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Study of surgical management of distal femur fracture using locking compression plate

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Abstract

Introduction: Distal femur fracture are being treated with distal femur nail, dynamic condylar screw and even addition of a medial plate with good clinical results. By this study, we explore the potenti ability of a distal femur locking plate to counter distal femur fractures of extra articular, partial or intra- articular nature. Positive results have been brought out by various groups from all over the world.

Aim: To study the clinical, functional and radiological outcome of distal femoral fractures managed by open reduction and internal fixation with distal femur locking plate in skeletally mature patients.

Materials and Methods: This was a prospective study conducted from January 2018 to January 2021 at the Government Medical College Khandwa with a 6month follow-up in skeletally mature patients with post-traumatic distal femur fractures were included. Follow and evaluation was done according to the Neer scoring system. The statistical data analysis was carried out using SPSS version 20 (IBM, Chicago, USA). The p-value <0.05 was considered significant.

Results: Following all principles of fracture reduction, union was achieved in all patients with mean time to radiological union being 19 weeks. The mean Range of Motion (ROM) was 109 degrees with 20 patients having a Neer score graded as excellent to satisfactory. Three patients developed complications in the form of infection (two cases) and mal-union (one case) during the course of our study, but were completely treated by the end of the study.

Conclusion: Positive results can be obtained by distal femur locking plate alone as it is the main implant of choice for distal femur fractures of all varieties. Best outcome is expected if fracture fixation is done following all the basic principles of fracture fixation and taking benefit of the mechanical properties of a locking plate.

Keywords: surgical management, distal femur fracture, locking compression plate

Introduction

Distal femoral fractures account for 4-7% of all femoral fractures.¹ The distal femoral fracture occurs in approximately 37 per 1,00,000 per years.^{2,3,4} This fracture occurs in a particular bimodal distribution, 1st group patients are below 40 years of age, mostly males, sustained high energy trauma such as RTA or a fall from heights; second group consists of patients above 50 years, mostly females, with osteoporosis sustained relatively low energy trauma [5-8]. These fractures are difficult to treat because of osteoporosis, severe comminution, too short distal femoral fragment [9] compound injuries and associated ligament injuries, meniscal and extensor mechanism injuries [11].

The goals of surgical treatment should be anatomic reduction of the articular surface, restoration of limb alignment, length, and rotation, bone grafting for extensive bone loss and stable fixation that allows for early mobilization [10] After the development of various implants and techniques, the management of distal femoral fractures has shifted from non-operative to operative methods [11, 12]. Operative methods include traditional plating technique that require compression of the implant to the femoral shaft (blade plate, dynamic condylar screw, nonlocking condylar buttress plate), antegrade/retrograde nail fixation, submuscular locked internal fixation and external fixation [2, 13-15]. Distal femoral locking compression plate allows both locking and compression screw fixation of the distal femur fracture along with articular surface realignment [10]. It works on the principle of rigid fixation [2, 16-18], acts as an extramedullary load bearing device [5, 19] leading to early union along with knee mobilization.

It works on splinting rather than compression, therefore it provides flexible stabilization causes induction of callus formation and it avoids stress [2, 20, 21]. Recent generation of distal femoral locking compression plate is precontoured plate based on the anatomy of bone. The pull out strength of locked screws better than conventional screws and that's why, it is useful in osteoporotic bone [22].

The purpose of this study is to evaluate functional outcome, fracture healing and the complications of distal femoral fractures using open reduction and internal fixation with distal femoral locking compression plate.

Material and Methods

This was a prospective study conducted from January 2018 to January 2021 at Government Medical College Khandwa with a 6 month follow-up. The study was approved by Institutional Ethical Committee and informed consent was taken from all the 37 patients included in the study.

Inclusion Criteria

1. All patients who are above the age of 18 years having distal femoral fractures.
2. Exclusion Criteria
3. Patients of age less than 18 years.
4. Open distal femur fractures.
5. Pathological fractures.
6. Associated tibia fractures.
7. Distal femur fractures with neuro-vascular compromise.
8. Patient having other fractures in the same limb, hip and vertebra.

Initial resuscitation of patients was done in emergency department, limb splinted, appropriate radiographs and CT scan as per requirements was done. Preoperative investigations were done consisting of haemoglobin level, platelet count, serum electrolytes and renal function tests, coagulogram, fasting or random blood sugar levels and viral markers consisting of Hepatitis B, C and HIV. A blood group cross-match of the patient was sent to the transfusion medicine department of the hospital prior to surgery. A chest X-ray and ECG were done in those patients as required by the anaesthetic team. Spinal or epidural anaesthesia was given. Scrubbing painting drapping done using standard protocols. Standard lateral approach by developing the plane between vastus lateralis muscle and lateral intermuscular septum was used for closed fractures of distal femur. Lateral parapatellar arthrotomy by using the Swash- buckler approach or its modifications were used to address the articular involvement of the lateral femoral condyle or the inter- condylar notch. A dual incision (standard lateral plus a medial subvastus incision) was also done in cases where a Hoffa's fracture or articular fracture of the medial femoral condyle had to be addressed in cases where access via the lateral approach was not possible. We always strived for obtaining anatomical reduction and good solid fixation in the articular area of the distal femur even at the cost of spending an extra amount of time, rather than giving the patient an incongruous joint. Distal femur locking condylar plate was used for fracture fixation using locking, 4.5mm cortical screws and partially-threaded cancellous screws of diameter 4.5mm, Herbert screws for smaller articular fragments and 6.5mm for articular reduction of condyles. Technique of counter sinking for

screws heads was used when proper seating of the plate had to be obtained. Length of the plate used was judged based on the extent of fracture of distal femur. In cases of fractures with metaphyseal-comminution with no bony reference point along the lateral cortex for direct fracture reduction the shaft of femur was aligned in the center of the condyles and it was ensured to prevent lateralization of the shaft at time of plate application Primary bone grafting was done in closed cases where the demand for such a procedure was gauged by the operating surgeon. The average blood loss was 300- 400ml in each case. No use of tourniquets was done in any of the case. Post-operatively suction drain was removed after 24-48 hours and first wound inspection was done on 2nd post-operative day. Intra-venous antibiotics were continued for 24 hours in closed fractures. Post-operative physiotherapy regime was tailored according to the fracture pattern and fixation achieved. In cases where ever possible, knee bending and assisted knee Range of Motion (ROM) exercises were initiated on postoperative day 1. Patients were mobilized based on the degree of bone quality, severity of injuries, and pattern of fractures. At post-operative day 2 to 3, the patients were mobilized with crutches/walker until 6 weeks. Full weight bearing ambulation without any aids was started at approximately 3 months in majority of the cases with radiographic evidence of fracture union. Patients were discharged at post-operative day 3 with stitch removal being done on day 14th, making it convenient for the patient to take bath and maintain good body hygiene. Regular follow-up of all cases was done at 6 weeks, 12 weeks and 24 weeks. At each follow-up patients were evaluated clinically using knee society Neer's scoring system and radiologically with appropriate x-rays. No patients were lost to follow-up.

Statistical analysis

The statistical data analysis was carried out using a computer based statistical analysis programme, SPSS version 20 (IBM, Chicago, USA). For the statistical data analysis, paired t-test was used between two correlated groups while for uncorrelated groups; means were compared using independent t-test. A p-value

Results

Table 1: Distribution of Age of Distal Femur Fracture Patients

Age (year)	Frequency (N)	Percent (%)
20-30	3	8.1
30-40	12	32.4
40-50	8	21.6
50-60	5	13.5
≥60	9	24.3
Total	37	100

Out of the 37 cases in our study, the mean age of cases in our study was 45.70±15.35 years ranging from 20 to 78 years approximately 25(67.6%) of the patients were male, 12(32.4%) were female. The road traffic accident was the most common mode of injury, in 27 number (72.9%). Fall due to various reasons experienced by 10 patients (27.1%) The side affected in distal femur fracture among studied patients was noted more on left by 54.1% while the right seventeen (45.9%) cases.

Table 2: The frequency and percentage distribution of preoperative diagnosis to muller’s classification

Preoperative Diagnosis	Frequency (N)	Percent (%)
Muller Type A-1	10	27.0
Muller Type A-2	3	8.1
Muller Type A-3	5	13.5
Muller Type B-1	7	18.9
Muller Type B-2	2	5.4
Muller Type B-3	2	5.4
Muller Type C-1	4	10.8
Muller Type C-2	1	2.7
Muller Type C-3	3	8.1

In our study, 6(16.2%) patient had post-operative complication two patients had early post-operative complication in the form of superficial infection. These were then treated with culture sensitive parenteral antibiotics and antiseptic dressing, which resulted in satisfactory healing of the fracture. One case was found to have late complication in the form of mal-union of the distal femur fracture [Table 3]. Out of total, 37 patients, six patients (16%) achieved full flexion of 130 degrees or more. Better outcome was observed in terms of range of motion at knee joint in extra-articular fractures (82%) than intra- articular fractures (72%) treated with distal femur locking plate. The mean ROM in all 37 patients was 114 degrees.



Fig 1: clinical photograph at 6 month followup



Fig 2: clinical photograph at 6 month follow up

Table 3: Distribution of late complications of distal femur fracture patients

Late complications	Frequency (N)	Percent (%)
Wound infection	2	5.4
Knee stiffness	3	8.1
Malunion	1	2.7
Total	6	16.2

According to Neer’s criteria which included evaluation in terms of pain, range of motion, walking and work capacity, anatomy and X-ray findings score at 6 months was calculated results were compared in case of intra- and extra-articular fractures, clinically ROM at knee joint and score at 6 months was better in extra-articular fractures than intra-articular, although statistically insignificant (p-value = 0.5012) in this situation as well. In the present study, results were tabulated into 4 groups i.e., excellent, satisfactory, unsatisfactory and poor according to criteria laid down by Neer *et al.*, [11], the results were excellent in 14 (37.8%), good in 8 (48.6%) fair in 3 (8.1%) and poor in 2 (5.4%) patients.

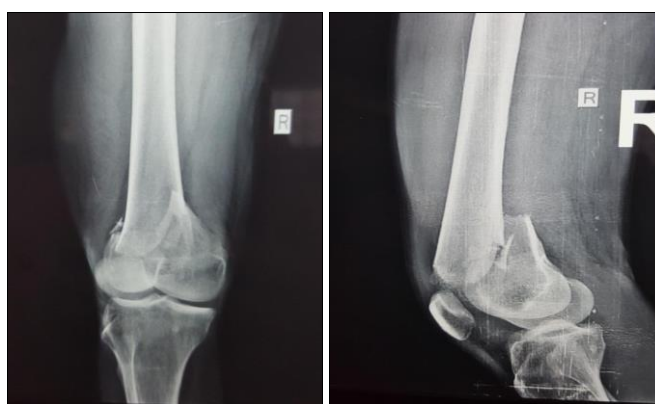


Fig 3: Pre-Operative X-ray Antero-Posterior view and lateral view



Fig 4: Post-operative X ray Anteroposterior and Lateral view

Table 4: Assessment of clinical and functional outcome by neer’s society scoring system

Scoring with Category	AT First Follow up		At second Follow up		At Third Follow up		
	n	%	n	%	n	%	
<55	Poor	32	86.5	10	27.0	2	5.4
55-69	Fair	4	10.8	12	32.4	3	8.1
70-85	Good	1	2.7	15	40.5	18	48.6
>85	Excellent	0	0.0	0	0.0	14	37.8
Total		37	100.0	37	100.0	37	100.0
Mean ± Std. Deviation		43.54±10.65 points		63.11±12.50 points		79.03±12.15 points	

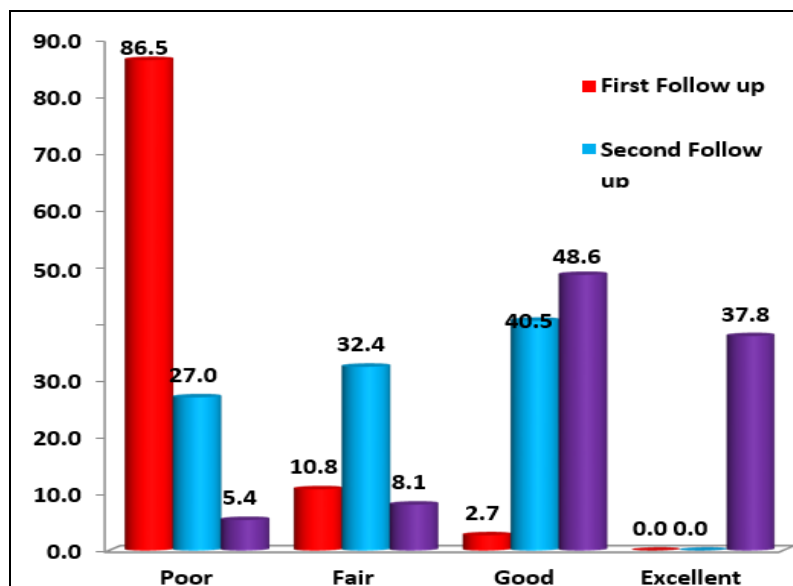


Fig 5: Distribution of clinical and functional outcome at first, second and third follow ups

Table 5: Distribution of Time of Union of Distal Femur Fracture Patients

Time of union	Frequency (N)	Percent (%)
11-13 weeks	7	18.9
13-15 weeks	11	29.7
15-17 weeks	11	29.7
17-19 weeks	8	21.6
Total	37	100

Most of the cases (44%) attained radiological union in 19-22 weeks. The mean time for radiological union was 19 weeks

Discussion

The mean age in our study was 45.70years. A study published by Reddy J.A.V mean age was 40 years (range 20-70) [23] Ramanand M. *et al* found mean age 52.25 years (range 20-60 years) [24]. Dr. Pugazhendhi *et al.* conducted a short term prospective study of the functional outcome in distal femoral fractures treated by locking compression plate, they reported that out of 22 patients, there were 12 patients in 21-30 age group, 5 patients in 31-40 age group, 3 patients in 41-50 age group and 2 patients in 51-60 age group. They concluded that the most common age group was 21-30 years [25]. Scope of distal femur locking plate is limited not only to isolated distal femur fractures but also in the use of peri-prosthetic distal femur fractures in patients of Total Hip Replacement (THR) [26] and Total Knee Replacement (TKR). Even extreme distal peri-prosthetic supracondylar fractures can be managed with lateral locked plate with predictable results similar to those seen in more proximal fractures [27].

In our study, the average time of union was 14.5 weeks, with majority of cases united between 13-17 weeks. Time of union in other studies are tabulated below in table

Time of union in other studies are tabulated below in table

Author	Time of union (weeks)
Shreedhar M. <i>et al</i> [28]	20
Pugazhendhi G. <i>et al</i> [25]	16
Reddy J.A.V. <i>et al</i> [23]	12
Shriharsha <i>et al</i> [29]	19.6
Panchal P. <i>et al</i> [30]	18
Ramesh Krishna <i>et al</i> [1]	15.3
Mahesh D.V. <i>et al</i> [10]	18
Our study	14.3

In our study, by using Neer’s society scoring system, the results were excellent in 14 (37.8%), good in 18 (48.6%), fair in 3 (8.1%) and poor in 2 (5.4%) patients. Our study was comparable with standard studies of management of distal femur fracture using distal femoral locking compression plate. Functional outcome of other studies are tabulated below in table

Functional outcome of other studies are tabulated below in table

Author	Results			
	Excellent	Good	Fair	Poor
Ramesh Krishna <i>et al.</i> [1]	15	11	3	1
Tapi Nalo <i>et al.</i> [31]	25	3	1	0
C.V. Dasaraiah <i>et al.</i> [2]	15	11	3	1
Pradip B Patil <i>et al.</i> [32]	18	11	1	0
Shriharsha R.V. <i>et al.</i> [29]	4	10	5	6
Parth Panchal <i>et al.</i> [30]	11	5	3	1
Our study	14	18	3	2

Dr. Pugazhendhi G. *et al.* Concluded that, the early complications were encountered in 3 patients, 2 patients developed superficial infection and 1 patient had wound gaping. Late complications included knee stiffness in 2 patients. None of the patients had loss of fixation or malunion or non

Union [25] According to Parth Panchal [30] *et al* study on treatment of distal end of fracture femur by locking compression plate, 5 patients developed complications, with 4 (20%) patients experiencing superficial infection and 1 (5%) patients delayed union. Tapi Nalo *et al* conducted the study on treatment of supracondylar fracture of distal femur with condylar locking compression plating, and they reported that, there were 2 cases of superficial infection [31].

Limitation: The requirement for more number of patients was felt during the conduct of our study but with a longer follow-up of 2 years it was reasonable to restrict ourselves to a follow-up compliant group.

Conclusion

Distal femur locking plate is still the way forward for treating distal femur fractures. Positive results have been published by researchers with implants such as distal femur nail, dynamic condylar screw and even addition of a medial plate to a distal

femur locking plate for treating distal femur fractures. By conducting this study we can put forward the assumption with some degree of confidence that fractures of the distal femur of all varieties extra-articular, partial articular and intra-articular non-comminuted as well as comminuted ones, if fixed in a proper fashion following all the basic principles of fracture fixation, good results can be obtained by using a distal femurlocking plate alone as the main implant of choice for such fractures. It has also reduced the requirement of secondary procedures such as bone grafting especially in fractures with metaphyseal comminution.

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