

# Is there a place for open intramedullary nailing in femoral shaft fractures?

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## Abstract

**Background:** Femoral shaft fractures are among the most common fractures following high trauma injuries. Different kinds of treatment have been suggested for these injuries.

**Aim:** The aim of this study was to compare the results femoral fractures treated by mini open and close intramedullary nailing (IMN) technique.

**Materials and Methods:** A total of 48 adult patients were operated due to fracture of the femur with close or open IMN technique between September 2010 and September 2011. 23 patients operated with close IMN technique was included in Group I while 24 patients operated with mini open IMN technique constituted Group II. In Group I, all patients. Were operated on the fracture table in the supine position while in Group II, all patients underwent surgery on standard tables in the lateral position.

**Results:** The mean age of patients was 27.3 years, ranging between 16 and 62. The mean age of the close nailing and open nailing groups was 30.5 and 24.5 respectively ( $P = 0.052$ ). Only one patient from the open nailing group failed to unite. The mean time for union in close and open nailing groups was  $13 + 2.4$  and  $17.7 + 2.3$  weeks respectively ( $P = 0.001$ ). No infection or limb length discrepancies were observed in the two groups.

**Conclusion:** Although close nailing is the preferred methods in most cases, but in poly-traumatized patients or in centers where there are no fracture tables or C-arm, open nailing is a good option.

**Key Words:** Femur fracture, intramedullary nailing, surgical technique

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## INTRODUCTION

There has been a great advance in the treatment

of femoral shaft fractures during the past four decades. In the early 20<sup>th</sup> century, different kinds of traction was popular for the treatment of femoral shaft fracture, afterward the use of plates became approved; however, currently, they are used just in special conditions.<sup>[1-4]</sup>

Hey Groves was one of the first surgeons who presented intramedullary nailing (IMN) for the treatment of femoral shaft fractures in United Kingdom, and later in Germany Kuntcher made a significant progress in the technique of this operation.<sup>[5]</sup> Today, the gold

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standard treatment of a femoral diaphyseal fracture is ream lock IMN.<sup>[6-12]</sup>

Different open and close techniques have been described for using this device and each may be preferred by some surgeons according to availability of operating room equipment (such as C-arm and fracture table), patient's factor (such, as morbid obesity), and fracture pattern and associated injuries (i.e., floating knee injury, concomitant acetabular fracture, and spinal injury).<sup>[13]</sup> According to the majority of studies ream intramedullary technique is the preferred method and has a greater chance of healing and lower rate of complications with regard to unreamed technique.<sup>[7,12,14-18]</sup> From the early papers until now, there are still controversies in results of femoral shaft fractures treated by close versus open IMN.<sup>[7,15,19-24]</sup>

Since, close IMN is not feasible in all patients with femoral shaft fractures and there are reports of serious complications associated with the use of fracture table, such as compartment syndrome in the normal leg and peroneal nerve palsy,<sup>[6]</sup> the purpose of this study was to compare and evaluate the results of healing and its complications in femoral shaft fracture treated by open and close IMN technique.

## MATERIALS AND METHODS

A total of 48 adult patients were operated due to fracture of the femur with close or open IMN technique between September 2010 and September 2011.

A total of 23 patients operated with close IMN technique were included in Group I while 24 patients operated with mini open IMN technique constituted Group II.

Inclusion criteria for our study included adult patients with acute fracture of the femur, and exclusion criteria included pathologic fractures, significant open fractures (Gustilo type 2 and 3), patients less than 16 years old, previous surgery on the femur or hip, anatomical deformity of the femur, non-acute fracture (more than 72 h since trauma insult), and patients who declined to participate in the study. During the follow-up period in Group I, 3 patients dropped out of the study; hence, the results of 20 patients were evaluated. During the follow-up period in Group II, 2 patients dropped out of the study, so the results of 22 patients were evaluated in this group.

Demographic details of the patients included age, sex, medical co-morbidities, history of smoking, mechanism of injury, open or closed injury, type of fracture, associated injuries, time to union, malunion, non-union,

Infection, and systemic complications were recorded. AO and Gustilo-Anderson classification were used for closed and open fractures respectively. All patients in both groups were operated by two surgeons (the authors), with reamed, locked IMN technique who were experienced in these techniques. In Group I, patients were operated on the fracture table in the supine position. An incision centered over the great trochanter was made and an entry into the proximal femoral canal was made through the piriformis Fossa. Antegrade nail insertion was used for femoral diaphyseal and subtrochantric fracture and retrograde technique was used for distal femoral fracture. Static locking screws were applied distally and proximally. Proximal and distal screws were applied with insertion guide. In Group II, all patients underwent surgery on standard tables in the lateral position. Access to piriformis fossa was as the same as in Group I, but an additional incision was made over the fracture site and with one or two fingers the reduction and rotation was checked. Subsequently, a guide rod was passed from the piriformis fossa toward the distal fragment.

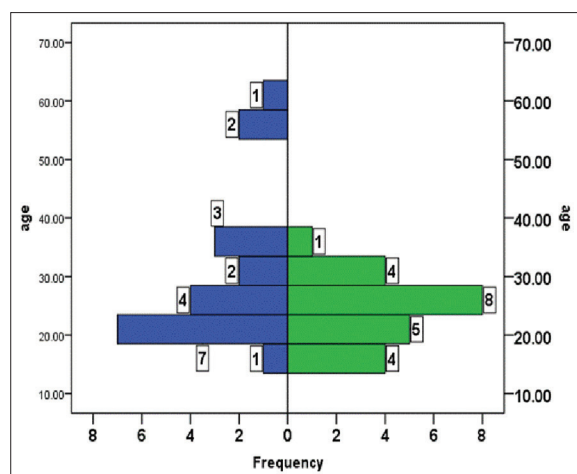
Afterward reaming was performed. Antegrade nail with distal and proximal screws were inserted with insertion guide and without using fluoroscopy.

Isometric exercises for quadriceps were started at the post-operative first day, and the patients were mobilized with crutches on post-operative second day if there was no associated injury. Monthly clinical and radiological follow-up was performed. Union was defined as the absence of pain and instability at the fracture site and the presence of radiological consolidation of the fracture site.

## RESULTS

The final participants in the study were 42 patients, 20 of whom had undergone close nailing operation and 22 open nailing. Their mean age was 27.3 years, ranging between 16 and 62. The mean age of the close nailing and open nailing groups was 30.5 and 24.5 respectively; the difference between the mean age of the two groups proved not to be statistically significant based on a t-test ( $P = 0.052$ ). The distribution of the participants by age is shown in Figure 1. By gender, there were 16 male patients in the close nailing and 21 in the open nailing group respectively; the rest of the patients were female. According to a Fisher test, the difference in the distribution of the two groups by gender was not statistically significant ( $P = 0.17$ ).

The majority of fractures in the two groups were located in the femoral shaft (12 patients in close nailing and 17 in open nailing). The difference in the fracture



**Figure 1:** Frequency of patients in both groups (blue: Group I, green: Group II)

location between the two groups was not statistically significant ( $P = 0.17$ ). The other fracture sites were subtrochanteric, supracondylar, and segmental.

Most fractures were of A2 pattern (AO) classification in both groups, 4 patients in the close nailing group and 3 in the open nailing group were of A2 pattern. The difference between the two groups was checked with Fisher test and proved to be statistically insignificant ( $P = 0.06$ ).

In this study, 14 and 10 patients in close and open nailing groups respectively suffered from other fractures in limbs (70% against 45%). Chi-square test revealed no statistically significant difference ( $P = 0.13$ ) between the two groups.

The selected nails for the patients included conventional locked intramedullary nail, distal femoral nail and cephalomedullary nail, depending on fracture pattern, and associated fractures [Table 1].

The mean time for union in all patients was  $15.4 \pm 3$  weeks (10-21 w) we had no infection in either group. Only one patient from the open nailing group failed to unite, on whom reoperation was carried out with exchange nailing. The mean time for union in close and open nailing groups was  $13 \pm 2.4$  and  $17.7 \pm 2.3$  weeks respectively. The results as illustrated in Table 2 were put to a t-test that showed the difference between the groups was statistically significant ( $P = 0.001$ ). No infection or limb length discrepancies were observed in the two groups.

## DISCUSSION

Closed nailing was introduced after the advent of intraoperative radiology (C-arm), and usually it

**Table 1: Frequency of different variables between Group I and II**

Variable	Group I	Group II	P value
Age			
Mean	30.5±12.8	24.5±5.4	0.052
Sex			
Male	16 (80)	21 (95.5)	0.17
Female	4 (20)	1 (4.5)	
Fracture site			
S	12 (60)	17 (77.3)	0.17
ST	3 (15)	3 (13.6)	
DF	1 (5)	2 (9.1)	
Others	4 (20)	0 (0)	
Fracture pattern			
A2	4 (20)	3 (13.6)	0.06
A3	3 (15)	3 (13.6)	
B1	0 (0)	3 (13.6)	
B2	2 (10)	3 (13.6)	
B3	1 (5)	5 (22.7)	
C2	6 (30)	0 (0)	
C3	2 (10)	1 (5.4)	
Others	2 (10)	2 (18.2)	
Associated injuries			
Yes	14 (70)	10 (45.5)	0.13
No	6 (30)	12 (54.5)	
Treatment device			
CIM	14 (70)	22 (100)	0.007
CMN	1 (5)	0 (0)	
DFN	5 (25)	0 (0)	

S: Shaft, ST: Subtrochantric, DF: Distal femur, CIN: Conventional intramedullary nailing, CMN: Cephalomedullary nailing, DFN: Distal femoral nailing

needs fracture table. Many published studies have demonstrated superior results of closed over open femoral nailing, such as reliable fracture healing and a low infection rate.<sup>[20,22]</sup> Closed nailing allows the original hematoma to remain intact. An important point to emphasize is that closed reaming of the intramedullary canal deposits bone graft material at the fracture site. Moreover, soft-tissue damage is reduced.

On the contrary, routine open reduction and internal fixation of the fractured femur require stripping of the periosteum and subsequent reduction of the blood supply at the fracture site. This often results in extensive soft-tissue damage and increased blood loss, and raises concerns of fracture non-union and infection.

Therefore, the open technique is not recommended as a routine procedure in most cases. However, in Iran, there are few centers, which have intraoperative radiology facilities at basic health infrastructure level. Realizing the benefits, limitations, and potential complications of various methods of femoral nailing, we prefer to use the method described herein, especially for critically traumatized fracture healing was not compromised by the mini-open technique. Disadvantages of open reduction were minimized by

**Table 2: Time to union of femoral fractures according to patient's variables**

Variable	Time to union	P value	
Method of treatment			
Close	13±2.4	≤0.001	
Open	17.7±2.3		
Sex			
Male	15.8±3.4	0.08	
Female	13±1.6		
Fracture site			
S	15.5±3.3	0.81	
ST	14.8±3.9		
DF	17±3.5		
Others	14.8±3.6		
Fracture pattern			
A2	13.9±2.8	0.52	
A3	17.3±2.8		
B1	16.7±4		
B2	15.3±4.3		
B3	17.2±2.2		
C2	13.7±3.3		
C3	17.3±3.2		
Other	15.8±4.5		
Associated injuries			
Yes	15.1±3.3		0.51
No	15.8±3.4		
Treatment device			
CIN	15.5±3.4	0.59	
CMN	12		
DFN	15.4±2.9		

S: Shaft, ST: Subtrochantric, DF: Distal femur, CIN: Conventional intramedullary nailing, CMN: Cephalomedullary nailing, DFN: Distal femoral nailing

using our new technique. Using 1 or 2 fingers to reduce the fracture through a small incision are important. In our experience, because an accurate reduction is not required for passing of the guide rod into the distal canal, an incision that is as small as 2.5 cm often sufficed for this purpose.

A satisfactory reduction was usually achieved later with a larger reamer. In this way, we preserved the surrounding soft-tissues and the reamed fragments of bone collected in the flutes of the reamers also remain around the fracture site as bone graft material. Thus, in poly-traumatized patients or in centers where there are no fracture table or C-arm, mini open nailing is a good option and might be superior to other techniques.

## REFERENCES

- Scannell BP, Waldrop NE, Sasser HC, Sing RF, Bosse MJ. Skeletal traction versus external fixation in the initial temporization of femoral shaft fractures in severely injured patients. *J Trauma* 2010;68:633-40.
- O'Beirne J, O'Connell RJ, White JM, Flynn M. Fractures of the femur treated by femoral plating using the anterolateral approach. *Injury* 1986;17:387-90.
- Rozbruch SR, Müller U, Gautier E, Ganz R. The evolution of femoral shaft plating technique. *Clin Orthop Relat Res* 1998;354:195-208.
- Geissler WB, Powell TE, Blickenstaff KR, Savoie FH. Compression plating of acute femoral shaft fractures. *Orthopedics* 1995;18:655-60.
- Rokkanen P, Slätis P, Vankka E. Closed or open intramedullary nailing of femoral shaft fractures? A comparison with conservatively treated cases. *J Bone Joint Surg Br Vol* 1969;51:313-23.
- Liao JC, Hsieh PH, Chuang TY, Su JY, Chen CH, Chen YJ. Mini-open intramedullary nailing of acute femoral shaft fracture: Reduction through a small incision without a fracture table. *Chang Gung Med J* 2003;26:660-8.
- Bishop JA, Rodriguez EK. Closed intramedullary nailing of the femur in the lateral decubitus position. *J Trauma* 2010;68:231-5.
- Anastopoulos G, Asimakopoulos A, Exarchou E, Pantazopoulos T. Closed interlocked nailing in comminuted and segmental femoral shaft fractures. *J Trauma* 1993;35:772-5.
- Clawson DK, Smith RF, Hansen ST. Closed intramedullary nailing of the femur. *J Bone Joint Surg Am* 1971;53:681-92.
- Hooper GJ, Lyon DW. Closed unlocked nailing for comminuted femoral fractures. *J Bone Joint Surg Br* 1988;70:619-21.
- Winquist RA, Hansen ST Jr, Clawson DK. Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases. 1984. *J Bone Joint Surg Am* 2001;83-A: 1912.
- King KF, Rush J. Closed intramedullary nailing of femoral shaft fractures. A review of one hundred and twelve cases treated by the Küntscher technique. *J Bone Joint Surg Am* 1981;63:1319-23.
- Köseoğlu E, Durak K, Bilgen MS, Küçükalp A, Bayyurt S. Comparison of two biological internal fixation techniques in the treatment of adult femur shaft fractures (plate-screws and locked intramedullary nail). *Ulus Trauma Acil Cerrahi Derg* 2011;17:159-65.
- Aiyer S, Jagiasi J, Argekar H, Sharan S, Dasgupta B. Closed antegrade interlocked nailing of femoral shaft fractures operated up to 2 weeks postinjury in the absence of a fracture table or C-arm. *J Trauma* 2006;61:457-60.
- Crist BD, Wolinsky PR. Reaming does not add significant time to intramedullary nailing of diaphyseal fractures of the tibia and femur. *J Trauma* 2009;67:727-34.
- Wolinsky PR, McCarty E, Shyr Y, Johnson K. Reamed intramedullary nailing of the femur: 551 cases. *J Trauma* 1999;46:392-9.
- Brumback RJ, Virkus WW. Intramedullary nailing of the femur: Reamed versus nonreamed. *J Am Acad Orthop Surg* 2000;8:83-90.
- Debrauwer S, Hendrix K, Verdonk R. Anterograde femoral nailing with a reamed interlocking titanium alloy nail. *Acta Orthop Belg* 2000;66:484-9.
- Wu CC, Lee ZL. Treatment of femoral shaft aseptic nonunion associated with broken distal locked screws and shortening. *J Trauma* 2005;58:837-40.
- Taitsman LA, Lynch JR, Agel J, Barei DP, Nork SE. Risk factors for femoral nonunion after femoral shaft fracture. *J Trauma* 2009;67:1389-92.
- Schatzker J. Open intramedullary nailing of the femur. *Orthop Clin North Am* 1980;11:623-31.
- Leighton RK, Waddell JP, Kellam JF, Orrell KG. Open versus closed intramedullary nailing of femoral shaft fractures. *J Trauma* 1986;26:923-6.
- Wu CC, Shih CH. Simultaneous bilateral femoral shaft fractures. *J Trauma* 1992;32:289-93.
- Amis JA, Frank Jr DJ, Burkhead Jr WZ, Buchholz RW. The role of medullary reaming in closed nailing of femur fractures. *Intramedullary Rods: Clinical Performance and Related Laboratory Testing*. Vol. ASTM STP1008. J. P. Harvey, Jr., A. U. Daniels, and R. F. Games, editors., American Society for *Testing and Materials, Philadelphia, 1989. p. 108-18.*

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