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A study on functional outcome of distal end femur fracture in adults managed with locking compression plate

Abhinav Vatsa[1], Mohammed Sohail Siddiqui[2], Maheshkumar Prajapati[3], Ronak Daglia[4], Charchit Baurasi[4]*, Ravi Patel[5]

[1]Department of Orthopaedics, Bombay Hospital, Indore, Madhya Pradesh, India
[2]Department of Orthopaedics, Apollomedics Superspeciality Hospital, Lucknow, Uttar Pradesh, India
[3]Department of Orthopaedics, SAIMS, Indore, Madhya Pradesh, India
[4]Department of Orthopaedics, Medi-square Hospital, Indore, Madhya Pradesh, India
[5]Department of Orthopaedics, Banas Medical College and Research Institute, Palanpur, Gujarat, India

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***Correspondence:**
Dr. Charchit Baurasi,
E-mail: charchitbaurasi@gmail.com

ABSTRACT

Background: We have evaluated the clinical outcome of surgery using locking compression plate in patients with fracture of distal end of femur in terms of union time, weight bearing and complications.
Methods: The present study was conducted in the department of orthopaedics, Bombay hospital, Indore (M. P.). With a prevalence of 3% of adult distal femoral fracture, the sample obtained was 30 with distal end femur fractures in the study. Protocol of surgery was followed in each patient. Postoperative rehabilitation was also adhered to in all patients.
Results: The mean age of 37.87±11.76 years with a male (25) predominance and more right-side involvement. RTA constituted 90% of the patients. According to AO/ASIF classification, type C1 (23.3%) and type A2 (20%) were the common fracture types seen. The radiological union was achieved in majority by 19-20 weeks. Full weight bearing was started by 15-16 weeks with mean of 18.93±2.02 weeks. In 43.3% patients knee flexion of more than 110 degree was achieved. Infection was seen in 10% patients and limb shortening (<10 mm) was seen in 6.7% patients. According to Neer's scoring system, 56.7% patients had excellent, 33.3% patients had good, 3.3% patients had fair and 6.7% patients had poor functional outcome.
Conclusions: The treatment of fracture distal end of femur using locking compression plate was found to provide good to excellent functional outcome in majority of the patients, with low prevalence of complications.

Keywords: Distal end femur, Fracture, Locking compression plate, Union, Weight bearing

INTRODUCTION

In the modern world, rapid industrialization, increase in speed and fast-moving vehicles has increased in number and severity of fractures. Among all the fractures due to road traffic accidents knee joint is most vulnerable for injuries, since bumper of most of the car is knee height. Estimated frequency of distal end femur fractures is less than 1% of all fractures and 4-6% of all femoral fractures.[1] There is bimodal distribution of fractures based on age and gender. Most high-energy distal end femur fractures occur in males between 15-50 years, while most low-energy fractures occur in osteoporotic females >50 years.[1] Most common high energy mechanism of energy is a traffic accident (53%) and most common low energy mechanism is a fall at home (33%).[1] However, in both instances, axial load to the leg is the most common cause.

Management of distal femoral fractures remains a challenge to orthopaedic surgeons and they are associated with many complications. In the early 1960s, there was a great reluctance towards operative management of these

fractures because of high incidence of infection, non-union, malunion, inadequate fixation and lack of proper instruments, implants as well as antibiotics. Then, the traditional management of displaced supracondylar fracture was along the principles of Watson Jones and John Charnley.[2,3] This comprised of skeletal traction, manipulation of fracture and external immobilization in the form of casts and cast bracings. This method however, met with problems like deformity, shortening, prolonged bed rest, knee stiffness, angulation, joint incongruity, malunion, quadriceps wasting, knee instability, post-traumatic osteoarthritis, deep vein thrombosis, urinary tract infection and pulmonary infection. Sufficient stabilization to withstand static loading forces on bone and dynamic muscular forces in distal end femur fracture can only be obtained with surgery.

The trend of open reduction and internal fixation has become evident in the recent years with good results being obtained with the AO blade plate, dynamic condylar screw, intramedullary retrograde nail, dynamic compression plate and other implant system like locking compression plate.[4] These fractures are also associated with higher incidence of infections, joint stiffness and early onset of osteoarthritis. So, these fractures have to be appropriately managed to overcome these factors. This led to the concept of indirect reduction and biological fixation of fractures along with preservation of vascularity and soft tissue attachment to bone fragments. Principles of management includes anatomic restoration, axial alignment and rotational stability of particular surface. The management of distal end femur fracture with anatomical distal locking compression plate (LCP) has multiple benefits.[1] The locking screws also provide stronger fixation of the plate by eliminating any potential toggle and sequential screw loosening (locking plate acts as internal fixator and screw is fixed to plate rather than bone as primary preventing sequential loosening). Anatomically pre contoured built reduces soft tissue problems.[5] Elderly patients with severe osteoporosis add further to difficulties in management of fractures around knee which requires restoration of articular congruency for painless free movements of joint. Locking compression plate with its numerous advantages is of great use in such circumstances.[6] The purpose of this study is to evaluate the results of fracture distal end of femur treated by open reduction and internal fixation using locking compression plate.

Aim and objectives

Aim and objectives were to quantify functional outcome of distal end femur fracture managed by locking compression plate using NEER's scoring system and to record and investigate the complications of locking compression plate used for fracture distal end of femur.

METHODS

The present study was conducted in the department of orthopaedic in Bombay hospital, Indore (M. P.).

It was a prospective, observational study.

Inclusion criteria

Patient of age more than 18 years of either sex and patient with distal end femur fracture (closed and open Gustilo-Anderson type I fracture) and patient and/or his/her legally acceptable representative willing to provide their voluntary written informed consent to participate in the study were included in study.

Exclusion criteria

Patient with pathological fractures, patient with open distal end femur fracture (other than Gustilo-Anderson type I fracture) and patient and/or his/her legally acceptable representative not willing to provide their voluntary written informed consent to participate in the study were excluded from study.

Study period

Study conducted from November 2019 to March 2021.

Statistical tool (software) used for analysis of data was IBM SPSS version 2022.

Statistical analysis

Sample size calculation with justification, the incidence of adult distal femoral fracture is around 3%. Considering this value and putting in the formula for sample:

$Z^2 \times (p) \times (1-p) / C^2$

Where: Z=1.96-Z value for 95% confidence level, p=0.03 (3%)-Incidence of distal femoral fracture expressed as decimal and c=0.05 (5%)-expected error, expressed as decimal.

Ethical approval

Ethical approval was obtained with a permission letter from institutional ethic committee of the institution.

The study was explained to the patient and/or his/her legally acceptable representative in great detail in their own language, the procedure to be performed, the outcome, the risks/benefits, etc. All the patients underwent thorough general, systemic and local examination. Assessment to rule out head / chest / abdominal / spinal or pelvic injuries was done. Musculo-skeletal examination was done to rule out any associated fractures. Neurovascular status of the affected limb was done. Preoperative blood investigation and pre anaesthetic checkup was done. ORIF distal end femur with locking compression plate was done.

Toe-touch weight bearing and full-weight bearing was started after assessment of clinical and radiological

images. The initial fracture geometry, comminution, stability of fixation was considered before being advised for progressive weight-bearing. Unprotected weight-bearing was not allowed till there was good clinical and the radiological evidence of the progressive fracture healing.

Clinically, fracture was considered to be united when there was no pain on palpation and no discomfort on weight-bearing. Radiological evidence of callus and consolidation were analysed. Results were evaluated for each fracture type. Neer's rating system was used, which assigns points for pain, working and walking capacity, range of movement, radiological appearance, etc. At each follow-up the clinico-radiological union in the form of pain at fracture site, thickening at fracture site, warmth at fracture site, radiographic alignment, evidence of callus, knee range of motion, extensor lag and shortening were evaluated.

For data collection, a customized proforma was designed for the specific requirement of the study. All the data was collected in this proforma. The side, site and type of fracture was assessed. Mechanism of injury, associated injuries, injury to surgery interval, operative time, size of plate used. In postoperative follow-up-radiological union time, initiation of partial and full weight bearing, knee flexion, knee extensor lag, varus/valgus deformity, complications and functional outcome were evaluated. The Neer's Scoring system was used for evaluating the Functional and Anatomical evaluation.

RESULTS

Three (10%) patients were in the age group 18-20 years, 17 (56.7%) were in the age group 21-40 years and 10 (33.3%) patients were in the age group 41-60 years. The mean age of the patients was 37.87±11.76 years (range: 18 to 58 years) (Table 1).

Table 1: Distribution of patients according to age and sex.

Variables	N	Percentage (%)
Age group (years)		
18-20 years	3	10.0
21-40 years	17	56.7
41-60 years	10	33.3
Total	30	100.0
Sex		
Female	5	16.7
Male	25	83.3
Total	30	100.0

There were 25 (83.3%) males and 5 (16.7%) females in our study (Table 1). In 21 (70%) patients' right side was involved and in 9 (30%) patients left side was involved. In 27 (90%) patients sustained injury due to road traffic accident, 2 (6.7%) patients had a fall and 1 (3.3%) patient sustained injury due to assault (Table 2).

Table 2: Distribution of patients according to mechanism of injury.

Mechanism of injury	N	Percentage (%)
Assault	1	3.3
Fall	2	6.7
Road traffic accident	27	90.0
Total	30	100.0

AO/ASIF classification system was used for fracture type classification. 4 (13.3%) patients had fracture type A1, 6 (20%) patients had A2, 2 (6.7%) patients had A3, 1 (3.3%) patient had B2, 7 (23.3%) patients had C1, 5 (16.7%) patients had C2 and 5 (16.7%) patients had C3 fracture type (Table 3).

Table 3: Distribution of patients according to type of fracture (AO/ ASIF classification system).

Type of fracture	N	Percentage (%)
A1	4	13.3
A2	6	20.0
A3	2	6.7
B2	1	3.3
C1	7	23.3
C2	5	16.7
C3	5	16.7
Total	30	100.0

In 8 (26.7%) patients the operation time was ≤90 minutes, in 16 (53.3%) patients the operation time was between 91-120 minutes and in 6 (20%) patients the operation time was more than 120 minutes. The mean operation time was 111.83±37.45 minutes (range: 45 to 200 minutes).

In 3 (10%) patients 4-6 holed plate was used, in 11 (36.7%) patients 7-9 holed plate was used, in 15 (50%) patients 10-12 holed plate was used and in 1 (3.3%) patient >12 holed plate was used.

In 8 (26.7%) patients the radiological union was achieved in 16-18 weeks, in 13 (43.3%) patients it was achieved between 19-20 weeks, in 6 (20%) patients it was achieved between 21-22 weeks and in 3 (10%) patients it was achieved after 22 weeks (Table 4).

In 29 (96.7%) patients, knee extensor lag was 0-5 degrees and in 1 (3.3%) patient it between 6-10 degrees (Table 5).

In 17 (56.7%) patients the functional outcome was 'excellent', in 10 (33.3%) patients it was 'good', in 1 (3.3%) patient the functional outcome was 'fair' and in 2 (6.7%) patients functional outcome was 'poor' (Table 6).

In 2 (6.7%) patient there was limb shortening (10 mm), in 3 (10%) patients there was infection and in 25 (83.3%) patients had no complications (Table 7).

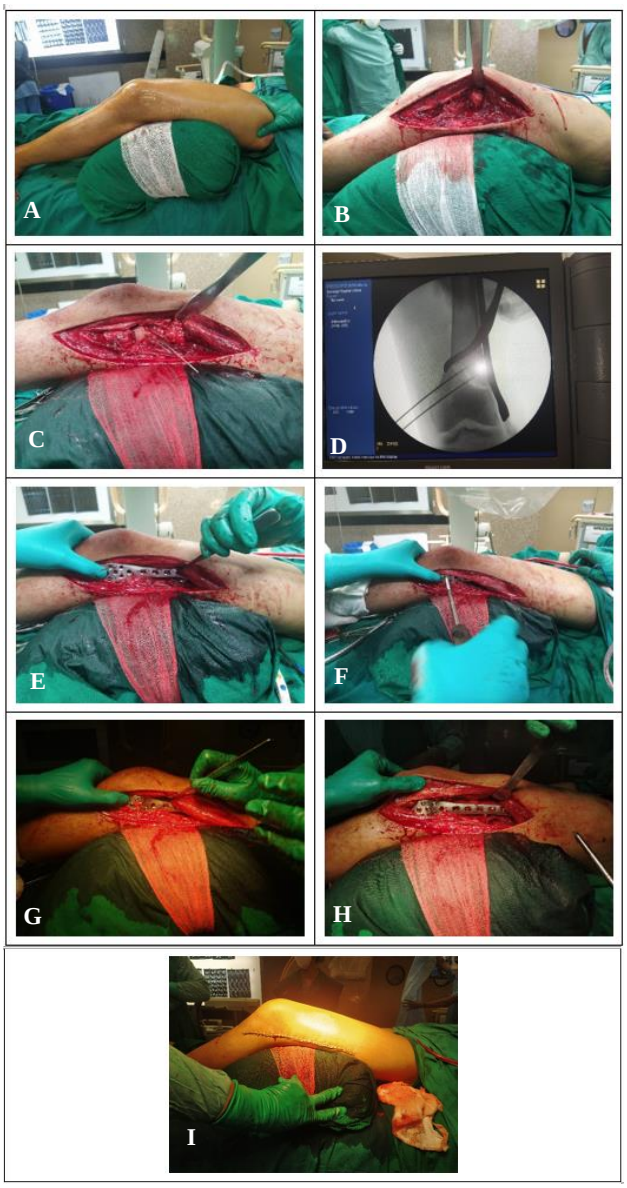

Figure 1: Surgical procedure from incision to closure. (A) Painting and draping, (B) Lateral incision, distal femur exposed, (C) Fracture fragments reduced, (D) Fracture fragments reduced on fluoroscopy, (E) Distal femur locking compression plate placed, (F) Locking cancellous screw placed, (G) Cortical screw placed, (H) Plate after putting all screws and (I) Wound closed in layers

Table 4: Distribution of patients according to radiological union time.

Radiological union time (weeks)	N	Percentage (%)
16-18	8	26.7
19-20	13	43.3
21-22	6	20.0
>22	3	10.0
Total	30	100.0

Table 5: Distribution according to knee flexion and knee extensor lag.

Variables	N	Percentage (%)
Knee flexion		
<90 degrees	8	26.7
91-109 degrees	9	30.0
≥110 degrees	13	43.3
Total	30	100.0
Knee extensor lag		
0-5 degrees	29	96.7
6-10 degrees	1	3.3
>10 degrees	-	-
Total	30	100.0

Table 6: Distribution according to functional outcome as per Neers scoring.

Functional outcome	N	Percentage (%)
Poor	2	6.7
Fair	1	3.3
Good	10	33.3
Excellent	17	56.7
Total	30	100.0

Table 7: Distribution according to complications.

Complications	N	Percentage (%)
Limb shortening (10 mm)	2	6.7
Infection	3	10.0
None	25	83.3
Total	30	100.0

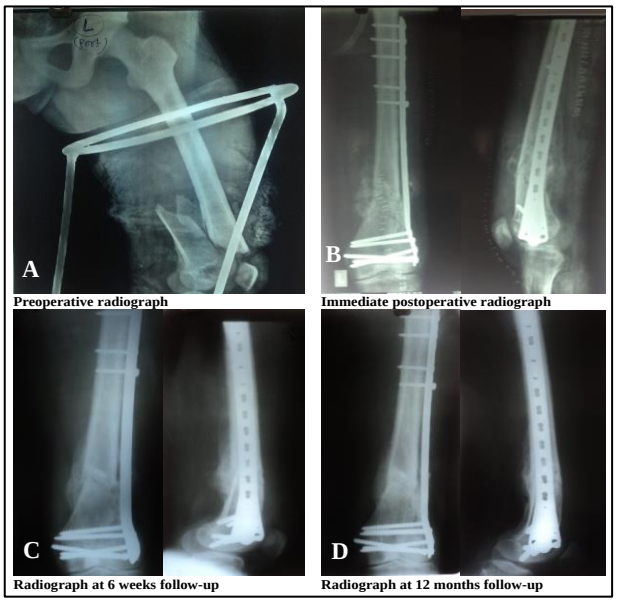

Figure 2: Case 1. (A) Preoperative radiograph, (B) Immediate postoperative radiograph, (C) Radiograph at 6 weeks follow-up and (D) Radiograph at 12 months follow-up.

Figure 3: Case 2. (A) Preoperative radiograph, (B) Immediate postoperative radiograph, (C) Radiograph at 6 weeks follow-up, (D) Radiograph at 12 months follow-up

DISCUSSION

The fractures of the distal end of femur have a prevalence of 1% of all the fractures types and 4-6% of all the femoral fractures.[1] As these fractures carry a high incidence of complications, the treatment remains a challenge for the orthopaedic surgeons. Locking compression plate has benefits like multiple points of fixed plate to screw contact, greater stability by a single lateral construct, etc. As there is less chances of screw loosening it also provides stronger fixation.

Majority of patients were in the age group 21-40 years with a mean age of 37.87±11.76 years (range 18 to 58 years). There was male predominance (25) in comparison to females (5). Right side involvement was more pronounced in comparison to the left side. Kumar et al in their study had included patients with a mean age of 35 years (range: 20-72 years), having 36 males and 10 females.[7] Mahesh et al patients had a mean age of 53 years (range: 20-86 years) and males were 7 and females were 3.[8] The mean age of our patients is comparable with the study done by Kumar, while the studies done by Mahesh, Pipal and Reddy have reported a higher mean age

Road traffic accidents was the major cause of injury seen in 90% of the patients. According to AO/ASIF classification, type C1 was most common (23.3%), followed by type A2 (20%) and type C2 and C3 seen in 5 (16.7%) patients each. Associated bony injuries were seen in 15 (50%) patients. Kadam et al in their study reported incidence of road traffic accident to be 75%. Mahesh et al also reported road traffic accident to be the commonest cause of injury. Garg et al also reported that 75% of injuries were caused due to road traffic accidents.[8,9] The results of our study corroborate with the results of other studies.[10]

A knee flexion of more than 110 degree was achieved in 13 (43.3%) patients, in 9 (30%) patients it was between 91-109 degrees and in 8 (26.7%) patients it was less than 90 degrees. Kadam et al in their study reported that 50% of the patients had knee flexion of 110 degree, 8 patients had between 91 to 109 degrees and 2 (10%) had knee flexion less than 90 degree. In our study prevalence of knee flexion <90 degree was slightly higher in comparison to the Kadam study.[9]

Only 1 (3.3%) patient had an extensor lag of 10 degree, while rest all the patients had an extensor lag of less than 5 degrees. Poptani et al in their study reported a mean extensor lag of 5.6 degrees.[11] Mani et al in their study reported an extensor lag of more than 15 degrees.[12] Our results are comparable to the study done by Poptani, while Mani reported a larger extensor lag.

According to Neer's scoring system, 17 (56.7%) patients had excellent functional outcome, 10 (33.3%) patients had good outcome, 1 (3.3%) patient had fair outcome and 2 (6.7%) patients had poor functional outcome. Virk et al in their study found satisfactory to excellent outcome in 20 (66.7%) patients.[13] Poptani et al reported good to excellent outcome in 80% patients, while study done by Mani et al reported excellent outcome in 30% patients, satisfactory outcome in 45%, unsatisfactory outcome in 20% and failure in 5%.[11,12] In all the studies, good to excellent functional outcome according to Neer's Scoring system was achieved, which is comparable to our study findings.

The limitations of this study are the lack of a bigger sample size and long term follow up. However, with our study we proved surgical management to be way better with an excellent functional outcome. Although we could not conclude on the delayed unions, non-unions and other complications as these were not encountered during our study interval. Also, the study has been done at a single centre with small population group, so on a larger scale and longer follow ups we could have studied more.

CONCLUSION

The treatment of fracture distal end of femur using locking compression plate was found to provide good to excellent functional outcome in majority of the patients, with a very low prevalence of complications. The complications were manageable. Limb shortening and infection were the only complications encountered. We highly recommend the treatment of distal end of femur fracture with locking compression plate.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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