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### Analysis of functional outcome of IMSC (Intra medullary supracondylar) nail for distal femoral fractures

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#### Abstract

The distal femur is an area that is particularly vulnerable to the dangers of our modern life styles and high velocity methods of transportation. Among young patients, fractures of the distal femur usually are a component of multiple traumas sustained through high – velocity, high-impact injuries such as motor vehicle accidents or fall from a height.

**Objectives:** To analyze the functional outcome of distal femoral fractures treated by retrograde intramedullary nailing.

**Materials and Methods:** Between January 2016 and June 2018, 11 distal femoral fractures in 10 patients were operated using retrograde intramedullary nail at tertiary care hospital Surat. There were 7 (70%) males, & 3 (30%) were females; Age was ranging 18-74 years, with an average of 43.4 years. 7 patients were due to polytrauma.

Fractures were classified according to Muller's classification, 4.76% were Type A1, 14.8% were Type A2, 42.8% were Type A3, 9.52% were Type C1, 14.28% were Type C2 and 14.28% were Type C3. All the cases were operated with retrograde intramedullary nailing using patellar splitting approach.

**Observations:** The mean operative time was 19 minutes (16 to 240 minutes). Primary bone grafting was done in 2 cases (19%), Open reduction was done in 2 cases. Post operatively knee mobilization was done using CPM. The average follow up interval was 13 months (3 to 36) months.

**Results:** All fractures healed by 4 months range 3 to 3.5 months. The mean knee range of movements was 98<sup>0</sup> (80<sup>0</sup> to 140<sup>0</sup>). There was deep infection in one case, shortening more than 2 cm in one case, 8<sup>0</sup> valgus angulation in one case, anterior knee pain in 1 case and implant protruding to knee joint in 1 case. There were no late mechanical failures of the implant.

Neer's knee rating system was used to evaluate the function, there were 3 (30%) excellent, 5 (50%) satisfactory results, 1 (5%) was unsatisfactory results and 1(5%) of the case failed. The results correlated with age of the patient and the presence of an intra- articular fracture.

**Conclusion:** This study shows distal femoral fractures were common in males due to high velocity injuries. Retrograde intramedullary nailing is an excellent technique for management of distal femoral fractures since there is less soft tissue dissection. The preferred portal of entry can be reached quickly & effectively, shortens the duration of surgery, decreases the need for bone grafting, high union rate and good knee range of movements. Complications were few, which includes infection, shortening, angulation and anterior knee pain.

**Keywords:** distal femoral fractures, retrograde intramedullary nailing, supracondylar nailing, muller's

#### Introduction

The distal femur is an area that is particularly vulnerable to the dangers of our modern life styles and high velocity methods of transportation. Among young patients, fractures of the distal femur usually are a part of multiple traumas sustained through high – velocity, high-impact injuries such as motor vehicle accidents or fall from a height.

Fractures of the distal femur are complex injuries that can be difficult to manage. These serious injuries have the potential to produce significant long term disability.

Watson-Jones noted that “few injuries present more difficulty than supra-condylar fracture femur” [5].

Despite the advances in the techniques and the improvement in the surgical implant, treatment of distal femoral fractures remains a challenge in many situations.

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The distal femur includes the distal 15 cms of the femur including the distal femoral metaphysis (supracondylar) and the intra condylar area [1]. The supracondylar area of the femur is defined as the zone between the femoral condyles and the junction of the metaphysis with the femoral shaft. This comprises the distal 9 cm of the femur, as measured from the articular surface. It is important to distinguish supracondylar fractures from low diaphyseal fractures of the distal femur because the methods of treatment and prognosis are considerably different.

Distal femoral fractures account for 7% of all femoral fractures, predominant in young males following high energy trauma [1].

Various treatment options are available for the management of these fractures. Earlier most of the distal femoral fractures were treated by non operative method but the complications like angular deformity, joint incongruity, knee stiffness and delayed patient mobilization were common.

In 1970, the AO (Arbeitsgemeinschaft für Osteosynthesefragen) reported "if normal or near normal function is to be achieved ... then unquestionably, if correctly employed, open reduction and internal fixation ensures a very high rate of success" [3]. The AO has used angled blade plate in the treatment of these fractures, but there was an increased incidence of infection, inadequate fixation in the osteoporotic bone, malunion and the need for bone grafting in many cases.

Over the past 30 years implants and techniques have improved. Intramedullary nailing concept was introduced by Küntscher and later it was modified. The intramedullary interlocking nail has emerged as the new treatment option in the management of distal femoral fractures. They obtain more "Biological" fixation than plates, are load sharing devices, offer greater soft tissue preservation, present less need for bone grafting, show less chances of infection, provide good fixation in osteoporotic bone, have a 99% union rate and provide post-operative knee range of motion of nearly 130°.

The preferred portal of entry, through intercondylar notch can be reached quickly and effectively. There are potential problems such as intraarticular sepsis, synovial metallosis and patellofemoral arthritis.

The anatomical alignment, stable internal fixation, rapid mobilization, and early functional rehabilitation of the knee are the effective ways of management of distal femoral fractures which can be achieved by intramedullary interlocking nail.

Many classification systems have been used for fractures of the distal femur, including those of Tess, Stewart *et al.* Neer *et al.* Schatzer and Lambert, Seinsheimer classification, Healy and Brooker. Of the comprehensive classification of fractures of the long bones, Muller's classification is probably the most widely accepted classification of supracondylar fractures<sup>1</sup>. Comparisons of published series is often difficult because of differences in the classification schemes and it is further complicated by the use of different systems for rating.

The purpose of this study was to determine the outcome of the management of distal femoral fractures by the retrograde intramedullary interlocking nail and analyzing the complications and the causes of failure. The rating system of Neer *et al.* was employed to determine the functional outcome.

#### Aims and Objectives

- To determine the age distribution, sex distribution and mechanism of injury.
- To determine the incidence of different types of fractures

according to Muller's comprehensive classification.

- To study the functional outcome treatment of distal femoral fractures by retrograde intramedullary nailing.
- To study advantages and complications of retrograde intramedullary nailing.
- To verify the hypothesis that retrograde Intramedullary Nailing for the treatment of distal femoral fractures results in a better bony union with decreased complications.

#### Materials and Methods

Between January 2016 and June 2018, 11 distal femoral fractures in 10 patients were operated using retrograde intramedullary nail at tertiary care hospital Surat.

#### Inclusion and exclusion criteria

##### Inclusion criteria

- Patients with distal femoral fractures including the supracondylar and intercondylar fractures.

##### Exclusion criteria

- Patients managed conservatively.
- Associated with vascular injury that requires amputation.
- Fractures with epiphyseal plate open.
- Pathological fractures.
- Patients lost in follow up

On admission of the patient, a careful history was elicited from the patient and / or attendants to reveal the mechanism of the injury and the severity of the trauma. The patients were then assessed clinically to evaluate their general condition and the local injury

In general condition of the patient the vital signs were recorded. Methodical examination was done to rule out fractures at other sites. Palpation revealed abnormal mobility, crepitus and shortening of the affected limb. Distal vascularity was assessed by dorsalis pedis and posterior tibial arterial pulsations and capillary refilling.

Radiograph of the knee with the distal half of the femur AP, lateral, right and left oblique views were obtained. The pelvis with both hips AP view and tibia full length AP and lateral view was done to rule out other fractures. The limb was then immobilized in Thomas splint.

The patient was then taken up for surgery after investigations and making the patient medically fitness for surgery. The routine investigations were done.

#### Pre-operative planning

- Appropriate length of the nail to be used was assessed clinically and radio graphically
- Preparation of the required part was done prior to the surgery.

#### Operative procedure

- **Type of anaesthesia-** General Anaesthesia was used in 4 cases and spinal anaesthesia was used in the remaining 6.
- **Position-**Some of the patients were positioned on the traction table in the supine position with the hip at an angle of approximately 15 degrees and the knee at an angle of 40-90 degrees and some were positioned supine on a radiolucent table, the extremities draped free.
- **Reduction-**The reduction of the fracture fragment was done by closed method in extra-articular fractures and by open method in intra-articular fractures.
- **Immobilization-**When fracture reduction was not stable

limb was immobilized in above knee cast or above knee slab.

**Post operative care**

1. Suction drainage for 1 to 2 days was kept in case of open fractures
2. Day 1:- Mobilization of the knee started using CPM.
3. Day 2:- active quadriceps and hamstring exercises and continued CPM was done.
4. Day 3 Onwards: - Patients were kept touch-down weight bearing until there were radiographic signs of callus formation. In case of unstable fractures and osteoporotic patients the weight bearing was delayed.
5. By 6 weeks partial weight bearing was started.
6. By 12 weeks, full weight bearing was started.

**Follow up:** All the patients were followed up at about 3 weeks, 6 weeks, 3 & 6 months and 1 year. The evaluation was done based on Neer’s knee rating system. Pain, function, range of movements was noted and the union was assessed radiologically at regular intervals. The fracture was said to be united when there was a presence of periosteal callus bridging the fracture site and trabeculation extending across the fracture site

**Results**

The present study includes treatment of 11 distal femoral fractures in 10 patients by retrograde intramedullary nailing. The age of these patients was from 18 to 74 years. The fracture was commonest in the 30-50 years age group with an average of 43.4 years.

**Table 1:** Male patients were aged between 18 and 64 years with an average of 41.7 years. Female patients were aged between 23 and 74 years with an average of 47.1 years.

Age	No. of patients	Percentage
18-20	1	10%
21-30	2	20%
31-40	2	20%
41-50	3	30%
51-60	1	10%
> 60	1	10%
Total	20	100%

**Table 2:** Out of 10 patients 7 (70%) were male and 3 (30%) were female showing male preponderance, that is probably due to because of working in factories, fields and traveling.

Sex	No. Of Patients	Percentage
Male	7	70%
Female	3	30%
Total	10	100%

**Table 3:** There were 6 (60%) with right sided and 4 (40%) with left sided distal femoral fracture

Side Affected	Right	Left
No. Of patients	6	4

Majority of the injuries were due to road traffic accident 7 (70%) and 3 were due to fall. Of the 21 fractures studied 3 were open fractures and 7 were closed fractures.

Of the 11 cases majority of them were of type A 3 (42.8%) and the remaining are type A 1, A 2, C 1, C 3. Of the 10 patients 7 were associated with the other skeletal trauma most common being associated tibial fracture, and one case had posterior cruciate ligament injury avulsion which was treated

conservatively. The additional cannulated screws were used outside the nail in 2 patients of Type C3 for better stabilization. Out of the 11 cases, 1 were immobilized in above knee cast, 1 was immobilized in above knee slab, 1 was immobilized in knee brace. We have not used any method of immobilization in 7 of the cases.

Out of the 21 cases, in 5 cases the duration was 1-1.5hrs, 1 cases it was 1.5-2 hrs, 1 case it was 2-2.5 hrs, 2 cases it was 2.5-3 hrs and 1 case it was 3.5- 4 hrs. Average duration of surgery was 90minutes.

**Table 4:** Type A1 fractures had an average range of movement of 100°, Type A2 fractures had 96.6°, Type A3 had 102.85°, Type C1 had 120° Type C2 had 95° and type C 3 had 96.6°.

Type Of Fracture	Average Knee Range Of Movements In Degrees
A - 1	100
A - 2	96.6
A - 3	102.85
C - 1	120
C - 2	95
C - 3	96.6

**Time Taken for Fracture Union**

**Table 5:** The average Time taken for union was 4 months ranging from 3 to 5.5 months.

Time Taken For Fracture Union	No. Of Patients
< 4 months	2
4-5 months	4
5-6 months	4
Total	10

**Complications**

Out of total 20 cases, 1 cases had infection, 1 case had a shortening of 2.s cms and valgus angulation of 8<sup>0</sup>, 1 had an intraoperative hypotension, anterior knee pain in 1 case, proximal screw backing out in one case, implant protruding to knee joint in 1 case. Unable to do proximal locking in one case but the fracture was united.

**Results**

**Table 6:** Out of the 10 cases, 3 of them had an excellent result, 5 had satisfactory result, 1 had an unsatisfactory results and 1 was a failure due to infection.

Results	No. Of Cases	Percentage
Excellent	3	35
Satisfactory	5	50
Unsatisfactory	1	10
Failure	1	10

**Discussion**

In our study the average age was 43.4 years with ranging from 18 to 74 years. In Mosheiff. R *et al.* study the average age was 55 years (21 to 101) years. In Henry *et al.* the average was 48.6 years (16 to 101) years. In Patterson *et al.* the average age was 40 years (21 to 63) years.

Our findings are comparable to the study made Patterson *et al.* Gellman, Mosheff. R *et al.* & Gellman *et al.* In Patterson *et al.*, Mosheff. R *et al.* and Henry *et al.* males were more than the females. In Gellman *et al.* females (58%) were outnumbered males (42%). In our study males 70% were more than females.

**Table 7:** Table show series

Series	Males (%)	Females (%)
Mosheiff <i>et al.</i>	57	43
Henry <i>et al.</i>	61	45
Patterson <i>et al.</i>	76	24
Gellman <i>et al.</i>	42	58
Present study	70	30

Our findings are not comparable to the study made Patterson, *et al.* Gellman, Winquist *et al.* regarding type of fracture. In Winquist *et al.* study closed type (83%) was more than the open (17) type. In Patterson *et al.* & Gellman, open type were more than closed type.

### Duration of surgery

**Table 8:** The duration of surgery ranged between 60-240 minutes, with an average of 90 minutes.

Series	Average duration in minutes	Range in minutes
Brijlal <i>et al.</i>	70	-
Henry <i>et al.</i>	137.2	45-345
Patterson <i>et al.</i>	60	-
Gellman <i>et al.</i>	154	60-315
Present study	90	60-240

### Need for bone grafting

Henry *et al.*, series required bone grafting in 39% cases Gellman *et al.*, series required bone grafting in 4% of their cases.

**Table 9:** In our series bone grafting was required in 19% of cases.

Series	Percentage
Henry <i>et al.</i> ,	39%
Gellman <i>et al.</i> ,	4%
Present study	19%

### Range of movements

**Table 10:** The mean range of movements of the knee achieved in our series was 98° and the average range of movements was 80° - 140° which is comparable to Henry *et al.* series.

Series	Knee range of movements in degrees	Average in degrees
Moed <i>et al.</i>	> 90	
Brijlal S <i>et al.</i>	105	5-130
Henry <i>et al.</i>	105	84-120
Gellman <i>et al.</i>	106	55-150
Present study	98	80-140

In Moed *et al.* 9.7% non-union, In Brijlal *et al.* 19% shortening more than 2cms.

In Henry *et al.* 5.6% non-union, & one case angulation of more than 5°, In Leung – KS *et al.* 8% of anterior knee pain, In Gellman *et al.* 4.5% angulation of more than 5°, 25% of shortening more than 2 cms. In our study 4.76% infection, 4.76% angulation more than 5°, 2 patients had anterior knee pain, 4.76% of cases had shortening more than 2 cms. Proximal Screw backing out in one case & nail protruding to the knee joint in two cases.

### Functional results

The functional results were evaluated using Neer's criteria. Janzing *et al.* reported about 56% cases as excellent, 33% cases as satisfactory, 11% cases as unsatisfactory and 0%

failures.

In our series we had 35% cases with excellent results, 50% cases with satisfactory results, 5% with unsatisfactory results and 5% cases with failure.

Series	Excellent (%)	Satisfactory (%)	Unsatisfactory (%)	Failure (%)
Janzing <i>et al.</i>	56	33	11	0
Present study	30	50	10	10

### Conclusion

Treatment of distal femoral fractures by retrograde intramedullary nailing eliminates the need for extensive surgical dissection and so prevents the scarring around the knee and hence reduces the knee stiffness. It decreases the amount of blood loss, Shortens duration of surgery and Decreases the need for bone grafting.

Nailing Provides biological fixation since the haematoma was not disturbed at the fracture site and no periosteal stripping thus it helps in rapid mobilization and early functional rehabilitation.

Long term studies (5 years) are required to accurately assess the functional outcome of treatment of distal femoral fractures with retrograde intramedullary nailing.

Thus we conclude that retrograde intramedullary nailing is an excellent technique for management of distal femoral fracture including supracondylar and intracondylar fractures.

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