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Original Article

Evaluation of Functional Outcome of Distal Femur Fractures Treated by Open Reduction and Internal Fixation with Locking Compression Plate and Screws

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Md. Shafiqul Islam[1], Jahidul Islam[2], Md. Khademul Islam[1], Md. Rafiqul Islam Khan[1], Md. Mehedy Hasan[3]

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ABSTRACT

Background: *Distal femur fractures account for about 7% of all femur fractures. These fractures can lead to knee stiffness and have the tendency to collapse into varus. The management of distal femur fractures has seen a paradigm shift from nonoperative measures to biological fixation and evolution of modern implants like Locking Compression Plate has been used in current times. With the use of Locking Compression Plate double plating can be avoided.* ***Objective:*** *In our study, we have evaluated the short-term Functional Outcome of patients who underwent open reduction internal fixation with Locking Compression Plate using Sander's criteria.* ***Method & Materials.*** *Ours is both prospective and retrospective study of 20 patients with distal femur fractures treated operatively from April 2018 to October 2020. Our surgical modality of treatment is open reduction and internal fixation with locking compression plate using standard lateral approach. We have used AO classification to classify the distal femur fractures.* ***Results:*** *our study, we have come to a conclusion that locking compression plate is a best option for both intra-articular and extra-articular distal femur fractures.* ***Conclusion:*** *It avoids the use of dual plating of distal femur which requires extensive soft tissue stripping in both sides, resulting in reduced blood supply, potential non-union and implant failure. Locking Compression Plate also helps in anatomical reduction of comminuted intra-articular fractures and it could also be used effectively in osteoporotic bone.*

Keywords: *Distal Femur Fractures, Locking Compression Plate (LCP), Sander's Criteria, AO Classification*

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1. *Assistant Professor, Department of Orthopaedic Surgery, Sher-E-Bangla Medical College Hospital, Barishal. Bangladesh*
2. *Registrar, Department of Orthopaedic Surgery, Sher-E-Bangla Medical College Hospital, Barishal. Bangladesh*
3. *Assistant Registrar, Department of Orthopaedic Surgery, Sher-E-Bangla Medical College, Hospital, Barishal. Bangladesh*

INTRODUCTION

Distal femur fractures account for about 7% of all femur fractures and have bimodal age distribution. That is, they occur with high energy trauma in younger patients and with low energy trauma in elderly. These fractures can lead to knee stiffness and have the tendency to collapse into varus. Up to 50% are intra-articular and require anatomical reduction. Both high and low energy injuries can cause metaphyseal comminution depending on the bone quality. Previously, the trend in treatment of these fractures leaned towards closed conservative management with traction, casting or combination of both. The problems with conservative management are limitation of reduction and difficulty in maintaining reduction.

Associated complications of prolonged immobilisation, economic consideration of increased hospital stay also limits their utility. The management of distal femur fractures has seen a paradigm shift from non-operative measures to biological fixation and evolution of modern implants as well as specific techniques in current times. Internal fixation devices that have been used to treat these fractures include 95 degree angled blade plate, dynamic condylar screw plate, condylar buttress plate and retrograde supracondylar nail.

However, as the complexity of fractures needing treatment has changed from simple extra-articular supracondylar types to intercondylar and metaphyseal comminuted types, these implants may not be ideal. Double plating and more recently locked plating has been advocated. However, with double plating there is extensive soft tissue stripping in both sides of femur, resulting in reduced blood supply and potential non-union and implant failure.

Distal femur locking compression plate has a smaller application device and allows both locking and compression screw fixation in the femur shaft. In our center, we have decided to evaluate the short term functional outcome of operative treatment of distal femur fractures using Sander's et al criteria. We classified distal femur fractures using AO (Muller's) Classification.[1]

OBJECTIVES

To evaluate the functional outcome of distal femur fractures treated with locking compression plate.

METHODS & MATERIALS

The present study has totally 20 cases who took operative treatment for distal femur fractures from April 2018 to October 2020. It is a prospective and retrospective study. For all the cases, we used the Standard Lateral Approach.[2] Out of 20 cases, 15 cases were closed fractures and 5 cases were grade-I compound fractures. Out of 20 cases, 13 were right- sided and 7 were left-sided distal femur fractures. The age group of patients ranges from 24 to 72 years.

All patients were followed up regularly and they were assessed using Sander's et al scoring system. Patients were followed up at 6 weeks, 3 months, 6 months, 12 months and then yearly

Inclusion Criteria

- Age 20 to 80 years.
- Closed or open (Gustillo Anderson[3] grade I) fractures.
- AO type A, B and C fractures of distal femur.

Exclusion Criteria

- Patients with head injury and vascular injury.
- Age <20 years and >80 years.
- Patients not fit for surgical

intervention.

RESULTS

In the period between April 2018 to October 2020, 20 patients with 20 fractures of the distal femur were taken up for this study. In our study, we did not have any bilateral distal femur fractures. All the patients were treated by distal femur Locking Compression Plate.

Table-1 Age distribution of the patients (N=20)

Age in Years	No. of cases (N)	Percentage (%)
20-30	5	25.0
31-40	9	45.0
41>50	3	15.0
>50	3	15.0
Total	20	100.0

In this study, age of the patients ranged from 24 to 72 years. The patients between the age group 31-40 years comprise the majority. The average age of the patients was 39.4 years.

Table -2 Sex distribution of the patients (N=20)

Sex	No. of Cases (N)	Percentage (%)
Male	12	60.0
Female	8	40.0
Total	20	100.0

Out of 20 patients there were 12 (60%) male and 8 (40%) female in our study.

Table-3 Side distribution of the patients (N=20)

Side	No. of Cases (N)	Percentage (%)
Right	13	65.0
Left	7	35.0
Total	20	100.0

Majority of the patients in this study 13 (65%) sustained injury to the right side.

Table-4 Mode of injury of the patients (N=20)

Mode of Injury	No. of Cases (N)	Percentage (%)
RTA	17	85.0
Fall	3	15.0
Total	20	100.0

In this study, 17 (85%) patients sustained injury due to road traffic accident which comprises the majority.

Table -5 Type of injury of the patients (N=20)

Type of Injury	No. of Cases (N)	Percentage (%)
Closed	15	75.0
Grade I compound	5	25.0
Total	20	100.0

In our study, 15 patients had closed injury and 5 patients had compound fracture.

Table-6 Classification of fractures of patients (N=20)

AO Type	No. of Cases (N)	Percentage (%)
A1	7	35.0
A2	6	30.0
A3	3	15.0
B1	-	
B2	-	
B3	-	
C1	3	15.0
C2	1	5.0
C3	-	
Total	20	100.0

The fractures were classified as per AO (Muller's) classification. Muller's type A1 comprises 7 (35%) cases, with maximum incidence in this study.

Table-7 Time of presentation after injury (N=20)

Time of Presentation	No. of Cases (N)	Percentage (%)
0-1 day	16	80.0
< 1 week	4	20.0
Total	20	100.0

Out of 20 patients, 16 patients presented to the hospital within 24 hours, 4 cases presented between 2 to 7 days.

Table-8 Time of surgery after admission (N=20)

Duration in Days	No. of Cases (N)	Percentage (%)
<7 days	5	25.0
8-15 days	12	60.0
>16 days	3	15.0
Total	20	100.0

In our study, patients were operated within 7 days, 12 patients were operated between 8 to 15 days and 3 patients operated after 16 days.

Table-9 Mode of anaesthesia (N=20)

Type of Anaesthesia	No. of Cases (N)	Percentage (%)
GA	3	15.0
Spinal	13	65.0
Epidural	1	5.0
Combined	3	15.0
Total	20	100.0

In our study, majority of patients 11(55%) were operated under combined spinal and epidural anaesthesia.

Table-10 Rate of radiological union (N=20)

Duration in Weeks	No. of Patients (N)	Percentage (%)
0-15	5	25.0
16-30	14	70.0
> 30	1	5.0
Total	20	100.0

Out of 20 cases, 5 cases showed radiological union within 15 weeks and 14 cases between 16-30 weeks. Average rate of union is 20.5 weeks.

Table-11 Duration for full weight bearing (N=20)

Initiation of Full Weight bearing in Weeks	No. of Cases (N)	Percentage (%)
0-15	1	5.0
16-20	11	55.0
21-25	4	20.0
>26	4	20.0
Total	20	100.0

In our study, we started full weight bearing once there is evidence of radiological union. For majority of cases, we started full weight bearing at 16-20 weeks after surgery.

Table-12 Range of knee flexion (N=20)

Knee Flexion in Degrees	No. of Cases (N)	Percentage (%)
<70	2	10.0
71-100	10	50.0
>100	8	40.0
Total	20	100.0

In our study, less than 70 degrees knee flexion was attained in 2(10%) cases, 71-100 degrees knee flexion in 10(50%) cases and more than 100 degrees of knee flexion attained in 8(40%) cases.

Table-13 Complications

Complication	No. of Cases (N)	Percentage (%)
Superficial infection	3	15.0
Deep infection	1	5.0
Delayed union	0	
Non-union	0	
Malunion	0	
Shortening	1	5.0
Implant breakage	1	5.0
Knee stiffness	4	20.0
Neurovascular injury	0	
DVT	0	
Total	10	

The complications observed in this study were 1 case with deep infection, 3 cases with superficial infection, 1 case with shortening, 1 case with implant breakage and 4 cases of knee stiffness.

Table-14 Functional results (N=20)

Sander's et al Criteria	No. of Cases (N)	Percentage
Excellent	1	5%
Good	13	65%
Fair	5	25%
Poor	1	5%
Total	20	100.0

The function results of the study were assessed based on Sander's et al functional evaluation criteria. Out of 20 patients treated surgically, 1 (5%) patient had excellent results, 13 (65%) patients had good results, 5 (25%) cases with fair result and 1 (5%) patient had shown poor result. Hence, overall Locking Compression Plate has given reasonably a better functional outcome.

DISCUSSION

The treatment of complex distal femur fractures requires a thorough understanding of fracture biology. Treatment methods vary from conservative to internal fixation. Conservative treatment is associated with unsatisfactory outcomes. Conservative treatment using tibial traction for distal femoral fractures was reported by Mahorner and Bradburn [1933][4], with good final results in only few cases.

Operative treatment of distal femur fractures was revolutionized in the 1970s with the advent of AO implants, instruments and techniques. Dynamic condylar screws and blade plates require removal of large amount of bone for insertion, which limits their use in some fracture types.

3 type C3 fractures. Four (36.4%) of the fractures were compound and seven

In our study, 20 patients with distal femoral fractures were treated with distal femur locking compression plate and results were evaluated. Among 20 patients, 12 (60%) patients were male and 8 (40%) were female. The age of the patients in our study ranged from 24 to 72 with mean age of 39.4 years. Mode of injury was road traffic accident in 17 (85%) patients and fall in 3 (15%) patients. Right limb was commonly involved with 13 (65%) fractures in right side and 7 (35%) fractures involving left side. Average number of days from injury to surgery was 10 days with range from 7 days to 16 days. The operative time ranged from 60 min. to 150 min. with average of 102 min. All fractures in our study were classified according to AO classification system. There were 7 (35%) type A1, 6 (30%) type A2, 3 (15%) type A3, 3 (15%) type C1 and 1 (5%) type C2 fractures. Among these, 15 (75%) patients had closed fracture and 5 (25%) had grade I compound fracture.

Yeap EJ et al[5] in his study on 11 patients with distal femur fractures treated by locking compression plate, seven were male and four female patients. The patient's age ranged from 15 to 85 with mean age of 44 years. The causes of fractures were motor vehicle accident in 7 patients and fall in 4 patients. Seven fractures involved the right side and four involved the left. The average number of days from injury to surgery was

9.9 days with range of 4 to 18 days. The operative time ranged from 80 min. to 180 min. with an average of 119.2 min. In his study, there were 4 type A1, 2 type A3, 1 type C1, 1 type C2 and

(63.6%) were closed fractures.

Author	No. of Cases	Open#(%)	Average Age (Years)	Average Follow-Up (Months)
Yeap et al	11	36	44	9.7
Hosam et al	23	8.7	48	32
Kanabar et al	17	17.6	12	12
Our study	20	25	39.4	14.2

Hosam M et al**6** in his study on 23 patients treated for distal femur fractures were in the age group ranging from 28 to 76 years, with an average of 48.25 years.

Fourteen cases (60.7%) were right-sided and nine cases (39.13%) were left-sided fractures. 15 (65.22%) cases suffered from road traffic accident while 8 (34.78%) patients suffered injury due to fall. 2 cases (8.70%) were open fractures and 21 cases (91.3%) were closed fractures. Nine cases (39.13%) were operated upon within the week after injury, eight cases (34.78%) in the second week and six cases (26.09%) two weeks after injury.

In our study, the range of knee flexion is 50 degrees to 120 degrees and average knee flexion is 98 degrees. Average time of union was 20.5 weeks with a range from 10 weeks to 34 weeks. All the patients were evaluated using Sander's et al scoring system and we had 70% excellent to good result. Various complications encountered in our study are 3 (15%) patients with superficial infection which subsided with oral antibiotics, 1 (5%) had deep infection which subsided with wound exploration and suction-irrigation, 1 (5%) patient with limb shortening, 4 (20%) patients had knee stiffness which needed physiotherapy treatment. Out of this, 1 patient came back with broken implant and re-fracture following native treatment for the knee stiffness and lost follow-up.

Author	Average Knee Flexion in Degrees	Time for Union (Weeks)
Yeap et al	107	18
Hosam et al	98	-
Kanabar et al	93	17
Our study	98	20.5

Author	Deep Inf. (%)	Sup. Inf (%)	Revision/Failure (%)	Mal-alignment/Shortening (%)	Knee Stiffness (%)
Yeap et al	3	-	1.5	4.5	-
Hosam et al	4.3	-	-	8.7	13.4
Kanabar et al	11.7	-	17.6	-	11.7
Our Study	5	15	5	5	20

Kanabar et al,[7] in his study noted bone union in a mean period of 17(Range, 10-36) weeks and mean range of knee flexion was 93 degrees (80-130 degrees). Complications encountered in his series included 1 patient with deep infection, 2 patients with superficial infection and 1 patient with implant breakage.

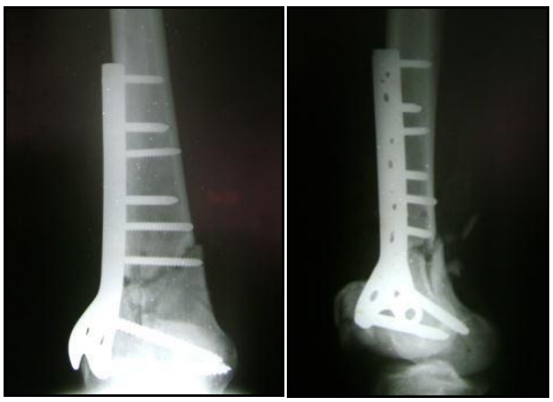
Hosam M et al, in his study had excellent and good results in 18 patients (78.26%), with fair and poor results in 5 patients (21.74%). In his study, various complications encountered were deep infection in one case (4.35%), delayed union in three cases (13.04%), knee joint stiffness in three cases (13.04%) and shortening in two cases (8.70%).

Yeap et al, in his study reported average range of knee flexion 107 degrees and average time to union was 18 (Range 6-36) weeks. In his study, there were 4 (36.4%) excellent results, 4(36.4%) good results, 2(18.2%) fair results and 1(9%) poor result. Complications are one implant failure and one mal-alignment of lower limb.

Author	Scoring System	Excellent and Good Results (%)
Yeap et al	Schatzker	72.7
Hosam et al	Neer	78.26
Kanabar et al	Neer	88.23
Our study	Sanders	70

1: Excellent Result

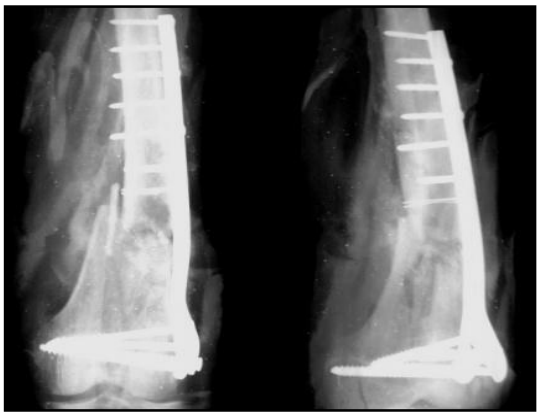
Pre-op



Post-op

6 months

1 year



Post-op

Complications

X-ray

Clinical picture

x-ray

Knee flexion

Knee extension

Knee stiffness:

CONCLUSION

Locking compression plating is appropriate for extra-articular and intra-articular distal femur fractures, particularly metaphyseal fractures. Osteoporosis, loss of cancellous bone in metaphyseal fractures loosens screws, which the locking compression plate fixes. Locking compression plates

allow for combination procedures in heavily comminuted metaphyseal fractures. This device's flexibility and fixed-angle features provide an effective alternative to existing implants for treating distal femur fractures, including comminuted intra-articular fractures and osteoporotic bone. Knee stiffness is prevalent in intra-articular distal femur fractures and infection in complex fractures. Locking compression plates are displacing alternative fixing systems.

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