48% excellent, 24% good, 16% fair, 12% poor	5 knee pain, 1 shortening, 1 delayed union, 2 infection, 1 implant failure



Figure 1: Pre -operative x-ray.



Figure 2: patient position



Figure 3 : Incision for entry point



Figure 4: Guide wire insertion

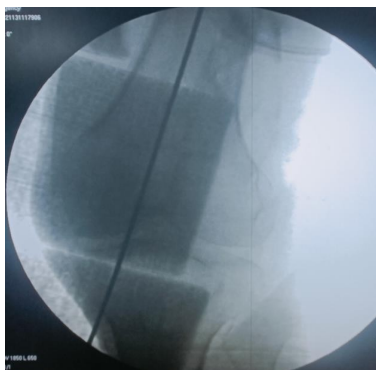


Figure 5: Guide wire in medullary cavity



Figure 6: Supracondylar femur nail in medullary cavity with reduced fracture Site



Figure 7: Post op X-RAY

Case Illustration



Figure 8: PRE OPERATIVE X-RAYS

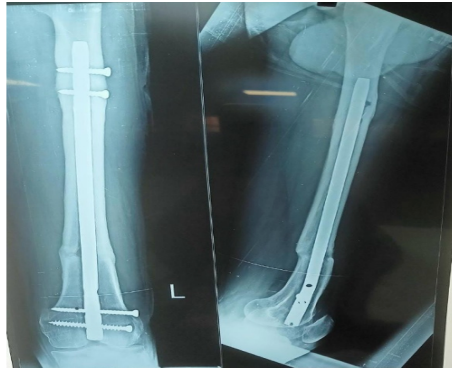


Figure 9:

IMMEDIATE POST OP



KNEE FLEXION



KNEE EXTENSION

Figure 10:



Figure 11: AFTER 24 WEEK



AFTER 28 WEEKS



AFTER 32 WEEKS

Figure 12:

We used Neer's score since it emphasizes on important patient outcome variables such as pain, functions as related to daily living activities, range of motion, return to work, gross anatomic alignment and roentgenographic evaluation of union and mechanical alignment. However no rating scale is validated to be superior to other.

Conclusion

Distal femoral fracture poses a challenging problem to the orthopedic surgeon as it occurs in young with high velocity and elderly with low velocity trauma. Early internal fixation and mobilization of the patients is of paramount importance.

Presence of osteoporotic bone and presence of other injuries around the knee complicate the problem further. Retrograde intramedullary supracondylar nail is a good fixation system for distal third femoral fractures, particularly extra-articular type. It has benefits of less periosteal stripping, reduced blood loss, decreased hospital stay and less surgery duration.

Based on our study, we concluded that early surgical intervention and mobilisation of patients gives better results. Moreover, closed method of reduction can be achieved by not disturbing fracture hematoma and soft tissue.

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