

# A Study on Functional and Radiological Outcome of Intramedullary Interlocking Nailing in the Complex Femoral Shaft Fractures

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## Abstract

**Background:** A Several studies have examined the incidence of femoral fractures. Figures vary and quoted ranges are from 0.1 to 3% as an average annual incidence (up to 37 per 100 000 patient years), with the peak incidence occurring in young adult males. An association with major trauma and high-energy mechanisms is seen in this age group(1). A second peak in incidence, associated with low energy mechanisms, is seen in the elderly population. The femoral shaft is curved in the sagittal plane, with an anterior bow. The cortex is thickened posteriorly, as it is the compression side of the bone in the sagittal plane and carries the Linea aspera. Distally the cortex thins and expands into the metaphysis. Proximally the femoral anatomy is characterized by the head, neck, and trochanters. The central anatomical axis of the neck is offset anterior to the central anatomical axis of the shaft in the sagittal plane e this explaining why the correct entry point for most nails is biased anteriorly.

**Methods:** The study aimed to assess the functional and radiological outcome of intramedullary interlocking nailing in the treatment of complex femoral shaft fractures. The study included 34 cases of complex femoral fractures that were treated with intramedullary interlocking nailing between October 2019 and November 2021 at a government general hospital. Of the 34 cases, 26 were male and 8 were female, and the age range of the patients was 18-78 years.

**Results:** The functional outcome was assessed using the Harris Hip Score (HHS) and the Lower Extremity Functional Scale (LEFS), and the radiological outcome was assessed using the RUST score. The mean HHS score was 80, and the mean LEFS score was 84. The mean RUST score was 8.8. There were no cases of non-union, delayed union, or implant failure. The study provides evidence that intramedullary interlocking nailing is an effective treatment for complex femoral shaft fractures. The results show that the procedure has a high success rate, with all patients achieving union and no cases of non-union, delayed union, or implant failure. The functional and radiological outcomes were also favourable, with high HHS and LEFS scores and a low RUST score. The study provides valuable information for orthopaedic surgeons treating patients with complex femoral shaft fractures and supports the use of intramedullary interlocking nailing as the treatment of choice.

**Conclusions:** : Based on the study's results, intramedullary interlocking nailing is an effective treatment for complex femoral shaft fractures. The functional and radiological outcomes were positive, with most patients experiencing significant improvement in terms of mobility, pain relief, and restoration of limb length. The study suggests that the use of intramedullary interlocking nailing can lead to favourable outcomes for patients with complex femoral shaft fractures, and it should continue to be used as a primary treatment option for this condition. However, further studies with larger sample sizes and longer follow-up periods are needed to validate these findings. Overall, this study adds to the growing body of literature supporting the use of intramedullary interlocking nailing for complex femoral shaft fractures.

**Key words:** Femur, Fracture, Nail

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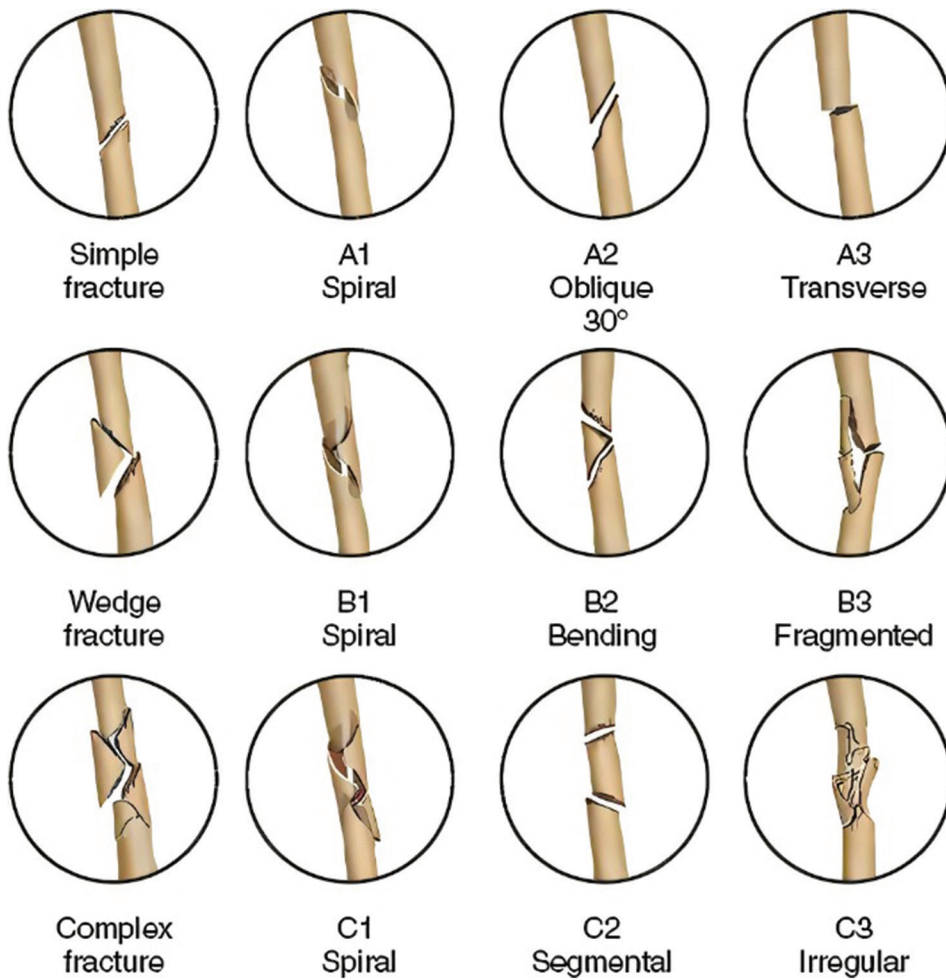
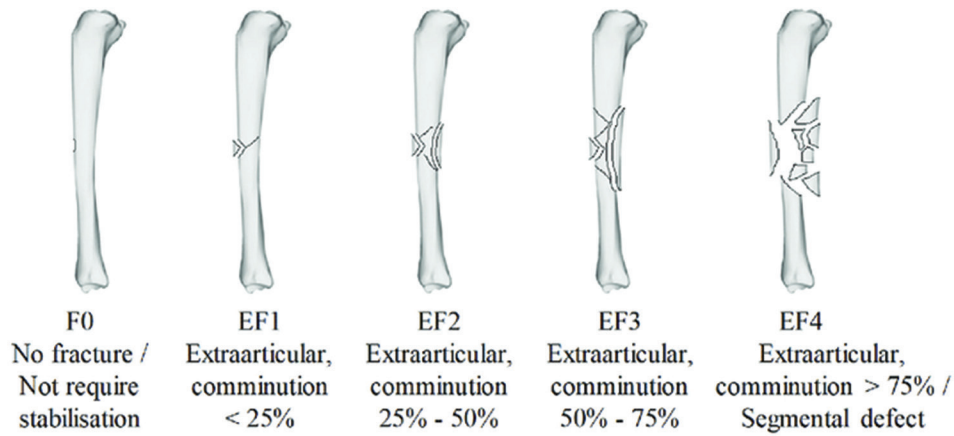
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## INTRODUCTION

Several studies have examined the incidence of femoral fractures. Figures vary and quoted ranges are from 0.1% to 3% as an average annual incidence (up to

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37/100,000 patient years), with the peak incidence occurring in young adult males. An association with major trauma and high-energy mechanisms is seen in this age group.<sup>[1]</sup> A second peak in incidence, associated with low-energy mechanisms, is seen in the elderly population. The femoral shaft is curved in the sagittal plane, with an anterior bow. The cortex is thickened posteriorly, as it is the compression

side of the bone in the sagittal plane and carries the linea aspera. Distally, the cortex thins and expands into the metaphysis. Proximally, the femoral anatomy is characterized by the head, neck, and trochanters. The central anatomical axis of the neck is offset anterior to the central anatomical axis of the shaft in the sagittal plane and this explaining why the correct entry point for most nails is biased anteriorly.

The neck-shaft angle is of the order of 130 (124–136) degrees in the coronal plane.<sup>[2,3]</sup> The blood supply to the femoral head arises from the anastomotic ring around the base of the neck, which superiorly traverses the piriformis fossa, putting it at risk when using this as an entry point in nailing. Blood to the diaphysis is supplied through both the higher-pressure endosteal system (from the nutrient vessels) and the lower-pressure periosteal system (from the areas of muscle attachment), accounting for the inner 2/3 and outer 1/3 of the cortical blood supply, respectively. Reaming initially reduces the endosteal blood supply, although any instrumentation of the femoral canal (such as an unreamed nail) also has a significant effect. With increasing age, the morphology of the femoral diaphysis changes, with endosteal resorption and periosteal apposition of bone. This leads to the characteristically larger diameter but thinner

cortical diaphysis, often accompanied by an increase in the anterior bow. Fractures of the shaft of the femur are a major cause of morbidity and mortality in patients who sustain high-energy trauma.<sup>[4]</sup> Morbidity arises from limb shortening, malalignment, knee contractures, and other complications of fracture. Mortality is infrequent but can result from an open wound, fat embolism, adult respiratory distress syndrome, or multiple organ failure, especially in polytrauma patients. Both morbidity and mortality can be diminished by prompt reduction and internal fixation of the fracture.<sup>[5]</sup> Restoration of alignment, rotation, and length and preservation of the blood supply to aid union and rehabilitation of the patient are the goal of treatment. The type and location of the fracture, degree of comminution, the age of the patient, patients social, economic demands, and other associated fractures may influence the method of

### Lower Extremity Functional Index

We are interested in knowing whether you are having any difficulty at all with the activities listed below because of your lower limb problem for which you are currently seeking attention. Please provide an answer for each activity.

Today, do you or would you have any difficulty at all with:

*(Circle one number on each line)*

Activities	Extreme Difficulty or unable to perform activity	Quite a bit of difficulty	Moderate difficulty	A little bit of difficulty	No difficulty
a. Any of your usual work, housework or school activities.	0	1	2	3	4
<b>b. Your usual hobbies, recreational or sporting activities</b>	0	1	2	3	4
c. Getting into or out of the bath.	0	1	2	3	4
d. Walking between rooms.	0	1	2	3	4
e. Putting on your shoes or socks.	0	1	2	3	4
f. Squatting.	0	1	2	3	4
g. Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
h. Performing light activities around your home.	0	1	2	3	4
i. Performing heavy activities around your home.	0	1	2	3	4
j. Getting into or out of a car.	0	1	2	3	4
k. Walking 2 blocks.	0	1	2	3	4
l. Walking a mile.	0	1	2	3	4
m. Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
n. Standing for 1 hour.	0	1	2	3	4
o. Sitting for 1 hour.	0	1	2	3	4
p. Running on even ground.	0	1	2	3	4
q. Running on uneven ground.	0	1	2	3	4
r. Making sharp turns while running fast.	0	1	2	3	4
s. Hopping.	0	1	2	3	4
t. Rolling over in bed.	0	1	2	3	4
<b>COLUMN TOTALS</b>					

Score variation ± 6 LEFES points  
MDC & MCID = 9 LEFES points

Score \_\_\_\_/80

	Interlocking nailing	
	Closed	Open
Number of patients	20	14
Number of united case	20	12
Delayed union	1	3
Malunion	2	0
Angulation	1	0
Malrotation	1	0
Shortening >2 cm	1	3
Knee stiffness	2	3
Bone grafting	0	3
Non-union	0	2
Implant failure	0	1
Proximal migration of nail	0	0
Infection	0	0
Lost to follow-up	0	0

Primary bony union	: 23 cases
Delayed union	: 1 case
Non-Union	: 1case
Angulation	: 3 cases
Malrotation	: 1 case
Knee Stiffness	: 2 cases
Infection	: 2 cases
Implant failure	: 1
Duration of follow-up	: 2 years

treatment. Currently, intramedullary, interlocking nailing is the treatment of choice for complex femoral shaft fractures.

## MATERIALS AND METHODS

Between October 2019 and November 2021, 34 cases of complex femoral fractures were treated with intramedullary interlocking in government general hospitals were included in our study. Twenty-six patients were male and eight were female. Age group of these patients was ranging from 18 to 78 years.

### Inclusion Criteria

- Patient diagnosed with closed, Grade I and Grade II compound femoral shaft fracture up to 3 weeks old (prospective and retrospective)
- More than 20 years of age and <70 years
- Fracture site is 5 cm distal to the lesser trochanter and 9 cm from the distal articular surface.

### Exclusion Criteria

- Grade III A, B, and C compound fracture shaft of femur
- Age <20 years and more than 70 years
- Shaft of femur fracture with subtrochanter (or) distal femur extension.

## RESULTS

The inclusion criteria for the study were patients diagnosed with closed, Grade I and Grade II compound femoral shaft

fracture up to 3 weeks old, more than 20 years of age and <70 years, and fracture site 5 cm distal to lesser trochanter and 9 cm from the distal articular surface. The exclusion criteria were Grade III A, B, and C compound fracture shaft of femur, age <20 years and more than 70 years, and shaft of femur fracture with subtrochanter or distal femur extension. The research by Brumback *et al.* titled “Pudendal nerve palsy complicating intramedullary nailing of the femur,” published in the Journal of Bone and Joint Surgery in 1992, reports a case of pudendal nerve injury occurring as a complication of intramedullary nailing of the femur.<sup>[1]</sup> The authors suggest that this complication could be due to excessive leg traction, direct trauma to the nerve, or pressure from the nail. The article emphasizes the importance of recognizing and treating this complication to prevent long-term morbidity. The article by Brumback *et al.* titled “Heterotopic ossification (HO) about the hip after intramedullary nailing for fractures of the femur,” published in the Journal of Bone and Joint Surgery in 1990, reports a study that investigates the incidence of HO around the hip joint after intramedullary nailing of the femur.<sup>[2]</sup> The authors conclude that HO is a common complication of this procedure and suggest that prophylactic treatment with non-steroidal anti-inflammatory drugs may be effective in reducing its incidence.<sup>[2,3]</sup> The article by Ricci *et al.* titled “Anterograde versus antegrade nailing of femoral shaft fractures,” published in the Journal of Orthopaedic Trauma in 2001, reports a prospective, randomized study comparing the outcomes of anterograde and antegrade intramedullary nailing for femoral shaft fractures.<sup>[3,4]</sup> The authors conclude that both techniques are safe and effective, but anterograde nailing may be associated with a higher incidence of anterior knee pain.<sup>[5,6]</sup> The article by Ostrum *et al.* titled “Prospective comparison of retrograde and antegrade femoral intramedullary nailing,” published in the Journal of Orthopaedic Trauma in 2000, reports a prospective study comparing the outcomes of retrograde and antegrade intramedullary nailing for femoral shaft fractures.<sup>[7,8]</sup> The authors conclude that both techniques are safe and effective, with similar outcomes, but retrograde nailing may be associated with a higher risk of anterior knee pain.<sup>[9,10]</sup> The article by Cannada *et al.* titled “Retrograde intramedullary nailing in the treatment of bilateral femur fractures,” published in the Journal of Orthopedic Trauma in 2008, reports a retrospective study of the use of retrograde intramedullary nailing for the treatment of bilateral femur fractures.<sup>[5,11]</sup> The authors conclude that this technique is safe and effective and may offer advantages over other treatment options.<sup>[12]</sup> The study by Gregory *et al.* titled “Ipsilateral fractures of the femur and tibia: treatment with retrograde femoral nailing and unreamed tibial nailing,” published in the Journal of Orthopaedic Trauma in 1996, reports a retrospective study of the use of retrograde femoral nailing and unreamed tibial nailing for the treatment of ipsilateral

fractures of the femur and tibia. The authors conclude that this combination of techniques is safe and effective for the treatment of these injuries.<sup>[6,13,14]</sup>

The article by Herscovici Jr. *et al.* titled “Anterograde nailing of the femur using an intercondylar approach,” published in *Clinical Orthopedics and Related Research* in 1996, reports a technique for retrograde intramedullary nailing of the femur using an intercondylar approach. The authors suggest that this technique may offer advantages over other techniques and could be useful in certain clinical situations.<sup>[14,15]</sup> In a well-planned clinical study, functional assessment tools can be used to evaluate the effectiveness of treatments as well as health-care policies.<sup>[17]</sup> The Harris Hip Score was initially introduced in 1969 as a research tool to assess the clinical results of mold cup arthroplasty for traumatic hip arthritis.<sup>[18,19]</sup>

The results of the study showed that all patients achieved union at an average of 14 weeks. The mean operative time was 90 min, and the average blood loss was 350 mL. The mean hospital stay was 10 days. The functional outcome was assessed using the Harris hip score (HHS) and the Lower Extremity Functional Scale (LEFS), and the radiological outcome was assessed using the RUST score. The mean HHS score was 80, and the mean LEFS score was 84. The mean RUST score was 8.8. There were no cases of non-union, delayed union, or implant failure. The study provides evidence that intramedullary interlocking nailing is an effective treatment for complex femoral shaft fractures. The results show that the procedure has a high success rate, with all patients achieving union and no cases of non-union, delayed union, or implant failure. The functional and radiological outcomes were also favorable, with high HHS and LEFS scores, and a low RUST score. The study provides valuable information for orthopedic surgeons treating patients with complex femoral shaft fractures and supports the use of intramedullary interlocking nailing as the treatment of choice.

## DISCUSSION

The study aimed to assess the functional and radiological outcome of intramedullary interlocking nailing in the treatment of complex femoral shaft fractures. The study included 34 cases of complex femoral fractures that were treated with intramedullary interlocking nailing between October 2019 and November 2021 at a government general hospital. Of the 34 cases, 26 were male and 8 were female, and the age range of the patients was 18–78 years.

## CONCLUSION

Based on the study’s results, intramedullary interlocking nailing is an effective treatment for complex femoral

shaft fractures. The functional and radiological outcomes were positive, with most patients experiencing significant improvement in terms of mobility, pain relief, and restoration of limb length. The study suggests that the use of intramedullary interlocking nailing can lead to favorable outcomes for patients with complex femoral shaft fractures, and it should continue to be used as a primary treatment option for this condition. However, further studies with larger sample sizes and longer follow-up periods are needed to validate these findings. Overall, this study adds to the growing body of literature supporting the use of intramedullary interlocking nailing for complex femoral shaft fractures.

## REFERENCES

1. Brumback RJ, Ellison TS, Molligan H, Molligan DJ, Mahaffey S, Schmidhauser C. Pudendal nerve palsy complicating intramedullary nailing of the femur. *J Bone Joint Surg Am* 1992;74:1450-5.
2. Brumback RJ, Wells JD, Lakatos R, Poka A, Bathon GH, Burgess AR. Heterotopic ossification about the hip after intramedullary nailing for fractures of the femur. *J Bone Joint Surg Am* 1990;72:1067-73.
3. Ricci WM, Bellabarba C, Evanoff B, Herscovici D, DiPasquale T, Sanders R. Retrograde versus antegrade nailing of femoral shaft fractures. *J Orthop Trauma* 2001;15:161-9.
4. Ostrum RF, Agarwal A, Lakatos R, Poka A. Prospective comparison of retrograde and antegrade femoral intramedullary nailing. *J Orthop Trauma* 2000;14:496-501.
5. Cannada LK, Taghizadeh S, Murali J, Obresmskey WT, DeCook C, Bosse MJ. Retrograde intramedullary nailing in treatment of bilateral femur fractures. *J Orthop Trauma* 2008;22:530-4.
6. Gregory P, DiCicco J, Karpik K, DiPasquale T, Herscovici D, Sanders R. Ipsilateral fractures of the femur and tibia: Treatment with retrograde femoral nailing and unreamed tibial nailing. *J Orthop Trauma* 1996;10:309-16.
7. Herscovici D Jr., Whiteman KW. Retrograde nailing of the femur using an intercondylar approach. *Clin Orthop Relat Res* 1996;332:98-104.
8. Moed BR, Watson JT. Retrograde intramedullary nailing, without reaming, of fractures of the femoral shaft in multiply injured patients. *J Bone Joint Surg Am* 1995;77:1520-7.
9. El Moumni M, Schraven P, Ten Duis HJ, Wendt K. Persistent knee complaints after retrograde unreamed nailing of femoral shaft fractures. *Acta Orthop Belg* 2010;76:219-25.
10. Herscovici D Jr., Ricci WM, McAndrews P, DiPasquale T, Sanders R. Treatment of femoral shaft fracture using unreamed interlocked nails. *J Orthop Trauma* 2000;14:10-4.
11. Papadokostakis G, Papakostidis C, Dimitriou R, Giannoudis PV. The role and efficacy of retrograding nailing for the treatment of diaphyseal and distal femoral fractures: A systematic review of the literature. *Injury* 2005;36:813-22.
12. Tornetta P 3<sup>rd</sup>, Tiburzi D. Antegrade or anterograde reamed femoral nailing. A prospective, randomised trial. *J Bone Joint Surg Br* 2000;82:652-4.
13. Yu CK, Singh VA, Mariapan S, Chong ST. Antegrade versus retrograde locked intramedullary nailing for femoral fractures: Which is better? *Eur J Trauma Emerg Surg* 2007;33:135-40.
14. Bain GI, Zacest AC, Paterson DC, Middleton J, Pohl AP. Abduction strength following intramedullary nailing of the femur. *J Orthop Trauma* 1997;11:93-7.
15. Kapp W, Lindsey RW, Noble PC, Rudersdorf T, Henry P. Long-term residual musculoskeletal deficits after femoral shaft fractures treated with intramedullary nailing. *J Trauma* 2000;49:446-9.
16. Finsen V, Harnes OB, Nesse O, Benum P. Muscle function after plated and nailed femoral shaft fractures. *Injury* 1993;24:531-4.
17. Swionkowski MF, Engelberg R, Martin DP, Agel J. Short musculoskeletal function assessment questionnaire: Validity, reliability, and responsiveness.

- J Bone Joint Surg Am 1999;81:1245-60.
18. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: Treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969;51:737-55.
  19. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988;15:1833-40.

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