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# INTRAMEDULLARY FIXATION OF FEMUR FRACTURES - A STUDY ON OUTCOME ASSESSMENT

Aarti Dewan<sup>1</sup>

<sup>1</sup>- Associate Professor, Department of Orthopaedics,  
Sri Guru Ram Das Institute Of Medical Sciences and  
Research, Amritsar

**Corresponding Author:**

Dr Aarti Dewan  
#470 Basant Avenue,  
AMRITSAR-143001, Punjab, India  
Phone:+91-9815593236  
E-Mail:aartisdewan@gmail.com

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**Abstract:**

**Purpose**

Distal femur fractures are complex in nature and need special management. Because of the proximity of these fractures to the knee joint, regaining full knee motion and function may be difficult. The present study is being undertaken to evaluate the results of intramedullary fixation for distal femur fractures with or without intra-articular extension.

**Methods**

Seventy nine cases of distal femur fractures with or without intra-articular extension treated by intra-medullary nail in the department of Orthopaedics, Dayanand Medical College and Hospital, Ludhiana, over a period of five years (1st January 1997 to 31st December 2001) were studied. Out of seventy nine cases, forty six cases are of distal femoral fractures could be followed up for atleast four months or till fracture union were considered for final evaluation.

**Results**

Average age of study patients was 44.80 years, most were males (75%). Majority of the fractures were compound (71.25%), and (67.08%) had intra-articular extension. Surgery was done by open technique in most (75.9%). All the closed fractures united at an average of 3.2 months and compound fractures united with an average of 4 months. Nonunion was 8.4% and

infection was 13.03%, all in the open fractures. Average range of motion at knee joint was 107.5°. Three patients had flexion of less than 90°.

**Conclusion**

Intramedullary fixation for fractures of femur gives good results with acceptable complication rate and has proved superior to other methods available today.

**Keywords:** Femur fractures, Intramedullary fixation, Infection, outcome assessment

## Introduction

Knee joint, though conventionally considered as a hinge joint, also has a rotatory component along with movements of flexion and extension. In younger patients, injury to the knee joint usually occurs as a result of direct hit with knee in flexion following high energy trauma occurring in motor vehicles. In elderly patients, it is usually due to minor slip or fall on flexed knee. Fractures of the distal femur are always regarded with great concern because they are difficult to treat either by closed or open methods. These fractures often are unstable and comminuted and tend to occur in either elderly or multiply injured patient<sup>1</sup>. Because of the proximity of these fractures to the knee joint, regaining full knee motion and function may be difficult.

Conservative treatment of the distal femur fractures includes skeletal traction, cast bracing and cast immobilization<sup>2,3</sup>. But with the development of improved internal fixation devices, treatment recommendations began to change. Operative treatment of the distal fractures of the femur includes condylar blade plates, condylar buttress plate, external fixation with or without minimal internal fixation, dynamic compression plates, fixation with wires and screws and arthroscopically assisted reduction of fractures with minimal internal fixation<sup>4,5</sup>. In all these above procedures, large exposure of the distal femur with unavoidable iatrogenic trauma to the soft tissue surrounding the fracture site has resulted in high rates of infection and pseudoarthrosis<sup>6</sup>. **A study by C. Krettek et al (1996)<sup>7</sup>**, observed that the complex nature of fractures of distal femur needs special attention and special management.

Lately to overcome the above difficulties, and with the success of modern interlocking intramedullary nailing for diaphyseal fractures, fractures of distal femur have also been treated with intramedullary devices with encouraging results<sup>8,9</sup>. We have used a special kind of intramedullary device for distal femur fractures. The present study is being undertaken to evaluate the results of intramedullary fixation for distal femur fractures with or without intra-articular extension.

## Material And Methods

All the patients coming to Dayanand Medical College & Hospital, Ludhiana having fractures of the distal femur and/or proximal tibia with or without intra-articular extension treated by intramedullary nailing form part of this study. The study period spanned from 1<sup>st</sup> January 1997 to 31 December 1999, retrospectively and 1<sup>st</sup> January 2000 to 31 December 2001 prospectively. Letters were sent to all the patients, and most of them were followed up in the clinics. Medical records were also used for data collection. The fractures were classified according to AO/ASIF classification for distal femur fractures. Only the cases which could be followed up for at least 4 months or till fracture union were considered for final analysis.

All such patients received in the emergency department, after necessary resuscitation and investigations, were evaluated for the limb injuries. Local skin condition, distal neurovascular status and wounds were noted. In some of the open fractures the antibiotic irrigation drip was started in the emergency and continued post-operatively for 1-7 days. The objective of treatment in most of the cases was to provide stable fixation, adequate soft tissue cover and to achieve the

best possible functional results. The objective in cases with intra-articular extension was anatomical joint reconstruction. In patients with severe open fractures with bone loss  $\pm$  soft tissue loss, the primary objective was to salvage the limb.

After preoperative assessment and planning, patients were taken up for debridement and irrigation of the wounds where ever required, and stabilisation of bony injuries within intramedullary supracondylar nail augmented with Kirschner-wires and cannulated/cancellous screws as and when required. Surgery was performed through the medial parapatellar incision with leg hanging and flexed at knee joint. For femur fractures with intra-articular involvement, first step in bony reconstruction was to assemble the condylar block using Kirschner wire/cannulated/ cancellous screws. The condylar block was then fixed to the shaft with the nail. Most of the cases were done through closed technique, if necessary open reduction was done in fractures having intra-articular involvement. Whenever fixation with lag screw was done, it was done in such a manner so that it avoids the track for intramedullary nailing.

Post operatively, the patients were kept in recovery and then shifted to the ward when stable, managed by daily dressings in open fractures and third day dressings for surgical wounds with I / V antibiotic cover. Active assisted range of motion at knee joint was instituted within the first postoperative week. Secondary procedures for soft tissue coverage like split thickness skin grafting, local rotation flap etc. were done when ever necessary. Toe touch weight bearing of the affected extremity was allowed as soon as the patient was able to ambulate with

either crutches or walker. This was progressed to full weight bearing according to progression in healing of the fractures, within the first three post operative months.

The condition of the wound, the range of motion at knee joint, the progress of union monitored by repeat check x-rays and any complications were noted at follow up. The criteria for estimating the fracture union was based on clinical and radiological findings. Clinically fracture was considered united when there was no abnormal mobility, tenderness at the fracture site and unprotected weight bearing was there. Radiologically, fracture was considered united when bridging callus was seen in three cortices out of four in AP and lateral views. Nonunion was considered when two x-rays taken at a interval of six weeks showed no further progression to union and the surgeons felt that the fracture cannot unite without further operative intervention. Delayed union was considered when the union has not occurred at four months in closed fractures and six months in open fractures.

Secondary procedures like bone grafting and dynamisation were done wherever required. Time taken for the fracture to heal, final range of motion of the knee joint involved, pain, deformity and other complications were assessed on completion of the treatment. Non union was considered the failure of the treatment.

The functional outcome was assessed according to scale developed by Sanders et al (1991)<sup>10</sup> as follows.

**Excellent** ++++ (No pain, full extension and flexion > 125° with no ext. lag, no varus/valgus deformity, no shortening).

**Good** +++ (Minimal pain, flexion 100° - 124° with extensor lag

<5° with <10° varus/valgus deformity, <1.5 cm shortening.

**Fair** ++ (Moderate pain, flexion of 90°-100° and extensor lag of >6°-10°, varus/valgus deformity 10°-15°, 1.5-2.5 cms shortening.

**Poor** + (Frequent pain, flexion of <90° and extensor lag >10° varus/valgus deformity >15°, > 2.5 cm shortening).

## Results

The total of seventy nine cases of fractures of distal femur who have completed four weeks of follow up were included in the analysis. The minimum age of the patients was 15 years and maximum was 80 years. The average age was 44.80 ± 13.75 years. Males predominated with occurrence of 75% of the femoral fractures.

**Table No. 1.**  
**Detailed description of fracture femur**

Variable	No (%)
<b>1. Side</b>	
Right	50 (63.29%)
Left	29 (36.70%)
<b>2. Mode of Injury</b>	
RSA	67(84.8%)
Gun Shot	2 (2.5%)
Fall	10 (12.65%)
<b>3. Intra articular extension</b>	
Present	53(67.08%)
Absent	26(32.9%)
<b>4.Type of wound</b>	
Closed	23(29.1%)
Comp. G-I	16(20.25%)
Comp. G-II	16(20.25%)
Comp. G-IIIA	8(10.12%)
Comp. G-IIIB	16(20.25%)
Comp. G-IIIC	0
<b>5. Associated injuries</b>	45(56.9%)
<b>6. Associated medical conditions</b>	20(25.3%)
<b>7. Time interval between injury and surgery</b>	
Upto 12 hours	53(67.0%)
13-24 hrs	13(16.4%)
2-5 days	9(11.3%)
6- 9 days	2(2.5%)
> 10 days	2(2.5%)
<b>8.Type of surgery</b>	
Open Reduction	60(75.9%)
Close Reduction	19(24.05%)

Detailed description of fracture femur is given in table 1. The involvement of right extremity was more in femur fractures. Road traffic accidents were the most common mode of injury in femur fractures(84.8%). Gun shot injuries were accountable for 2.5% of the cases. Ten patients had history of fall in house or bathroom. Majority of femoral fractures were associated with intraarticular extension(67%). The type of wound was assessed according to Gustilo and Anderson classification and greater proportion (29%) had closed wound. High incidence of associated injuries was seen in few of the femoral (56.9%) fractures. Associated injuries included fractures (shaft of femur, patella, I/T, S/T, metacarpal, metatarsal, both bone leg, talus, neck of humerus, neck of femur), soft tissue injuries, head injury, blunt trauma chest, blunt trauma abdomen etc. Associated medical conditions were seen in femoral (25.3%) fractures. Associated medical conditions included diabetes mellitus, hypertension, neurodermatitis, ankylosing spondylitis, pulmonary koch's etc.

Most of the cases were operated within 12 hours of injury in distal femur fractures. Cases in which the surgery was delayed, either had associated life threatening injuries or medical problems or reported late in the hospital. The maximum time interval taken between the injury and surgery was twenty two days. The minimum taken between the injury and surgery was four hours.

Majority of the cases of distal femur (75.9%) fractures were performed through open technique and nineteen cases (24.05%) were performed through closed technique.

## Division Of Fractures According To AO/ASIF

Fractures were classified according to AO/ASIF classification where type A fractures are extraarticular, type B fractures are partially articular and type C are intraarticular. Fracture types are numbered 1, 2 or 3 based on the degree of comminution A1 being a simple, 2-part fracture of the metaphysis, A2 having metaphyseal wedge and A3 having severe comminution. Partially articular condylar fractures are classified; B1 fracture of the lateral condyle, B2

fracture of the medial condyle and B3 fractures seen in the frontal plane involving the condyles. Intraarticular fractures are similarly classified; C1 fractures are a simple T or Y split of the femoral condyles. C2 fractures have metaphyseal comminution, and C3 having comminution of the articular surface.

Majority of the cases were type C i.e. intraarticular in both femoral and tibial fractures. The distribution of the division of fractures according to AO/ASIF is shown in table 2.

**Table No. 2.**  
**Type of femur fractures**

Type of #	Femur		
	A	B	C
1	10 (1.2%)		25 (31.6%)
2	4(5.06%)	10 (12.6%)	18 (22.7%)
3	3(3.7%)	-	9(11.3%)
Total	17 (21.5%)	10 (12.6%)	52 (65.8%)

## Wound Infection In Relation To Type Of Wound

Majority of the compound femoral fractures had no discharge from the wound during healing. Post operatively, seven cases of femur fractures had discharging wound, out of them three healed within three weeks with local treatment and four cases had discharge from the wound which persisted till the last follow up. Superficial infection was seen another in two cases after one month of surgery, which healed with local treatment and antibiotic cover. Deep infection was seen in two cases in which the discharge of wound was seen after 3 months and 4 months respectively and both these wounds had persistent discharge till the last follow up. There was no incidence of discharge from the wound in closed

fractures of femur (table no 3)

**Table No. 3.**

Wound infection	Closed reduction cases	Open reduction cases
Superficial infection	-	5
Deep infection	-	6

## Progression/ Improvements of patients at 4 weeks follow up

A total of forty six patients were followed up till 4 weeks postoperatively. Average flexion at knee joint was 107.5° (Range 90°-120°) in distal femur fractures. There were three patients having flexion less than 90° (one had 5°, one had 50° and one had 70°) in the distal femur fractures. The cases having flexion of 5° and 50° were those in

which guarded mobilization was done because of the fracture comminution. The case having flexion of 70° was due to the fact that patient was not cooperative. There were three cases of floating knee injuries in the study. All had good range of motion at knee joint (100-110°).

**Table 4.**  
**Progression/ Improvements at 4 weeks follow up**

Variable	Femur
<b>Range of Movements</b>	
5°-90°	3(6.5%)
90°-100°	2(4.3%)
100°-124°	32(69.5%)
124°-130°	6(13%)
* 100°-110°	3(6.5%)
<b>Extensor lag</b>	
0°	38
<5°	2(4.3%)
6-10°	4(8.6%)
>10°	2(4.3%)
<b>Deformity</b>	
Varus	
0°	-
<10°	2(5.2%)
Valgus	
0°	-
<10°	1(2.17%)
FFD	
10°	1(2.47%)
10-20°	2(5.2%)
<b>Shortening (cm)</b>	
0	-
<1.5	-
1.5-2.5	1(2.17%)
>2.5	1(2.17%)
<b>Pain</b>	
<b>Femur</b>	
Mild	9(19.5%)
Moderate	7(15.2%)
Severe	0

## \*Floating Knee injuries

Cases with residual extensor lag were either non compliant to physiotherapy or were bed ridden for some other reasons. There were two patients who had extensor lag >10° (one had 15° and one had 18°) in the distal femur fractures. Varus and valgus deformity as well as fixed flexion deformity (FFD) was seen in

distal femoral fractures. Shortening was seen in two cases having distal femoral fractures.

### Fracture Union

Majority of the fractures united between 3-5 months. Of the fourteen closed femur fractures, all united within four months. Of the thirty two open femur fractures, six cases were still under treatment and were uniting, four went into nonunion. Rest of the twenty two cases united between 3-5 months. Two were considered to be delayed union and united after seven months. The distribution of fracture union is shown in table no.5

**Table 5:**

#### Fracture union according to the type of wound

Fracture Union	Femur	
	Open	Closed
United	20	14
Nonunion	4	-
Delayed union	2	-
Union in progress at last follow up	6	

### Complications

Following complications were noted among femur fracture cases (Table 6). Breakage of distal screw occurred in five patients. Shortening of limb more than 2 cm happened in two patients.

**Table No. 6:**

#### Complications among femur fracture cases

Complications	Femur
<b>Early</b>	
Screw missing locking hole	1(2.17%)
<b>Delayed</b>	
Screw missing locking hole	1(2.17%)
Knee instability	1(2.17%)
Distal screw pain	8(17.3%)
Breakage of distal screw	5(10.8%)
Deep infection	6(13.03%)
Quadriceps lag >5°	6(13.3%)
Deformities	
• Valgus >5°	1(2.17%)

• Varus >5°	2(4.2%)
Non-union	4(8.4%)
Delayed union	2(4.2%)
Shortening >2cms	2(4.2%)

Dynamisation and split thickness skin grafting was done in ten patients (Table 7).

**Table No. 7**

#### Supplementary procedures done in addition to Intramedullary nailing

Supplementary procedures to I/M Nailing	Femur
Tightening of screw	1
Resciting of screw	3
Dynamisation	10
Bone grafting	5
Bone Marrow Injection	1
Split Thickness Skin Grafting	10
Local rotation flap	-
Gastronemius flap	1

### Final Outcome

Final outcome of the patients were graded as excellent, good, fair and poor according to the evaluation scale of Sanders et al (1991). Out of forty six cases of distal femoral fractures, six cases were still under treatment leaving forty cases. Four cases had gone into nonunion leaving thirty six cases for evaluation. According to the evaluation scale, there were six excellent, twenty five good, two fair and three poor results in the distal femoral fractures. (Table 8)

**Table 8:**

#### Final outcome of femur fracture cases

Final outcome	Femur
Excellent	6(15.0%)
Good	25(62.5%)
Fair	2(5.0%)
Poor	3(7.5%)
Failure of treatment (Non union)	4(10%)

### Discussion

This is the study of seventy nine distal femur fractures treated with intramedullary supracondylar nail in the department of Orthopaedics, Dayanand Medical College &

Hospital, Ludhiana. In the present study, maximum cases were in the age groups of 40-49 years with an average age of 44.80 years, most were males, as was seen in the other studies<sup>11,12</sup>. Majorities (71.62%) of the fractures were compound and 67.08% were having intra-articular extension in the present study.

In the present series, the time interval between the injury and the surgery was less than 12 hours in 67.08% of cases and rest delay in surgery was mainly due to the associated medical conditions and associated injuries which is as reported in the literature<sup>13,14</sup>.

Average union time in the present study for closed fractures was 3.2 months and in open fractures was 4 months ranging from 3-5 months in the present study. Overall, average union time was 3.4 months with two delayed unions. In the literature, average union time for closed and compound fractures was not reported separately. An average union time with IMSC nail reported in the literature was from 2-7 months<sup>15,16</sup>. An average union time with conservative and operative methods other than nailing reported in the literature was from 3-9 months<sup>17,18</sup>.

In the present study, the average range of motion was 107.5° at the knee joint. Average range of motion reported in the literature with IMSC nail was 100°-129°<sup>19,15,16</sup>. The average range of motion reported in the literature with conservative and other operative methods other than nailing was 60°-100°<sup>17,20</sup>. An average range of motion with conservative and operative methods other than nailing was significantly less as compared with IMSC nail.

The present study shows 8.6% of the cases required bone grafting. Gellman et al (1996)<sup>19</sup>, Lucas et al (1995)<sup>13</sup> reported 4.5% and 16.7%

respectively of the cases requiring bone grafting with IMSC nail. Siliski et al (1972)<sup>12</sup> reported 35% of the cases requiring bone grafting with condylar blade plate or a dynamic compression screw and supracondylar plate. The number of cases requiring bone grafting with IMSC nail was significant less as compared to other methods.

Non-union was seen in four cases (8.6%) in the present study. All these nonunions were seen in open fractures with or without bone loss. Non union reported in the literature with conservative and operative methods other than nailing was 9.7% to 30%<sup>17,18</sup>. The incidence of non union was significantly less with IMSC nail than other methods.

In the present study, there were 4.3% cases of delayed union. Delayed union reported in the literature with IMSC nail was 2%-11.7%<sup>19,21</sup>. Bone grafting was done in these cases to achieve union. Delayed union reported in the literature with conservative and operative methods other than nailing was 4.7%.to 12%<sup>18,17</sup>. The incidence of delayed union was also significantly less with IMSC nail than with other methods.

In the present study, there are 5% of cases of mal-union. Out of these, two had varus deformity and one had valgus deformity. There was no significant rotational deformity. Less number of deformities in the present study was due to the open technique. Malunion reported in the literature with IMSC nail was from 2.9% to 3.8%<sup>13,19</sup>. Malunion reported in the literature with conservative and operative methods other than nailing was 5.1% to 20%<sup>3,22</sup>. Malunion was also seen decreased with IMSC nail as compared to other methods.

Shortening was considered

significant if it is >2cms. In the two cases where shortening was reported, it was attributed to inadequate fixation. Infection was seen in 13.04% of the cases in the present study. Infection reported in the literature with IMSC nail was 2.9%-1\*3.1%<sup>13,23</sup>. Infection reported in the literature with conservative and operative methods other than nailing was 2% to 40%<sup>18,20</sup>. The incidence of infection was also significantly less with IMSC nail than other methods.

The present study is the largest series of distal femur fractures (46 cases) treated by intramedullary nailing. Our results of distal femur fractures are similar to the results reported in the literature with the use of IMSC nail. In general, these are better than those achieved with other conservative and operative methods.

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