

## Original Research Article

**TREATMENT OF FRACTURE OF DISTAL 1/3 FEMUR WITH RETROGRADE MULTIDIRECTIONAL INTRAMEDULLARY INTERLOCKING NAIL IN ADULTS** “Outcome of retrograde multidirectional interlocking Intramedullary nailing for distal third femur shaft fracture”

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### ABSTRACT

**Aims:** To study the “Outcome of management of distal 1/3 femur fractures by retrograde multidirectional intramedullary interlocking nail in adults”-retrograde intramedullary nailing for distal third femur shaft fracture in adult patients.

**Study design:** A prospective study, A case series study

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**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 >20 years old with a mean of 44.33 years with having closed type A distal third femur shaft fracture of distal 1/3rd femur type A- admitted in Department/Casualty of Orthopaedics at Government Medical College, Amritsar treated with retrograde multidirectional intramedullary interlocking nail.

**Results:** Mean union time was in our study was found to be 18.62 weeks (Min; Max). In 56.67% of the patients (17 patients), the knee flexion was between (111 to 120) degrees. Mean knee flexion of the patients was 113.23° (Min; Max). 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).

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**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, shorter operative time and exposure to c-arm radiations, It also provide early mobilization and weight bearing with low overall complications, and good anatomical and functional outcome.

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**Keywords:** Distal third 1/3rd femur fractures, AO type A fractures, retrograde multidirectional nailing.

### INTRODUCTION

Femoral fractures are an injury 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, 11] 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 differ 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 distal femoral

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fractures is approximately 37/1,00,000 person per year. Distal femur fractures make up to 6% of all femoral fractures. Most high energy distal femoral fractures occur in males in the age group 15-50 years and low energy fractures occur more commonly in osteoporotic women more than 50 years.[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 nonunion.[10]

## MATERIAL AND METHODS

This was a case series study of 30 patients of either sex with age above 20 years old 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. The study was undertaken after approval of Institutional Ethics Committee from Government Medical College, Amritsar. Written and informed consent of the patient was obtained before inclusion in the study.

### Inclusion Criteria:

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

### Exclusion criteria:

- 
- 
- Pathologic fractures.

Others

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° 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 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 all stitch was 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 with X-rays

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**Commented [MGM9]:** Again, No need to mention age as exclusion criteria. If you mention as you include age >20 years, by default it is know that age less than 20 years will not be included.

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These all matters on your rehabilitation and functional outcome

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.
- 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.

## RESULTS AND DISCUSSION

Most common age group in our study was 31-50 years which involved 56.7%

(17 patients). Mean age was 44.33 years (Min: [Max](#)). Males outnumbered females

. 70 percent (21 patients) were males. In 80% (24

patients), mode of injury was road traffic accident [and the remaining is fall injury](#).

. In 60% (18 patients), right side involved.

. In 36.7 percent of the patients (11 patients), type 33A1.3 fracture were present while in the 26.7 percent of the patients (8 patients), type 33A3.3 fracture were 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. Mean union time in our study was found to be 18.62 weeks. (Table 1) 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 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 6 patients (20 percent), surgical site infections were seen in 10% of the patients (3 patients) and delayed union and non-union was seen in 1 patient (3.3 percent) each respectively.

Although their treatment evolved during the last years, distal femoral fractures still remain challenging injuries for orthopedic 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.[11] The diversity of surgical options for the management of distal femoral fractures reflects the challenges inherent in these injuries. 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] 56.7 percent of the patients of the retrograde multidirectional nailing group belonged to the age group 31-50 years. This is probably due to the fact that this is the most active and productive age group with individuals involved more in outdoor and job related

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Then you will proceed with Discussion section where you will compare your result with previous article.

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activities. Mean age of the patients of the retrograde multidirectional nailing group was 44.3 years. 70 percent of the patients of the retrograde multidirectional nailing group were males while the remaining were females. In the present study, mean union time among the patients of the retrograde nailing group was 18.62 weeks. Mean knee flexion among patients among the patients of the retrograde nailing group was found to be 113.23°. The variation in knee flexion among the patients was probably due to the variation in patient compliance and the degree of postoperative knee pain. At 9 months follow-up excellent results were obtained 50% cases (15 patients), good results were obtained in 30% cases (9 patients), fair results were obtained in 16.7% cases (5 patients) and poor results were obtained in 3.3% cases (1 patient).

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**Table 1 : Union Time (Weeks)**

| 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<br>(after 39 weeks) | 1            | 3.33       |
| Total                         | 30           | 100.0      |
| Mean±SD                       | 18.62±3.91   |            |

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**Table 2: Outcome**

| 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      |

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Figure 1 : Pre operative X ray AP and lateral view



Figure 2 : Post operative X ray AP View



Figure 3 : Post operative X ray lateral view



**Figure 4 : Follow up X-Ray At 4 weeks**



**Figure 5 : Follow Up X Ray At 24 Weeks**



(a)



(b)



(c)



(d)

**Figure 6: Range of Motion. (a) Standing (weight bearing). (b) Extension at knee.(c)squatting.(d) Flexion of knee**

### CONCLUSION

From this study, we 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, lesser operative time and exposure to c-arm radiations, early mobilization and weight bearing with very decreased overall complications and good anatomical and functional outcome.

### CONSENT

All authors declare that "written informed consent was obtained from the patient(or other approved parties) for publication of this case report 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

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All authors hereby declare that all [procedures](#) performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

#### REFERENCES

1. Gregory JS, Aspden RM. Femoral geometry as a risk factor for osteoporotic hip fracture in men and women. *Med Eng Phys.* 2008;30(10):1275–86.
2. SN MM, Koch P, Schatzker J. The comprehensive classification of fractures of the long bones. Berlin: Springer; 1990.
3. Rau CS, Lin TS, Wu SC, Yang JC, Hsu SY, Cho TY et al. Geriatric hospitalizations in fall-related injuries. *Scand J Trauma Resusc Emerg Med.* 2014;22:63.
4. Chang MW, Liu HT, Huang CY, Chien PC, Hsieh HY, Hsieh CH. Location of Femoral Fractures in Patients with Different Weight Classes in Fall and Motorcycle Accidents: A Retrospective Cross-Sectional Analysis. *Int J Environ Res Pub Health.* 2018;15(6):1082.
5. Hsieh CH, Hsu SY, Hsieh HY, Chen YC. Differences between the sexes in motorcycle-related injuries and fatalities at a Taiwanese level I trauma centre. *Biom J.* 2017;40(2):113–20.
6. Stewart MJ, T David SI, Wallace JR SL. Fractures of the distal third of the femur: a comparison of methods of treatment. *JBJS.* 1966;48(4):784-807.
7. Martinet O, Cordey J, Harder Y, Maier A, Bühler M, Barraud G.E. The epidemiology of fractures of the distal femur. *Injury.* 2000;31(3):C62-3.
8. Kannus P, Niemi S, Palvanen M, Parkkari J, Pasanen M, Järvinen M et al. Continuously rising problem of osteoporotic knee fractures in elderly women: Nationwide statistics in Finland in 1970-1999 and predictions until the year 2030. *Bone.* 2001;29(5):419-23.
9. Kammerlander C, Riedmüller P, Gosch M, Zegg M, Kammerlander- Knauer U, Schmid R et al. Functional outcome and mortality in geriatric distal femoral fractures. *Injury.* 2012;43(7):1096-101.
10. Gwathmey WF, Jones-Quaidoo SM, Kahler D, Hurwitz S, Cui Q. Distal femoral fractures: current concepts. *J Am Acad Orthop Surg.* 2010;18(10):597-607.
11. Lupescu O, Nagea M, Patru C, Vasilache C, Popescu GI. Treatment options for distal femoral fractures. *Maedica.* 2015;10(2):117-22.

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