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A study on functional outcome of distal femoral fractures with distal femur locking compression plate

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Abstract
Background: Historically it is difficult to treat intercondylar and supracondylar distal femur fractures. The aim of this study is to assess the clinical and radiological functional outcome of distal femoral both extraarticular and intraarticular fractures types(A,B,C) treated with locking compression plate.
Material and Methods: We reviewed 30 distal femoral fractures treated with distal femoral locking compression plates between 2018 to 2019. There were 20 male and 10 female with mean age of 48 yrs(range 21 – 70). More patients were of type A2 (AO classification) and had been caused by high energy trauma.
Results: out of 30 patients, 11 had excellent, 13 had good and 6 had fair outcome. 6 patients had limb length discrepancy and 10 patients had extension lag. Three patient had valgus deformity and three patients had varus deformity.
Conclusion: It provides better fixation of fracture in elderly patient with osteoporosis. Post operative early passive mobilisation of the knee gives good range of motion. Operative time is lessened as the locking compression is pre contoured and does not require anatomical fracture reduction.

Keywords: Distal femoral fracture, internal fixation, distal femoral locking compression plate

Introduction
Fractures of distal femur present a huge surgical challenge. They produce long term disability because of comminuted pattern and instability. Their management evokes much controversy because of poor results and many complications
Distal femur fractures incidence is approximately 37 per 100000persons – years [1]. 6 percent of all fractures of the femur account for distal part of bone [2, 3]. Distal femur fractures commonly seen in two age groups, one group predominantly males below 40 years of age, due to high energy trauma which includes fall from height & road traffic accident and Other group predominantly females more than 50 years, due to trauma caused by low energy and with osteoporosis. Distal femoral fractures are less frequently caused by rotation forces[3]. In age group more than 50 the distal femoral fractures accounts for 60%. Popliteal artery or femoral artery damage accounts for 0.2% of these fractures [4].
For better outcome distal end of femur fractures need to be operated [5]. Traditionally the operative treatment options are plating techniques (blade plate, dynamic condylar screw), nailing both retrograde and antegrade and external fixation [6]. These implants may not be ideal in some situations because of fracture complexity. Double plating results in extensive stripping of soft tissue which in turn results in reduced blood supply that leads to implant failure [6, 7]. Recently locking plating fixation are becoming increasingly used for complex distal femur fractures.
Proper understanding of vascularity of tissue and biology of bone is necessary for locking plate fixation [8]. For better stability in the osteoporotic bone multiple fixed angled screws used to fix the locking plate. Multi articular fragments of the distal femur can be fixed by using more than one distal screw in this implant [7, 8]. Locking compression plates reduce varus collapse which is encountered with the use of traditional plates [9, 10]. Oval shaped holes of the locking plate provides good compression to the bone while applying locking screws. LCP has more advantage than compression and bridge plating. This preserves periosteal vessels and reduce soft tissue damage. Therefore it acts like an internal fixator [11].

Materials and Methods

A Longitudinal Prospective study was done in SRM Medical College Hospital and Research Centre, during Jan 2018 to June 2019 among 30 patients.

The Inclusion criteria were

- Patient aged above 18yrs
- Type A, B and C distal femur fractures
- Both Closed and Open Distal femur fractures
- Those willing to participate in the study and follow-up visits

The Exclusion Criteria were as follows

- Pathological fractures
- Revision of a previous surgery
- Grade 111 A, B, C open fractures
- Bilateral distal end of femur fractures

Patients underwent distal femoral plating with locking compression plate through lateral parapatellar approach. They were followed up every month till 6 months postop and then at 1 year finally. Postoperative radiological assessment of bony union and functional Assessment by NEER'S scoring system were done.

Results

		N	%
Gender	Male	20	66.7%
	Female	10	33.3%
	Total	30	100.0%
Mode of Violence	RTA	20	66.7%
	Slip & Fall	10	33.3%
	Total	30	100.0%
Side affected	Left	13	43.3%
	Right	17	56.7%
	Total	30	100.0%
Muller's type	A1	7	23.3%
	A2	10	33.3%
	A3	3	10.0%
	B2	2	6.7%
	C1	3	10.0%
	C2	2	6.7%
	C3	3	10.0%
	Total	30	100.0%
Type of fracture	Open	4	13.3%
	Closed	26	86.7%
	Total	30	100.0%
Associated comorbidities	None	23	76.7%
	DM	2	6.7%
	HTN	4	13.3%
	DM+HTN	1	3.3%
	Total	30	100.0%
Plate size (No. of holes)	5	1	3.3%
	6	6	20.0%
	7	8	26.7%
	8	7	23.3%
	9	4	13.3%
	10	3	10.0%
	11	1	3.3%
	Total	30	100.0%
Outcome	Excellent	11	36.7%
	Good	13	43.3%
	Fair	6	20.0%
	Total	**30**	**100.0%**
Age group	21-30 yrs	4	13.3%
	31-40 yrs	7	23.3%
	41-50 yrs	4	13.3%
	52-60 yrs	10	33.3%
	61-70 yrs	5	16.7%
	Total	30	100.0%
Duration of Surgery (min)	< 120 mins	18	60.0%
	>= 120 mins	12	40.0%
	Total	30	100.0%

		N	%
Associated fractures	None	24	80.0%
	Bb forearm#	1	3.3%
	Distal end of radius #	1	3.3%
	Humerus#	1	3.3%
	Jones #	1	3.3%
	L distal end of radius#	1	3.3%
	Left Olecrenon #	1	3.3%
	Total	30	100.0%
Malalignment in comorbidities	None	24	80.0%
	10 valgus	1	3.3%
	10 varus	1	3.3%
	5 valgus	2	6.7%
	5 varus	2	6.7%
	Total	30	100.0%
LLD (mm) (Shortening)	5	3	50.0%
	10	3	50.0%
	Total	6	100.0%
Extension lag (degrees)	3	2	20.0%
	5	8	80.0%
	Total	10	100.0%

In this study 20 were males (66.7%) and 10 were females (33.3%). patients age ranged from 21 to 70 years. In this study mode of injury was Road traffic accident in 20 patients (66.7%), slip and fall in 10 patients (33.3%). In this study right side limb involved in 17 patients (56.7%), left side limb involved in 13 patients (43.3%). Out of a total of 30 patients, 4 patients had open fractures (13.3%) and 26 patients had closed fractures (86.7%). Among a total of 30 patients 2 patients had diabetes (6.7%), 4 patients had hypertension (13.3%) and one patient had both diabetes and hypertension (3.3%). 7 patients had muller's A1 type fractures(23.3%), 10 patients had muller's type 2 fractures(33.3%), 3 patients had muller A3 type fractures(10.0%), 2 patients had mullers type B2 fractures(6.7%), 3 patients had muller's type C1 fractures (10.0%), 2 patients had muller's type C2 fractures (6.7%) and 3 patients had muller's type C3 fractures(10.0%). The most common plate used was 7 holes plate in (26.7%), 8 holes plate in (23.3%) and 6 holes plate in (20.0%), 9 holes plate in (13.3%), 10 holes plate in (10.0%) and 5 and 11 holes plate in (3.3%). 6 patients were associated with fractures other than distal end of femur.1 patient (3.3%) had 10 degree valgus, 1 patient (3.3%) had 10 degree varus, 2 patients (6.7%) had 5 degree valgus and 2 patients (6.7%) had 5 degree varus. In this study out of 30 patients 6 patients had limb length discrepancy, 3 patients in Muller type C3 had 5mm shortening and 3 patients in Muller type A3 had 10 mm shortening. In this study out of 30 patients, 10 patients had extension lag, 2 patients with Muller type B2 had 3 degree lag (20%) and 8 patients had 5 degrees lag (80%) out of which 3 patients were Muller type C1, 2 patients were Muller type C2 and 3 patients were Muller type C3. In this study out of 30 patients, 11

patients had excellent outcome (36.7%), 13 patients had good outcome (43.3%) and 6 patients had fair outcome (20.0%).

Discussion

Distal femur fractures has remained controversial and challenging despite the development of various new fractures reduction techniques and better soft tissue handling. Development of locking plates permits simultaneous application of locking screws as well as cortical screws in the same plate [12].

Good results were reported with locking plates for distal femur fractures. Weight and Collinge [13] reviewed 26 cases of distal femur fractures retrospectively treated with LISS. All fractures healed without secondary surgery. Syed *et al*. [14] and EJ Yeap *et al*. [15] reported similar results of fracture union in all acute cases without secondary surgery. In Nayak *et al*. [16] study among 31 patients, 30 patients had union without secondary surgeries and 1 osteoporotic women had implant failure at 10 weeks and had union after revisionsurgery weight and collinge, syed *et al*. EJ yeap *et al*. Nayak *et al*. reported a mean time of union of 13, 14,18 and 15 weeks respectively. In our study all fractures healed primarily without any need for a secondary procedure like bone grafting.

Ricci *et al*. [17] in their study of 355 distal femur fractures, resurgery enhancing union was required in 37% of open fractures (41/110) and 10% of closed fractures (23/225) and 28 percent of patient with diabetes (18/65) and 17% of non diabetic patients(46/270). When open fractures associated with diabetes were analysed, 67% (8/12) required resurgery. 8% patients which required resurgery were nondiabetic and closed fractures (13/172). In our study 4 patients had open fractures out of which 3 patients had diabetes. Despite open fractures with diabetes all fractures healed uneventfully with good functional outcome.

Smith *et al*. [18] reviewed 21 patients and found the incidence of deep infection to be 3.1%. Vallier and Immler reported 6% infection in their 70patients. A study done by Ricci *et al*. reported deep infection in 5% of the patient. Infection occurred in 11% of patients with diabetes (7/65) and 4% without diabetes (10/270), 8% open (8/110) and 4% of closed fractures (9/225), and 33% with diabetes and open fracture (3/9) and 3% with neither diabetes nor open fracture(5/172).

In schandelmaier *et al*. [19] study, the median neer functional score was 73.9(33-88). 6 had excellent, 14 satisfactory, 6 unsatisfactory and 1 poor result. Weight and collinge reported 1 excellent, 21 satisfactory, 1 unsatisfactory and 3 poor results. In our study out of 30 patients 11 had excellent, 13 had good and 6had fair results. The results of our present study are consistent with literature with minimal or no complications.

Jagandeep singh *et al*. from their study in distal femur fractures concluded that main implant of choice was locking distal plate in treating distal femur fractures with good results. A study done by Sridhar Reddy *et al*. [20] in management of distal femur fractures with locking compression plate in 2015 on 20 patients concluded that LCP is the treatment of choice and LCP decreases the chance of implant failure and screw backing out. In our study we used LCP with better outcomes.

Ravish VN *et al*. in his study surgical management of fractures of distal end of femur with locking compression plate conducted between November 2013 to may 2015 on 25 cases concluded that LCP is good for fixation, with minimum surgical dissection and early mobilisation as same as our study. In our study 30 fractures of distal femur were treated with LCP. Overall outcome of the surgical management of fracture lower end of femur using LCP was assessed in terms of regaining the lost knee function using Neer score. Cases studied in the series include both open and closed fractures. 20 patients were males and 10 patients were females. The mean age was 48 years.

Amongst that 30 patients treated in their series 20 of the fractures were caused by road traffic accidents, 10 were due to slip & fall. 17 patients were with fractures on right side and 13 on left side.

Mechanism of injury in our series all the younger patients (2nd to 4th decade) had a high energy trauma like the road traffic accidents and trivial trauma was the most common cause of fracture in older age group. Half of the patients beyond 50yrs had a slip and fall as the cause of fracture.

We had no non union and implant failure in this study. In our study we had malalignment in 6 cases with 10 degree valgus in 1/30, 10 degree varus in 1/30, 5 degree valgus in2/30 and 5 degree varus in 2/30 patients. Limb length discrepancy was seen in 6 case 0-5mm shortening in 3 patients and 5-10mm shortening in 3 patients. Extension lag noted in 10 patients 3 degrees lag in 2/30 and 5 degree lag in 8/30 patients. There was no knee stiffness in our series. Many patients achieved 0-90degree ROM at the end of three weeks(21/30). Those who failed to achieve this mark were taken to the OR and knee manipulation was done followed by CPM for knee. 9/30 patients needed knee manipulation in our series.

Rademakers *et al*. [21] on 67 patients with follow up for one year noted mean knee range of motion of 111 degree with excellent Neer score. They concluded that good long term results are seen with open reduction and internal fixation of mono and bi condylar femoral fractures and knee function increases through time. In our study knee flexion with excellent results seen in 36.7% patients, good results in 43.3% patients and fair results in 20% patients with 6 months follow up.

In our study no hardware revision was done when compared to kayali *et al*. study and fankhauser *et al*. vallier *et al*. studies in which hardware revision was 4% and 20% respectively [22, 23, 24].

In our study for osteoporotic and comminuted fracture LCP gives rigid fixation with multiple points of fixed plate and screw construct. This fixation reduces considerable varus collapse [25, 26].

Miclau *et al*. in their study bone graft rates of supracondylar femur fractures ranged between 0% and 87%. Relatively low rate of bone grafting in our study is probably due to improved surgical technique with better soft tissue handling.

Case Illustrations

Fig 1: Pre-Op X-rays

Fig 2: Immediate post op

Fig 3: 4th month post op

Fig 4: 6th Month Post Op

Fig 5: Active Extension

Fig 6: Active Flexion

Conclusion

High incidence of distal femur fractures is seen in young patients with high velocity injuries and accidental falls in older patients showing a bimodal distribution. It provides better fixation of fracture in elderly patient with osteoporosis. Post operative early passive mobilisation of the knee gives good range of motion. Operative time is lessened as the locking compression is pre contoured and does not require anatomical fracture reduction. To prevent non union and implant failure, position of screws and working length is important in comminuted fractures increases working length increases inter fragmentary motion promotes fracture healing with callus formation and less implant breakage chances.

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