

ORIGINAL RESEARCH**Study of surgical management of distal femoral fractures by distal femoral locking compression plate osteosynthesis**

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Abstract

Aims And Objectives: To study Union rate (time to union), time of mobilization, functional results, radiological results, complications of distal femur fractures treated by DF-LCP.

Material And Methods: This is a prospective study of 30 Patients, with distal femur fractures (AO classification A,C) who were treated with distal femur locking compression plate (DF- LCP) at Department of Orthopaedics, Dr BVPRMC, Loni, Maharashtra. The study sample was 30 patients and all these patients were included with predefined inclusion & exclusion criteria in this study. Minimum of 6 months and a maximum of 16 months follow up was done. The functional and radiographic results were recorded according to Neer's criteria.

Results: The average time to union was 3.83 months (15.36 weeks) with a range of 2 – 8 months (8 – 32 weeks) and standard deviation being 1.482. The Mean range of flexion obtained postoperatively was 111.3⁰ with a range of 70⁰ – 150⁰. Two Contracture and decreased knee movements, four mal-alignment/malunion, one implant failure and one infection were the residual complications in our study. Follow up of our cases included from a minimum of 6 months to a maximum of 16 months. Mean Neer's score was 80.20 and standard deviation was 9.084. Excellent results were seen in 15 cases, satisfactory in 11, unsatisfactory in 3 and 1 case of failure was seen.

Conclusion: We conclude that DF-LCP, the “ internal fixator” is a safe and reliable implant although careful preoperative planning and case selection are important factors which determine the final outcome. It may substitute a conventional plate and screw system (compression method) in treatment of complex distal femoral fractures especially in osteoporotic bone. Further randomised controlled studies are required in different situations to know the usefulness of this implant.

Key Words: Union rate, DF-LCP, Neer's criteria.

Introduction

Fractures of the distal femur constitute a heterogenous group of injuries affecting knee. High energy injuries tend to occur in young males, whereas low energy injuries occur in elderly females commonly.¹ These fractures often are unstable and comminuted and tend to occur in elderly or multiply-injured patients.² They are complex injuries that can be difficult to manage.³ Distal femoral fractures account for about 4% to 7% of all femoral fractures.¹ These fractures have got wide variety of fracture patterns and they are commonly associated with

injuries such as open wounds, patellar fractures and ligament disruption¹. These serious injuries have the potential to produce significant long-term disability especially when they are associated with extensive articular cartilage damage, marked bone comminution, and severe soft tissue injury.²

The fracture characteristics which make these fractures difficult to treat include, Osteoporosis, Multiplanar articular injury, High degree of comminution, Short distal femoral block in which it is difficult to insert fixation, associated Open wounds, Internal derangement of knee including ligament and meniscal injuries and possible Extensor mechanism injuries. Complications are significant and include Infection, Knee stiffness, Need for bone grafting, Non union and Malunion.⁴

In the modern world with the increase in speed and number of fast moving vehicles there is great increase in number and severity of fractures. Fractures may be associated with multiple systemic injuries and polytrauma. Distal metaphyseal fractures of femur have troubled orthopedic surgeons very much because of their common occurrence in present mechanized world. Methods of treatment vary according to type, level of fracture and age of patient and are based on assessment of advantages and disadvantages associated with each. But as the fracture management of distal femur continues to evolve, we become more sophisticated and efficient in managing complex injuries and thereby provide good results to the patients.

Materials And Method

We studied prospectively 30 Patients, with distal femur fractures (AO classification A,C) who were treated with distal femur locking compression plate (DF- LCP) at Department of Orthopaedics, Dr BVPRMC, Loni, Maharashtra. The study sample was 30 patients and all these patients were included with predefined inclusion & exclusion criteria in this study. All the patients underwent surgical fixation of fracture with DF-LCP with a mean of 6.1 days and duration of hospitalization mean was 2.6 weeks.

Minimum of 6 months and a maximum of 16 months follow up was done. Records available in the form of admission notes, operative notes, progress notes and follow up OPD records were analyzed. Patients not coming up for late follow up at OPD were interviewed on phone and sent mail. We considered a fracture united if there were no pain on palpation or attempted motion, no increase in warmth at the fracture site, no discomfort on full weight bearing and serial roentgenograms demonstrated bone trabeculae crossing the fracture site. The functional and radiographic results were recorded according to Neer's criteria. Functional grading was made depending on pain, walking capacity, mobility and work. Radiological grading was made based on varus or valgus deformity, shortening, signs of osteoarthritis and union of fracture. The final outcome is compared with the results available from the latest literature.

Patient included were with Closed distal femur fractures A1, A2, A3 , C1 , C2 , C3 types of Orthopaedic Trauma Association (AO/OTA) classification, Patients of age 18 yrs and above both males and females, Patients with comorbid diseases like controlled diabetes mellitus, hypertension, asthma, epilepsy and other medical conditions with closed distal femoral fractures.

Patient excluded were Compound fractures of distal femur, closed distal femur fractures B1, B2, B3 types of Orthopaedic Trauma Association (AO/OTA) classification, Pathological fractures, Pregnancy, Peri-prosthetic fractures, Patients of age group < 18 years, Patients unfit for surgery.

Collection of data was done from 30 patients coming with closed fractures of distal femur to Dr BVPRMC, Loni, Maharashtra, as follows:

➤ History by Verbal communication with patients and their attenders.

- Clinical examination, both local and systemic.
- Diagnosis: Clinical and Radiological.
- Base line investigation. Basic Radiological Examination.
- CT scan in selected cases.
- Surgery- Open reduction and internal fixation with Distal Femoral Locking compression plate (DF-LCP).
- Prophylactic Antibiotics and Analgesics/ Anti-inflammatory drugs.
- Post-Operative evaluation by clinical and radiological examination.
- Post operatively wound healing, complications, time for union, weight bearing, ambulation will be assessed, initially on weekly basis at 4weeks, 8weeks and 12 weeks followed by monthly basis at 4 months, 6 months, 8 months, 10 months.

All patients were treated according to a protocol which consisted of

1. Standard Antero posterior and lateral plain X-ray.
2. Pre Operative work up and pre operative planning.
3. Open distal femur fractures were not considered in our study.
4. Patients were operated with distal femur LCP after obtaining fitness for surgery.
5. Post operatively the limb was kept in BB splint to prevent contracture of the quadriceps.
6. Physiotherapy –
7. Quadriceps exercises and hamstring exercises were started on first post operative day depending on fixation, stability and fracture configuration.
8. After quadriceps and hamstring strengthening exercises, active and active assisted range of motion exercises of the knee were initiated.
9. Patients were discharged after suture removal once wound has healed completely and in case of unstable fractures patients were discharged with above knee cast for 3-5 w
10. Patients were followed up regularly initially on weekly basis at 6weeks and 12 weeks followed by monthly basis at 6 months, 9 months, 12 months.
11. On follow up, all patients were assessed using Neer's Criteria for functional outcome. The fracture was considered united, if there were no pain on palpation or attempted motion, no increase in warmth at the fracture site, no discomfort on full weight bearing and serial roentgenograms demonstrating bone trabeculae crossing the fracture site.
12. The functional and radiographic results were recorded according to Neer's criteria. Functional grading was made depending on pain, walking capacity, mobility and work. Radiological grading was made based on varus or valgus deformity, shortening, signs of osteoarthritis and union of fracture.
13. Partial weight bearing with early signs clinically and radiologically of union.
14. Patient follow up depended on the clinical examination as well as the x-ray findings.

Result

At our Hospital, the complex distal femur fractures especially fractures belonging to AO type A and C were managed as per the protocol. We carried out fixation of these fractures with Distal Femur Locking compression plate (DF-LCP), which combines the principle of fixed-angle locking screw technology with the option for conventional screw utilization. Experience with DF-LCP is still very limited in our hospital and this study is intended to overcome it and define its place further in the management of distal femur fractures. Thirty patients with distal femur fractures were treated with distal femur Locking compression plating from June 2010 to November 2011. Of this group 10 patients had associated injuries that influenced their course of treatment. Thirty patients were consecutively treated by distal

femur locking compression plating and represent the sample for the present study.
Table 1-To Assess significant association/correlation between Neer's results and age.

Age * NEER Crosstabulation

Count		NEER				Total
		Excellent	Satisfactory	Unsatisfactory	Failure	
Age	21 - 30	4	5	1	0	10
	31 - 40	5	4	1	0	10
	41 - 50	2	0	0	0	2
	51 - 60	1	1	0	0	2
	61 - 70	1	2	1	0	4
	71 - 80	1	0	0	1	2
Total		14	12	3	1	30

Fisher's Exact Test Value: 14.412 and **p** = 0.724 (Not significant)

Spearman Correlation r = 0.038 and **p** = 0.839 (Not Significant)

Inference: There was no significant association or correlation between Neer's score and Age in this study.

Table 2-CHI- SQUARE TEST

	Value	df	Asymp. Sig. (2-tailed)
Pearson Chi-Square	A 8.066	5	.153
Likelihood Ratio	9.703	5	.084
No of Valid Cases	30		

a - 10 cells (83.3%) have expected count less than 5. The minimum expected count is .53.

P value Results - $\text{Chi}^2=8.066$, $\text{DF}=5$

The two-tailed P value = 0.153

Inference: By conventional criteria, this difference is considered to be not statistically significant.

Discussion

Fractures in the distal femur have posed considerable therapeutic challenges throughout the history of fracture treatment. Most of these surgical failures were due to inadequate fixation of the fracture fragments (Mize et al 1982).⁵ The prognostic factors for supracondylar fracture included age, intra-articular involvement, methods of treatment, timing of joint motion, etc (Neer et al 1967; Morre 1987).⁶

In our study of 30 patients the mean age of the patients was 40.73 years and there were 22 males (73.3%) and 8 females (26.7%). The present study does not show a biphasic age

distribution of the patient population as seen in studies (Bell et al, 1992).⁷ This is a reflection of the mechanism of injury which was high energy trauma in 70% of our patients of which most of whom were younger. The reason being that, in male patients there was more outdoor activities, so they were more prone to vehicular accident and majority females being house wives were less exposed to road traffic accidents.

Mongkon Luechoowong⁸, analysed retrospectively medical records of 19 patients who underwent LCP plating for complex distal femoral fractures and reported higher incidence in males than females and the mean age in the study was 41.6 years.

In our study most of the injuries were caused by road traffic accidents affecting mostly males. We had 21 (70%) RTA injuries and 9 (30%) Falls. There were no sports or industrial accidents.

Yeap and Deepak⁹, reported higher incidence of RTA (7 patients) than Falls (3 patients).

In our study of 30 patients belonging to AO type A and C of distal femur fractures, two patients belonged to A1, three to A2, five to A3, eight to C1, seven to C2 and five to C3 type fractures respectively. Majority of fractures belonged to type C fracture which was 66.7% and remaining 33.3% belonged to type A fractures.

Yang Teng-heng, Zhong Zhi-nian, Lao Ji-yi¹⁰, reported 8 patients of A1, 5 of A2, 5 of A3, 4 of B2, 5 of C1, 3 of C2 and 5 of C3 type fractures.

The average time interval between injury and surgery in our study was 6.1 days with a range of 2 – 16 days. Delay in surgery is one of the factor contributing to unsatisfactory results. In a study by Seinshiemer¹¹ there is a positive correlation between time delay and final outcome. According to them surgery should be conducted preferably within a week.

We observed that satisfactory reduction and bone grafting is required in patients with extensive comminution for optimal results. And also an additional plating on medial side is may be considered to maintain alignment and prevent collapse. According to Benum¹², bone cement is not required in osteoporotic or highly comminuted fractures for early post-operative mobilisation. In none of our cases we have done cementing technique.

Pritchett¹³ also stressed on the need of bone grafting in cases of delayed or non-union in cases of these fractures.

Average duration of hospitalization in our study was 2.6 weeks (18.2 days), increased because of other associated injuries and the need for the strict postoperative physiotherapy which affected the course of treatment and rehabilitation.

Post operatively physiotherapy in bed was started on the 2nd post operative day or according to the tolerance of patient and associated injuries. The patients were started with quadriceps strengthening exercises, calf exercises, knee and ankle mobilization exercises.

Partial weight bearing was started after 6 weeks and full weight bearing was started according to signs of union on follow up.

K. Kolb, P. Grützne, H. Koller, C. Windisch, F. Marx and W. Kolb¹⁴ also mobilised their patient's non weight bearing as early as 2-3rd postoperative day.

Local complications were present in 50% of our patients. They included restriction of movements in two patients, extension lag in three, thigh pain in three, anterior knee pain in two, chronic swelling of injured lower limb in two, osteoporosis in two and superficial infection in one patient.

The average time to union was 3.83 months (15.36 weeks) with a range of 2 – 8 months (8 – 32 weeks) and a standard deviation of 1.482 in our study.

Kim KJ, Lee SK, Choy WS, Kwon WC, Lee DH¹⁵, reported mean time to union at postoperative 15 weeks with a range of 13 – 20 weeks.

In our study union occurred at an average of 15.36 weeks (3.84 months). Union was delayed in two patients of which one patient had infection and other due to severe osteoporosis. Infection completely subsided in 2 month's time after debridement and course of IV

antibiotics. There were no cases of non-union.

In our study we had four cases of varus malalignment for distal femur of which three were AO C2 type and one case was C3 type.

We had infection in 1 patient out of 30 patients who completed the study. We had 3.3% infection rate in that matter.

In our study we had one case of implant failure. The causes for the failure were severe comminution, severe osteoporosis, inadequate fixation, early postoperative full weight bearing against medical advice.

In our study, the mean flexion was 111.3° (range 70° -150°). It was attributed to the stable and sturdy construct and the early range of motion achieved with DF-LCP.

In our study the average follow up in our study was 10.9 months with a range of 6 –16 months.

Evaluation according to Neer's score showed a mean Neer's score of 80.2 with a range of 54 to 92 and a standard deviation of 9.084.

Out of our 30 patients in the study, fifteen patients (50%) had excellent results, eleven (36.7%) satisfactory, three (10%) had unsatisfactory and one (3.3%) failure case.

In our study we have used distal femur locking compression plate (DF-LCP) for fixing distal femoral fractures. Locking plates were mainly used in patients of older age group with osteoporotic bones and in patients with extensive comminution. In patients where locking plate were used, had early mobilization.

Conclusion

From our study we conclude that DF-LCP, the “ internal fixator” is a safe and reliable implant although careful preoperative planning and case selection are important factors which determine the final outcome. The new fixation system offers many fixation possibilities and has proven its worth in complex fracture situations especially in extensive comminution of femoral condyles with intra-articular involvement and osteoporosis where other fixation devices are incompetent. The DF-LCP has shown excellent to satisfactory results in majority of intra articular fractures (AO type C). Time to union was found to increase with increase in age ($p = 0.03$, statistically significant) and can be improved by early adequate fixation, primary bone grafting and immediate postoperative mobilization. Further randomised controlled studies are required in different situations to know the usefulness of this implant.

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