

# Outcome of Retrograde Multidirectional Interlocking Intramedullary Nailing for Distal Third Femur Shaft Fracture

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## Authors' contributions

This work was carried out in collaboration among all authors. Author RK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PSV and MS managed the analyses of the study. Authors SS and MG managed the literature searches. All authors read and approved the final manuscript.

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## ABSTRACT

**Aims:** To study the outcome of retrograde intramedullary nailing for distal third femur shaft fracture in adult patients.

**Study Design:** A case series study.

**Place and Duration of Study:** Department/Casualty of Orthopaedics at Government Medical College, Amritsar between November 2018 to December 2020.

**Material and Methods:** The study included a total of 30 cases of either sex adult patients with a mean of 44.33 years having closed type A distal third femur shaft fracture admitted in Department of Orthopaedics at Government Medical College, Amritsar treated with retrograde multidirectional intramedullary interlocking nail.

**Results:** Mean duration of surgery was 90.50 minutes(min- 80 minutes, max-104 minutes). Weight bearing was started on the 3<sup>rd</sup> day for 60% of the patients. Mean union time was 18.62 weeks (Min – 13 weeks; Max.- 26 weeks). In 56.67% (17 patients), the knee flexion was (111 to 120) degrees. Mean knee flexion of the patients was 113.23° (Min- 104 degrees; Max- 125 degrees). Excellent to

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good results were seen in 80%(24 patients) while fair to poor results were seen in 20% (6 patients). There were no cases with evidence of deep infection.

**Conclusions:** Retrograde multidirectional nailing is a good option in the management of distal femoral fractures (especially type A fractures) due to less invasive procedure and hence lesser blood loss and infection, short operative time and exposure to c-arm radiations. It also provides early mobilization and weight bearing with low overall complications like knee stiffness, and good anatomical and functional outcome with faster rates of union.

*Keywords: Distal third femur fractures; AO type A fractures; retrograde multidirectional nailing.*

## 1. INTRODUCTION

Femoral fractures are a type of injury that are commonly seen in the emergency room. As the longest bone in the human body, the femur is divided into several different parts including the head, neck, greater and lesser trochanters, shaft, and the distal condyles. Fractures can occur in any of these areas. The fracture site is determined by the force, impact point, and how the forces are transmitted through the bone [1]. In addition, the fracture site of the femur may also be determined by the structure and strength of the bone. The site of femoral fracture can be categorized according to the Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification as proximal femoral (type A: trochanteric; type B: neck; and type C: head), femoral shaft and distal femoral fractures [2]. Determination of the influence of age on the incidence of femoral fractures in any given part of the bone is complex, because many age-related factors, including gender, trauma mechanism, body weight, and bony density, would also have impact on the occurrence of the femoral fracture. The factors influencing femoral fracture site are interrelated and are not independent. For example, increasing age is associated with osteoporotic bony changes, which are believed to increase the rate of femoral fracture; falls occur more frequently in the elderly [3,4] but traffic-related fractures caused by motorcycle or bicycle accidents occur more often in younger adults and the rate of its occurrence differs between genders [4,5].

In a fall accident, the force directly impacts the posterolateral aspect of the greater trochanter, but the impact point is not limited to only this site in a non-fall accident. Therefore, proximal type A and B fractures are predominant in falls, but in motorcycle accidents, femoral shaft fracture comprises the most common fracture site, followed by distal femoral fractures [4]. The incidence of these fractures is around 37/100,000, representing 4-6 % of all femoral

fractures [6]. Fractures in the distal third of femur continue to perplex the surgeon whether they are transverse, oblique, comminuted, supracondylar or intracondylar fractures in a T or Y fashion. Additionally, the mortality for elderly patients who sustain these injuries may be as high as 18.4%, 39.1% and 48.8% at one, three and five years respectively [7-9]. Distal femoral fractures are often complex, intraarticular, comminuted, irrespective of etiology and thus making the adequate reduction challenging. Special care must be taken to avoid disrupting the soft tissue envelope to reduce the risk of non-union [10].

## 2. MATERIALS AND METHODS

This was a case series study of 30 patients of either sex with age above 20 years who have closed type A distal femur shaft fracture and admitted in the department/casualty of orthopaedics at Government Medical College, Amritsar. The aim of the study was to assess the outcome of treatment with retrograde multidirectional intramedullary interlocking nail during the period between November 2018 and December 2020. The patients in the emergency were resuscitated and stabilized accordingly. After proper investigations and pre-anaesthetic evaluation, the patient was operated with retrograde multidirectional interlocking nail.

### 2.1 Inclusion Criteria

- All type A fractures as per A.O./ASIF classification.
- Closed fracture of distal one third femur.
- Age > 20 years.

### 2.2 Exclusion Criteria

- Pathologic fractures.

As soon as the patient was fit, they were taken to operation theatre and placed on a radiolucent table in supine position. Under proper anaesthesia, the fractured limb was prepared

and draped. The knee was flexed at 60 degrees and with transpatellar approach to the knee, the entry point at the intercondylar notch anterior to Blumensaat's line along the femoral shaft axis was marked using image intensifier. Entry was made with the help of straight owl. Guide wire was passed through the distal and proximal fragment after reduction (which in some cases required percutaneous pin insertion to allow better control over the fracture fragments) and medullary canal was reamed in 0.5 mm increments until cortical contact appreciated. All fractures were reduced by closed methods and locked statically. Postoperatively, spinal precautions (elevation of lower extremity) were applied and regular monitoring of vitals was done which were found to be stable. Range of motion exercises were initiated on 2nd post op day. On the third post-operative day, aseptic dressing was done in the ward and the surgical wound was checked for any sign of collection or early infection. Non weight-bearing mobilization was allowed immediately with walker and pair of axillary crutches. Alternate stitch was removed at 10th post-operative day and remaining stitches were removed at 12th post-operative day and the patient was discharged in satisfactory condition. Weight bearing was gradually promoted to full weight bearing as bridging callus and union was noted on X-rays at follow ups. Patients were followed up at 4 weeks interval for 1st 6 months and 6 weeks interval for next 3 months. Patients were followed up with X-rays and Modified Knee-Rating Scale of Hospital for special surgery for assessing the clinical and functional outcome.

The following parameters were noted in the proforma:

- Time taken for fracture union defined by radiography showing bridging callus on at least 3 cortices based on the RUST score.
- Secondary procedures performed if needed.
- Complications of the procedures like knee pain, angular deformity as on anteroposterior and lateral radiographs, rotational deformity and limb length discrepancies as measured clinically.
- Knee function as measured by modified knee-rating scale of the hospital for special surgery.

### 3. RESULTS

- Most common age group in our study was 31-50 years which involved 56.7%(17 patients). Mean age was 44.33 years (Min- 23 years; Max- 77 years).
- Males outnumbered females in the ratio of 7:3. 70 percent(21 patients) were males .

- In 80%(24 patients), mode of injury was road traffic accident and the remaining was fall injury.
- In 60%(18 patients), right side involved.
- In 36.7 percent of the patients(11 patients), type 33A1.3 fracture was present while in the 26.7 percent of the patients(8 patients), type 33A3.3 fracture was present.
- In 53.3% of the patients(16 patients), the duration from trauma to surgery was <1 day. In 36.7% of the patients(11 patients), the duration from trauma to surgery was between 1-3 days. Mean duration between trauma and surgery was 1.63 days.
- In 56.66% of the patients (17 cases), the duration of surgery was  $\leq 90$  minutes. Mean duration of surgery was 90.50 minutes.
- In 60% cases (18 cases) partial weight bearing was initiated within 3 days. Mean period of partial weight bearing from the day of surgery 3.80 days.
- In 56.67% of the patients(17 patients) knee flexion was between 111 to 120 degrees. Mean knee flexion of the patients was 113.23°.
- Mean union time in our study was found to be 18.62 weeks(Table 1).
- Mean Modified Knee Rating Scale Score among the patients was 97.27.
- Among the patients, excellent to good results were seen in 80 percent of the patients(24 patients) while fair to poor results were seen in 20 percent of the patients(6 patients) (Table 2).
- Knee pain was seen in 20% of the patients (6 patients), surgical site infections were seen in 10% of the patients (3 patients) and delayed union and non-union was seen in 3.3% of the patients (1 patient) each respectively.

### 4. DISCUSSION

Although their treatment evolved during the last years, distal femoral fractures still remain challenging injuries for orthopaedic surgeons, due to their high complication rate and negative impact of those complications upon the function of the lower limb. The incidence of these fractures is around 37/100,000, representing 4-6% of all femoral fractures [6]. The diversity of surgical options for the management of distal femoral fractures reflects the challenges inherent in these injuries.



Name		Date :				Excellent	Good	Fair	Poor
		10							
Radiographs	Medial tibiofemoral	4	3	2 Narrowing	0 Narrowing >1/2 joint	12	11-9	8-6	5-0
	Lateral tibiofemoral	NL	Mild	<1/2 joint	Sev.	10 pts.	7 pts.	4 pts.	0
	Patellofemoral	NL	Mild	Mod	Sev. (1"Severe"= poor)				pts.
		NL	Mild	Mod	Sev. (1"Severe"= poor)				
				Mod					
Function Testing	Use any Two					Level Pts.	Level Pts.	Level Pts.	Level Pts.
	One-Legged Hop, 1 hop for distance	- % limb symmetry				100-85	10	84-75	7
	One-Legged Hop, 3 hops for distance	- % limb symmetry						74-65	4
	One-Legged Hop, timed hop over 6 meters	- % limb symmetry – avg. % limb symmetry.							
	One-Legged Hop, 1 hop for distance	- % limb symmetry							
	One-Legged Hop, cross over for distance	- % limb symmetry							<65
Final Rating	Acute Injury Studies			Chronic Injury Studies					
	Excellent all in "Excellent" (may have one in "good")			Some point preoperatively and at follow-up;					
	Good al in "excellent" and "good"			report difference. No points total of differences					
	Fair, any one in "fair"			equal "excellent, good, fair, or poor" for					
	Poor, any one in "poor"			chronically – deficient populations.					
CINCINNATI KNEE RATING SYSTEM		FINAL RATING FORM							

These fractures are frequently comminuted and intra-articular, and they often involve osteoporotic bone, which makes it difficult to reduce and hold them while maintaining joint function and overall limb alignment. Surgery has become the standard of care for displaced fractures and for patients who must obtain rapid return of knee function. The goal of surgical management is to promote early knee motion while restoring the articular surface, maintaining limb length and alignment, and preserving the soft-tissue envelope with a durable fixation that allows functional recovery during bone healing. A variety of surgical exposures, techniques, and implants has been developed to meet these objectives, including intramedullary nailing, screw fixation, and periarticular locked plating, possibly augmented with bone fillers. Recognition of the indications and applications of the principles of modern implants and techniques is fundamental in achieving optimal outcomes [10].

In the present study, mean union time among the patients of the retrograde nailing group was 18.62 weeks. In a previous study conducted by Kurahatti A et al, authors reported that average fracture union healing rate was 20 weeks in retrograde nailing group [11,12].

Mean knee flexion among patients among the patients of the retrograde nailing group was found to be 113.23°. Our results were also in concordance with the results obtained by Krishna C et al, who reported that the total amount of knee flexion in retrograde nailing was 109.5±11.46 [13].

In the present study, among the patients of the retrograde multidirectional nailing group, excellent results were obtained in 50 percent of the patients. Our results were in concordance with the results obtained by Kurahatti A et al, where excellent results were obtained in 51.7% in retrograde nailing patients [14].

In the present study, delayed union and non-union was seen in 1 patient (3.3 percent) each, Knee pain was seen in 6 patients (20 percent). SSI was seen in 3 patients (10 percent). In our study, non union was seen in 1 patient which was probably due to nutritional deficiency, smoking and alcohol abuse and poor patient compliance. In a study conducted by Rathi N B et al. showed 15% patients with non-union in retrograde nailing group [15].

**Table 1. Showing the healing time in weeks for the distal third femur shaft fracture managed with interlocked type of multidirectional intramedullary nail**

Weeks	No. of cases	Percentage
12-16	4	13.33
17-20	17	56.67
21-24	6	20.00
>24	2	6.67
Non union (after 39 weeks)	1	3.33
Total	30	100.0
Mean±SD	18.62±3.91	

**Table 2. Showing the outcome for the distal third femur shaft fracture managed with interlocked type of multidirectional intramedullary nail**

Outcome	No. of cases	Percentage
Excellent	15	50.0
Good	9	30.0
Fair	5	16.7
Poor	1	3.3
Total	30	100.0



**Fig. 1. Pre operative X ray AP and lateral view**



**Fig. 2. Post operative X ray AP View**



**Fig. 3. Post operative X ray lateral view**

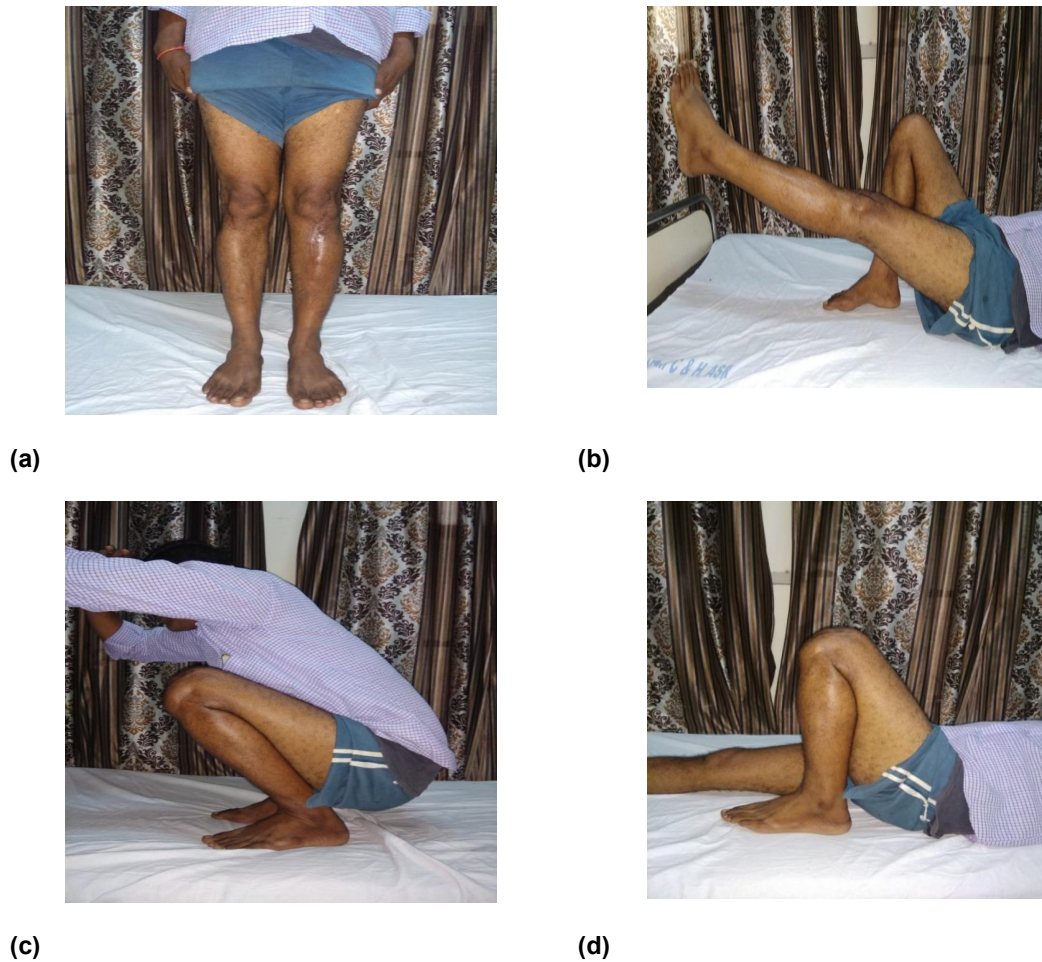


**Fig. 4. Follow up X-Ray At 4 weeks**



**Fig. 5. Follow up X ray At 24 weeks**





**Fig. 6. Range of motion. (a) standing (weight bearing). (b) extension at knee.(c)squatting.(d) flexion of knee**

## 5. CONCLUSION

From this study, we can conclude that retrograde multidirectional nailing is a good option in the management of distal femoral fractures (especially type A fractures) due to less invasive procedure and hence lesser blood loss and infection, short operative time and exposure to c-arm radiations. It also provide early mobilization and weight bearing with low overall complications like knee stiffness, and good anatomical and functional outcome with faster rates of union.

## CONSENT

All authors declare that written informed consent was obtained from the patient (or other approved parties) for publication of this case series study and accompanying images. A copy of the written consent available for review by the Editorial

office/Chief editor/Editorial board members of this journal.

## ETHICAL APPROVAL

All authors hereby declare that all procedures performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. The study was undertaken after approval of Institutional Ethics Committee from Government Medical College, Amritsar.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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