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PROSPECTIVE ANALYSIS OF RETROGRADE SUPRACONDYLAR NAILING IN THE MANAGEMENT OF SUPRACONDYLAR AND DISTAL FEMORAL FRACTURES

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ABSTRACT

Background: Due to the presence of soft tissue injury, intraarticular extension and injury to the extensor system, the distal third femoral fractures pose a great challenge in management. The debates among orthopedic surgeons on the choice of implant for distal third femoral fractures are ongoing. There is still debate as to the optimal device for distal femoral fixation. **AIMS & Objectives:** Using retrograde nailing techniques, to assess and compare the clinical and radiological results of distal third femoral fracture stabilisation. **Method:** Total of 11 participants underwent retrograde femoral nailing for the treatment of distal third femur fractures. They were followed up clinically and radiologically. Clinical assessment was made according to Neer knee scores and radiologically by Xrays. **Result:** 11 cases treated with distal femoral retrograde nailing were analysed. The results analyzed according to Neer knee scoring showed excellent in 5 cases (48.67%), good in 3 cases (34.51%), fair in 2 cases (9.73%) and poor in 1 case (7.07%). The Pearson's correlation coefficient (r) was 0.8 which favours a highly positive correlation between the fracture union and retrograde nailing. Conclusion: Retrograde distal femoral nailing for A O / ASIF type A and type C distal third femoral fractures are an established and effective fixation procedure. The study results prove that retrograde distal femoral nailing could be included as a reliable management plan for distal third femur fractures.

KEYWORDS: Distal third femoral fractures; Supracondylar femur fracture, Supracondylar nail, Retrograde nail; Neer knee Score.

INTRODUCTION

In recent years, due to rapid industrialization, modern lifestyle and swift pace of life have led to an accompanying rise in road traffic accidents that handicaps numerous lives. Also, due to the increased life expectancy, the old-age population carry dangers of osteoporosis and fractures.

Distal third femur fractures are associated with high morbidity and mortality. Available literature suggests that distal third femur fractures constitute nearly 6% of all femur fractures.[1]

Due to extensive comminution, soft tissue damage, an extension of the fracture into the knee joint, neurovascular damage, poor bone stock, less cortical bone in this region, wide medullary cavity and injury to the extensor mechanism in the distal femur, these distal third femoral injuries were complicated and difficult to manage.[2]

No single strategy of management has beaten all the problems related to this injury. Prior to 1970, most supracondylar fractures were treated non-operatively, however, angulatory deformities, knee joint incongruity, loss of knee motion, as well as the complications of recumbency led to better methods of treatment.[3,4,5]

Numerous devices have been proposed for the treatment of these fractures. These include maximum possible reduction of the distal femoral articular surface, anatomically stable internal fixation techniques, very less soft tissue stripping, and early active ambulation. However, plate devices needed extensive surgical exposure and potential risk of infection. Plates are also associated with knee stiffness. These complications are reduced by intramedulary implants because their location within the canal causes less stress on the implant, has the potential for load sharing and can be inserted with minimal soft tissue stripping.

Several studies have been carried out in recent times to a ssess the role and potency of supracondylar nailing, show ing variable results. There are lacunae in the current knowledge regarding the use of Supracondylar Nailing in distal femoral fractures. This study was conducted to

evaluate the outcome of the Retrograde supracondylar nail in fractures of the distal femur and supracondylar area in Indian population.

METHOD

- Health care setup-Tertiary Care Hospital
- Setting- Department of Orthopaedics, Traumatology and Rehabilitation N.S.C.B. Medical College, Jabalpur, M.P.
- Duration of the study- December 2017 to August 2019
- Type of the study-Prospective cohort study
- Sample size-11
- Selection of cases- Clinically and radiologically proven distal third shaft fractures, who then underwent intramedullary nailing as per our protocol.
- Radiological assessment-Anteroposterior and lateral views of femur with hip and knee joints.
- Functional assessment- using Neer knee scoring
  Osseous healing -the radiologic presence of bridging callus and crossing trabeculae on AP and lateral xrays in minimum of three cortices.
  Clinical healing - lack of pain and tenderness at the fracture site.
- Follow up-Clinical and radiological analysis done at predefined following time frames- immediate post-op period, at the end of 1, 3, 6, 12 and 18 months.

INCLUSION CRITERIA

- All patients above 18 years with closed fractures & grade I & II open fractures of supracondylar & distal femur fractures (up to 15 cm from the joint line).

EXCLUSION CRITERIA

- Stiff knee joint (will not allow flexion fo nail insertion)
- Pathological fractures & patients aged below 18 years.
- AO type B1 B2 & B3 fractures (Unicondylar fractures).
- AO type C3 fractures (Massive Intra articular comminution / bone loss).
- Grade III open fractures.
- Patella Baja.
- Patients not willing or giving consent for surgery.

The patients enrolled in the study were subjected to thorough clinical examination after obtaining IEC, informed and written consent from the patient's attendants. The baseline investigations and the affected femur's radiographic analysis were analyzed. The other associated injuries were addressed off with appropriate management.

SURGICAL PROCEDURE

Pre-operative planning: The appropriate length of the nail to be used was assessed clinically and radiographically. Using an AP radiograph nail diameter is assessed at the level of isthmus.

Preparation: The patients were painted and draped. Prophylactic IV antibiotics and injection TT were given 30 mins before surgery.

Operative technique

- *Anaesthesia:* All the patients were operated under either spinal anesthesia or epidural anesthesia.
- *Patient Positioning and Reduction of fracture:* The patients were placed in supine position with the knee flexed to 30°-55° with a leg roll followed by fracture reduction traction and internal rotation confirmed by the image intensifier guidance.
- *Approach:* A 3 cm skin incision give longitudinally, just distal to the inferior patellar pole extending towards the tibial tuberosity. Then the guide-wire is inserted after retracting the patellar tendon medially.
- *Entry point and insertion of guide wire:* Using image intensifier the portal of entry was made using a curved awl in the intercondylar notch, 1.2 cm anterior to the insertion of the posterior cruciate ligament on the femur. The entry was checked using the image intensifier in both AP and lateral views to confirm the central position of the nail. On lateral view, the entry point is just at the tip of blumensaat line. A guide wire is passed from the intercondylar femoral entry point through the condyles and advanced across the fracture site into the diaphysis under C arm guidance.

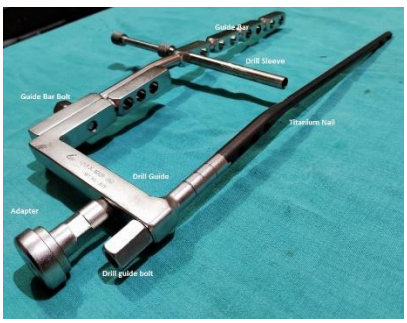


Fig – 1: Drill guide assembly of IMSC nail

Fig – 2: Intraoperative patient positioning

Fig – 3: Intraoperative - minimal infrapatellar incision

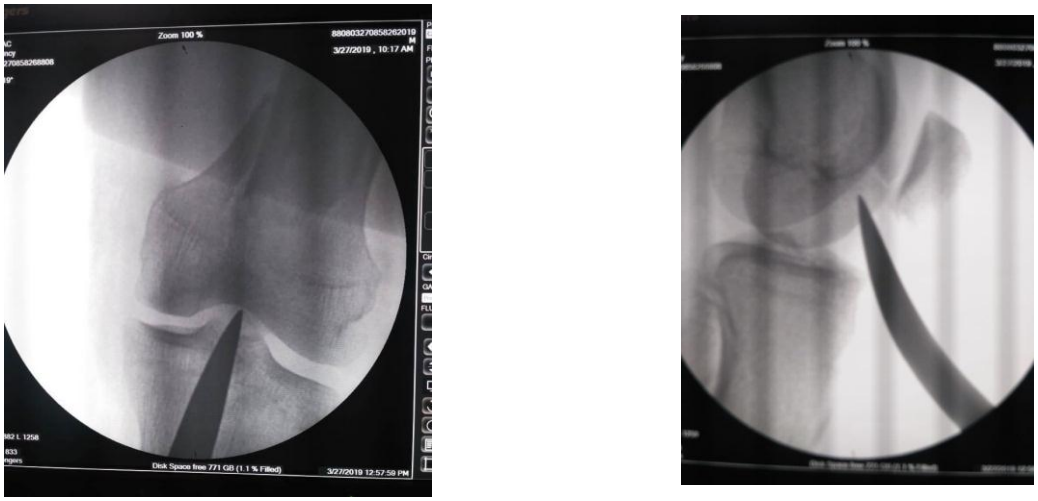


Fig – 4: Intraoperative C arm image while making the entry point

Fig – 5: Intraoperative images of passing the guidewire and nail insertion while maintaining reduction

- *Reaming:* Reaming was started with 8mm and gradually increased by 1mm it was over-reamed to 1mm larger than the nail selected. The shaft was reamed to a point slightly higher than the expected tip of the nail. The entry point was reamed 1.5mm larger than the selected nail to avoid displacing the condyles when the nail was advanced.
- *Insertion of the retrograde distal femoral nail:* A nail of proper length and diameter was connected to the drill guide with the help of a bolt placed through the drill guide and nail. The nail was pushed in by hand over the guidewire into the distal condyles and at the same time traction was applied with gentle pull behind the gastrocnemius with the knee in 30 to 55 degrees of flexion. The nail was advanced until the distal end is countersunk 2 to 5 mm below the intercondylar notch to avoid patellar impingement. Depending on the fracture pattern and the need for future dynamization nail was countersunk even further inside the articular surface. The insertion of nail was done under image intensifier guidance to confirm its that the tip of the nail lies centrally and the distal most tip of the nail is at least 5 mm below the articular surface.
- *Locking of the nail:* The screws were placed percutaneously through the drill guide beginning with the most distal screw. The distal cortex was drilled with a 5 mm drill bit and three 6.5 mm cancellous screws were inserted of the correct length. Proximally, 4mm drill bit was used to insert 5 mm self-tapping screws.
- *Closure:* The surgical closure was done in layers and the sterile dressing applied over wound and compression bandage was given.

Post-operative protocol: Intravenous antibiotics were given for 5 days followed by oral antibiotics for 5 days. Patients were encouraged to keep their limbs elevated to reduce the swelling. Isometric Quadriceps exercise started by the third day of surgery in all patients. At the same time, non-weight-bearing gait training was started with the help of a crutch or walker. Touch down weight-bearing was started when there were radiographic signs of callus formation(average of 8 weeks). Weight-bearing was increased gradually according to the callus formation until solid union was found on xrays for compete weight bearing.

Follow up: the patients were assessed at 1, 3, 6, 12 and 18 months post operatively with radiographs of full-length femur and neer scoring to assess the fracture union and the complications. The need for dynamization was addressed up to 3 months based on the progression of fracture healing to achieve early bony union. A record of history and the treatment given and the results of treatment for each patient was maintained in a follow up proforma.

CLINICAL PICTURES OF THE PATIENT SHOWING GOOD RANGE OF MOTION

AT 4 WEEKS **AT 12 WEEKS**


FLEXION AT KNEE JOINT


EXTENSION AT KNEE JOINT

PATIENT ID NO: DFN/08






PRE-OP XRAY **IMMEDIATE POST-OP XRAY** **FOLLOW UP AT 6 MONTHS**

RESULTS

A total of 11 cases of distal third femoral fractures were enlisted in the study. Qualitative (categorical) variables were coded numerically and frequency with percentage distribution was tabulated and Pearson's Chi-square test was applied for statistical comparison of 2x2 contingency tables as appropriate. Continuous variables were summarized in Mean standard deviation. Comparison between 2 means (Pre and post) was analyzed using the Paired t-test. Normality of data distribution was checked and if data were not normally distributed, it was normalized by log transformation before statistical comparison. All the statistical analysis was done utilizing the windows SPSS 22.0. A probability (p-value) of <0.05 was considered to be statistically significant.

Demography

The study comprises a total of 11 patients in the age range of 18 to 70 years. (Mean age = 46 yrs). 7 Patients were men with the age range of 25-60 yrs, while 4 patients were women with the age range of 40 to 50 yrs.

Mode of injury

Most of the cases were road traffic accidents which accounted for all the high velocity trauma needed for

femur fractures. Males outnumbered females in roadside accidents as they are more exposed to traffic.

Type of fracture pattern

Maximum number of patients belonged to A2 group of the AO/OTA classification. 2 cases (18.2%) in each A3 and C1 groups and 1 case in C3 group.

Fracture pattern according to AO Classification	No. of patients	Percentage
33A2	6	54.5
33A3	2	18.2
33C1	2	18.2
33C3	1	9.1
Total	11	100

Occupation

Most of the patients were Housewife or Labourers by occupation.

Side Involved

The left side of the lower limb was mostly involved in all the fractures in our study.

Hospital stay duration, mean surgery duration, average blood loss and the mean fluoroscopy time.

	Mean	SD	Range
Hospital Stay (Days)	26 days	11.66	14-42 days
Surgery Duration (Min)	78.18 min	18.87	50-120 mins
Blood Loss (mL)	110.45 mL	30.53	80-150 mL
Fluoroscopy Time (secs)	58.45 secs	14.41	45-90 secs

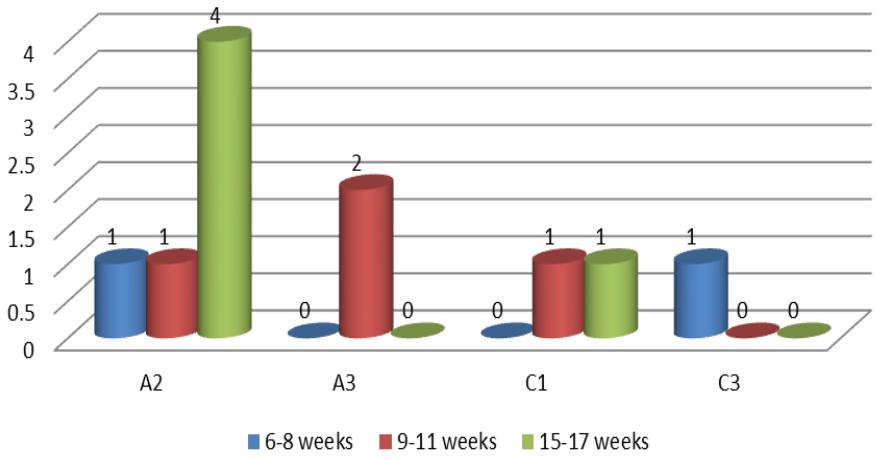
Mode of reduction of fracture

	Frequency	Percentage
Closed	7	63.6 %
Open	4	36.36 %
Total	11	100 %

Time to radiological union v/s fracture pattern

Time to Radiological Union	AO Classification				Total
	33A2	33A3	33C1	33C3	
6-8 weeks	1 (16.7%)	0 (0%)	0 (0%)	1 (100%)	2 (18.2%)
9-11 weeks	1 (16.7%)	2 (100%)	1 (50%)	0 (0%)	4 (36.4%)
15-17 weeks	4 (66.7%)	0 (0%)	1 (50%)	0 (0%)	4 (45.5%)
Total	6 (100%)	2 (100%)	2 (100%)	1 (100%)	11 (100%)
Mean	13.5 weeks	9 weeks	13. 5 weeks	8 weeks	

Time to Radiological Union



Range of Movements

Range of active flexion	60-80	81-100	101-120
No: of patients	3	3	5

The mean range of flexion at the end of 1 year follow up with vigorous physiotherapy was **104.55°**

Functional Rating as per Neer's Knee Score

Outcome	Neer's Knee Score		
	No. of patients at 1 month	No. of patients at 6 months	No. of patients at 1 year
Poor (<55 points)	2 (18.18 %)	1 (9.09 %)	1 (9.09%)
Unsatisfactory (55-69)	7 (63.63 %)	2 (18.18%)	1 (9.09%)
Satisfactory (70-85)	2 (18.18%)	6 (54.54%)	2 (18.18%)
Excellent (>85)	0	2 (18.18 %)	7 (63.63%)
Total	11 (100%)	11 (100%)	11 (100%)

We took Neer's Score since it was widely used in most of the studies and it focuses not only on the functional outcome variables such as pain, walking capacity, joint range of movement, work capacity but also on anatomical aspects such as gross anatomy and roentgenogram findings.

Results were graded according to the Neer's Knee Score taking into account the 6 parameters, each parameter was scored on a scale of 0 to a variable maximum of 10 or 20. The total amount was summed up and interpreted.

Complications

Complications	No. of Cases	Percentage
Knee Stiffness	4	36.36 %
Nail Protruding in Knee	2	18.18 %
Malunion – Posterior angulation	1	9.09 %
Valgus Malunion	1	9.09 %
Superficial Infection	1	%

1. **Knee Stiffness** was present in **4 patients** which were mainly due to damage to quadriceps mechanism and joint surface as a consequence of initial trauma (or) injury to the articular cartilage as a consequence of the creation of the intercondylar entry portal, distal locking screws, protruding nails and due to noncompliance to physiotherapy exercises.
2. **2 Patients** had their **nail protruding in the knee** after dynamization was done, these patients also had **anterior knee pain** which was assessed using the VAS score.
3. **2 Patients** had **Malalignment** of which 1 had posterior angulation of distal fragment which was noted on roentgenogram.
4. **1 Patient** had **Superficial wound infection** which resolved on a 10-day antibiotic course.

DISCUSSION

Distal third fractures make up 6 percent of all femoral fractures.[1] While there are different strategies of internal fixation in supracondylar femur fractures, the treatment guidelines include restoration of articular anatomy, stable fracture fixation, removal of angular or rotational deformity, and rapid mobility and function recovery. For the asian population anatomical plates are not in fact anatomical. Some studies suggests that the locking plates are not so pliable and hence do not alow callus growth required for secondary bone healing[11,12,13,14], and also do not match well with regular bone contours. Intramedullary nails serve as a load sharing system and provide the desirable intramedullary stability so that the nails can be successfully inserted in lower extremity fractures. In our study, the retrograde intramedullary nailing method was being used and closed indirect fracture reduction was achieved by inserting the nail at a correct insertion point thereby keeping the soft tissues intact.

In a study by **Pathak A et al**[6], the final functional according to Neer's criteria showed that among 36 cases 20 (55.5%) were having excellent results.

In a study of management of Supracondylar femur fractures by Supracondylar Nail, twenty supracondylar femur shaft fractures were treated by retrograde nail by **Dr Aparajit P**[7] and he found that the average range of knee motion in his series was 92.5 degrees. The risk of infection and non-union was low. The incidence and severity of significant malunion was nil. Supracondylar Nail offers a short hospital stay, early mobilization, and predictable healing**.** He concluded that supracondylar nail is an excellent option for management of

supracondylar femur fractures even in those with intercondylar extension.

Using Neer's Knee ranking, **Siliski et al**[8] analyzed the functional outcomes and found that C1 fractures had a better outcome (92% excellent and good outcomes) than C2 and C3 fractures (77% excellent and good results).

Leung S et al[9] assessed the functional results with the modified knee rating system of The Hospital for Special Surgery. 13 knees (35 per cent) had an excellent result; 22 (59 per cent), a good result; and two (5 per cent), a fair result.

Siddiqui S et al[10] evaluated distal femur fractures with intra-articular extension treated with internal fixation techniques to assess their clinical and functional outcomes using Neer's Scoring system and compared with the literature available. I The results were excellent in 56%, good in 24%, fair in 12% and poor in 08%.

In our study long term final results were rated using Neer's rating system. In our study, at the end of 6 months there were 2 (18.18%) excellent cases, 6 (54.54%) satisfactory cases, 2 (18.18%) unsatisfactory case and 1 (9.09%) poor case.

The advantages of this procedure includes formation of healthy fracture hematoma, decreased blood loss, soft tissue preservation owing to the small incision, percutaneous joint fixation, improved stability via the intramedullary load-sharing system.

The drawbacks of the retrograde nailing technique were loss of alignment stability, posterior angulation, joint cartilage perforation and intraarticular reaming debris distribution.

CONCLUSION

Retrograde distal femoral nailing for A O / ASIF type A and type C distal third femoral fractures are an established and effective fixation procedure. This study thereby clarifies that if done with minimal soft tissue exploitation and acceptable distal bone purchase, this technique can provide stable fixation allowing for early mobilisation and weight bearing. The rate of union is high and can be achieved with minimum complications. The simplicity of the procedure also facilitates fracture fixation in patients with multiple trauma, including those with multiple fractures. Hence the study results prove that retrograde distal femoral nailing could be included as a reliable management plan for distal third femur fractures.

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