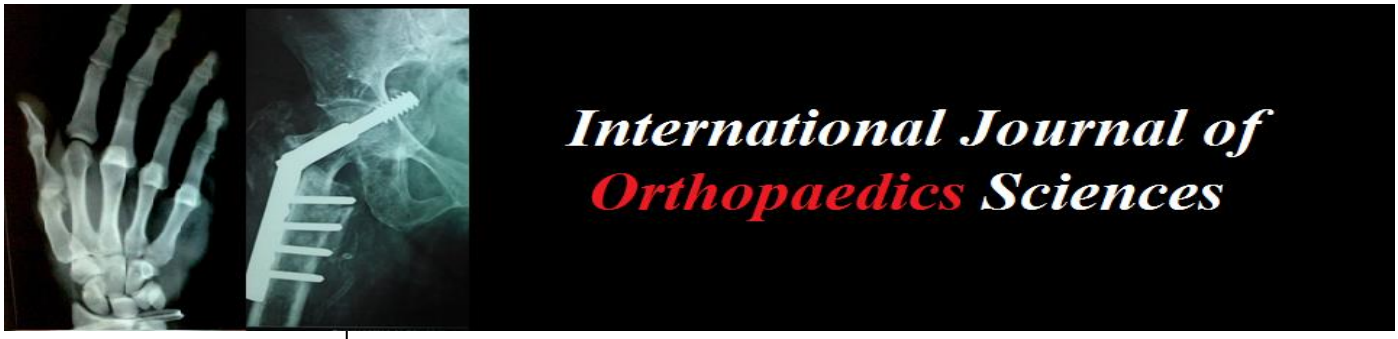

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To study the functional outcome in patients with compound supracondylar femur fracture managed using LCP: A prospective study

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Abstract
Background: Supracondylar and intercondylar fractures of femur are very often difficult to treat and they are notorious for many complications. Despite recent evolution in the operating techniques and surgical implants, debate continues around the choice of implant for management of distal femur fractures. By this study, we explore the capability of a distal femur locking plate to counter distal femur fractures.
Aim: To assess the efficacy of LCP in maintenance of post-operative total functional range of movements over the knee.
Methods: Prospective observational study conducted on 30 patients at Mamata General Hospital, Khammam with supracondylar femur fracture. Patients with open 3A, 3B, 3C distal femur fracture, based on Gustilo-Anderson classification were taken into the study. Follow-up at 3 months, 6 months, 12 months and 18 months was carried out and evaluation was done according to the Neer scoring system.
Results: In our study, the functional outcome was assessed by Neer's scoring system which revealed a satisfactory result upto a period of 6 months following which the results achieved at the end of 12&18 months showed excellent score where the p-value <0.001 and was considered significant.
Conclusion: Overall scores from all the parameters assessed indicated a significant p-value. Choosing an ideal implant for fixation of compound supracondylar femur fracture is crucial. Our study, based on Neer's score shows locking compression plate as one of the ideal implants.

Keywords: functional outcome, patients, supracondylar, fracture

Introduction

Fractures of distal femur account for less than 1% of all fractures and 4%-6% of all femoral fractures [1] Supracondylar and intercondylar fractures of the femur belong to the category of complex fractures [2], because they are associated with other injuries in young persons [3, 4] and their management can be difficult in view of achieving rigid fixation due to osteoporotic bone in the elderly [4-7].

Supracondylar femur fractures occur typically due to two discrete mechanisms of injury and in two separate populations. First, in young adults after high energy trauma (60% males <40 years; accidents and sports trauma) and second, elderly population after low energy trauma (60% females, older than 60 years; falls sprains etc.,) [8] Open fractures comprise 27% of cases and 58% have intra-articular extensions [9]. Surgical treatment of supracondylar or intercondylar distal femoral fractures remains a significant surgical challenge with significant complication rates [10]. Adverse events include infection, decreased range of motion, need for bone grafting, malunion, and nonunion [11].

The optimal method of treatment is still disputed. After the recent advances in techniques and implants, nonsurgical methods have largely fallen out of favour [12]. Locking plates employ a minimally invasive biologically friendly insertion technique with minimal soft issue stripping securing the blood supply as well as the fracture haematoma. Many internal fixation devices have been used for the treatment of distal femoral fractures. Implants consisting of plates and screws include devices such as the dynamic condylar screw (DCS), or angled blade plate (ABP) along with flexible and rigid intramedullary (IM) nail designs [13]. Studies have shown that internal fixation devices provide superior outcome as compared with closed methods by

providing stability that allows early mobilization [14].

Locking Distal Femoral Plates are the mainstay of treatment of complex intra-articular injuries. The primary goal of surgery with locking plates is to achieve union with bridging callus through relative stability which allows movement at the fracture gap. The biomechanical principle of relative stability allows a relative dynamic deformation [15] which induces secondary callus formation when compared to primary callus formation in absolute stability. Schutz *et al.* described new internal fixation systems such as LISS (less invasive stabilization system) and LCP (locking compression plate) as new approaches to treat metaphyseal fractures [16]. These implants improve fracture healing, especially in osteoporotic bone due to better holding capacity. Objective of the study was to assess the efficacy of LCP in maintenance of post-operative distal femoral alignment and in preventing post-operative varus collapse in supracondylar fracture of femur.

Material and Methods

Study setting: Mamata general hospital, Khammam, Telangana

Study design: Prospective longitudinal observational study.

Sample size: 30 patients with distal femur fracture.

Study period: August 2018 to May 2021.

Sampling method: All patients with confirmed diagnosis of distal femur fracture reported to our institution during above-mentioned period.

Scoring system: Functional score of Neer *et al.*

Inclusion criteria

1. Compound distal femur fracture
2. Age above 18years

Exclusion criteria

1. Distal femur fracture with osteoporotic changes
2. Age less than 18years
3. Pathological fractures
4. Periprosthetic fractures

Neer's criteria	Maximum score
Pain	20
Function	20
Work capacity	10
Gross anatomy	15
Radiological	15
Joint motion	20
Total	100

Pain

No pain	20
Intermittent pain	16
Fatigue on doing work	12
Restricted function due to pain	08
Constant night pain	04

Function

Functioning as before fracture	20
Mild restriction of function	16
Restricted function (stairs up and down).	12
Severe restrictions of function (patient walking with cane)	08
Patient using crutches or knee brace.	04

Work Capacity

Employed in same work as before fracture	10
Not employed in same work	00

Gross Anatomy

Thickening of bone without any angulation or shortening	15
Angulation<50& shortening <0.5cm.	12
Angulation>5-100&shortening>0.5-2cm	09
Angulation>10-150& shortening >2-3cm	06.
Nonunion at fracture site	0

Radiological

Near normal	15
Angulation 50& limb length discrepancy 0.5cm	12
Angulation 100& limb length discrepancy 1cm	09
Angulation 150& limb length discrepancy 2cm	06

Joint Motion

>1350	20
100-1340	16
80-990	12
60-790	08
40-590	04
<40	00

Total Score

>85 Excellent

70-85 Satisfactory

55-69 Unsatisfactory

<55 Failure

Results

Table 1: Age Distribution

Gender	N	Mean	Std. Deviation	t-value	p-value
Male	21	43.24	11.004	-1.366	0.183
Female	9	49.22	10.986		

In a study conducted by Ankit Mittal *et al.*, 16 males and 6 females with mean age 38.7±15.6 was noted while in our study the mean age group was 43.24 in males and 49.22 in females.

Table 2: Diagnosis (Gustilo Anderson Type) Distribution

Diagnosis	Frequency	Percent
3A	10	33.3
3B	18	60
3C	2	6.7
Total	30	100

In a study conducted by Saini *et al.*, out of 30 patients, there were 9 (30%) patients who had Muller type A1, 3 (10%) patient had A3 type, 8 (26.67%) patients had C1 type, 7(23.33%) patients had C2 type and 3 (10%) patients had C3 type of fractures based on Muller's classificatio. Our study showed a frequency of 10 cases of type 3A, 18 cases of 3B and 2 cases of 3C.

Table 3: Distribution of diagnosis (Gustilo Anderson Type) between gender

Diagnosis	Male	Female	Total	Fisher exact	P-value
3A	7	3	10	0.952	1.00
	33.30%	33.30%	33.30%		
3B	12	6	18		
	57.10%	66.70%	60.00%		
3C	2	0	2		
	9.50%	0.00%	6.70%		
Total	21	9	30		
	100.00%	100.00%	100.00%		

In a study by Saini *et al.* Out of 30 patients, there were 30% patients who had Muller type A1, 10% patient had A3 type, 26.67% patients had C1 type, 23.33% patients had C2 type and 10% patients had C3 type of fractures whereas our study showed a total of 33.3% of type 3A, 60% under type 3B, 30% accounted for 3C type of fractures.

Table 4: Mean Duration of pain score over the period of time

Duration	Pain				F-value	p-value	
	Mean	SD	Minimum	Maximum			Percentage
6 Weeks	17.8	2.25	4	16	47.361	<0.001	100%
6 Months	15.73	2.016	8	18			88.3%
12 Months	12.8	2.858	8	20			71.9%
18 Months	10.4	3.081	12	20			58.4%

Post-Hoc Test	Pain	
	Mean Difference	Significance
6 Weeks < 6 Months	-2.400*	<0.001
6 Weeks < 12 Months	-5.333*	<0.001
6 Weeks < 18 Months	-7.400*	<0.001
6 Months < 12Months	-2.933*	<0.001
6 Months < 18Months	-5.000*	<0.001
12 Months < 18 Months	-2.067*	0.002

In our study, the mean pain score obtained showed a mean value of 14.18 over 18 months i.e; 58.4% almost 50% in pain reduction was noted.

Table 5: Mean score for motion over the period of time

Duration	Motion				F-value	p-value	
	Mean	SD	Minimum	Maximum			Percentage
6 Weeks	8.87	3.048	0	16	26.684	<0.001	56%
6 Months	11.33	3.377	8	16			72%
12 Months	13.87	2.726	8	16			88.9%
18 Months	15.6	3.297	8	20			100%

Post-Hoc Test	Motion	
	Mean Difference	Significance
6 Weeks < 6 Months	-2.467*	0.003
6 Weeks < 12 Months	-5.000*	<0.001
6 Weeks < 18 Months	-6.733*	<0.001
6 Months < 12Months	-2.533*	0.002
6 Months < 18Months	-4.267*	<0.001
12 Months < 18 Months	-1.733*	0.034

* The mean difference is significant at the 0.05 level

By the end of 18 months in majority of the cases an excellent Range of motion was obtained at 100%

Table 6: Mean score for function over the period of time

Duration	Function				F-value	p-value	
	Mean	SD	Minimum	Maximum			percentage
6 Weeks	9.73	3.095	4	16	29.168	<0.001	59.3%
6 Months	11.8	3.167	4	16			71.9%
12 Months	14.47	2.556	8	18			88.2%
18 Months	16.4	3.035	8	20			94%

Post-Hoc Test	Function	
	Mean Difference	Significance
6 Weeks < 6 Months	-2.067*	0.008
6 Weeks < 12 Months	-4.733*	<0.001
6 Weeks < 18 Months	-6.667*	<0.001
6 Months < 12Months	-2.667*	0.001
6 Months < 18Months	-4.600*	<0.001
12 Months < 18 Months	1.933*	0.013

* The mean difference is significant at the 0.05 level.

In my study, at 18 months the variable of function achieved is 100%

Table 7: Mean score for Work over the period of time

Duration	Work				F-value	p-value
	Mean	SD	Minimum	Maximum		
6 Weeks	5.67	2.171	2	10	15.071	<0.001
6 Months	6.33	1.971	4	10		
12 Months	8.07	2.42	4	12		
18 Months	8.93	1.929	6	12		

Post-Hoc Test	Work	
	Mean Difference	Significance
6 Weeks < 6 Months	-0.667	0.228
6 Weeks < 12 Months	-2.400*	<0.001
6 Weeks < 18 Months	-3.267*	<0.001
6 Months < 12Months	-1.733*	0.002
6 Months < 18Months	-2.600*	<0.001
12 Months < 18 Months	-0.867	0.118

* The mean difference is significant at the 0.05 level

The mean score for work in my study is 7.25.

Table 8: Mean score for Gross anatomy over the period of time

Duration	Gross anatomy				F-value	p-value
	Mean	SD	Minimum	Maximum		
6 Weeks	6.2	2.219	3	9	11.507	<0.001
6 Months	6.9	1.788	3	9		
12 Months	8.2	2.074	6	12		
18 Months	9.2	2.497	6	15		

Post-Hoc Test	Gross anatomy	
	Mean Difference	Significance
6 Weeks < 6 Months	-0.7	0.212
6 Weeks < 12 Months	-2.000*	<0.001
6 Weeks < 18 Months	-3.000*	<0.001
6 Months < 12Months	-1.300*	0.021
6 Months < 18Months	-2.300*	<0.001
12 Months < 18 Months	1	0.076

* The mean difference is significant at the 0.05 level

Table 9: Mean score for Roentgenogram over the period of time

Duration	Roentgenogram				F-value	p-value
	Mean	SD	Minimum	Maximum		
6 Weeks	6.8	2.355	3	9	10.211	<0.001
6 Months	7.2	2.024	3	9		
12 Months	8.8	1.75	6	12		
18 Months	9.3	2.136	6	15		

Post-Hoc Test	Roentgenogram	
	Mean Difference	Significance
6 Weeks < 6 Months	-0.4	0.457
6 Weeks < 12 Months	-2.000*	0.003
6 Weeks < 18 Months	-2.500*	<0.001
6 Months < 12Months	-1.600*	0.003
6 Months < 18Months	-2.100*	0.353
12 Months < 18 Months	0.5	0.353

* The mean difference is significant at the 0.05 level.

Table 10: Mean score for Total Score over the period of time

Duration	Total Score				F-value	p-value
	Mean	SD	Minimum	Maximum		
6 Weeks	47.67	10.93	22	68	47.825	<0.001
6 Months	56.37	10.552	36	78		
12 Months	69.13	9.153	43	84		
18 Months	77.23	10.919	51	100		

Post-Hoc Test	Total Score	
	Mean Difference	Significance
6 Weeks < 6 Months	-8.700*	0.002
6 Weeks < 12 Months	-21.467*	<0.001
6 Weeks < 18 Months	-29.567*	<0.001
6 Months < 12Months	-12.767*	<0.001
6 Months < 18Months	-20.867*	<0.001
12 Months < 18 Months	-8.100*	0.003

In my study the mean score for the total score on Neer's at the end of 18 months is 77.23

Case 1

Pre-operative, post-operative radiographs at 12 months and 18 months Clinical photographs showing the excellent range of movements over the operated femur

Case 2

Pre-operative, post-operative radiographs at 12 months and 18 months Clinical photographs showing the excellent range of movements over the operated femur

Discussion

Our study using LCP was compared with other study groups using different modalities for treatment for supracondylar fractures of the femur.

In our study 30 patients, 21(70%) were Males, 09(30%) were Females. The distribution of sex shows males were more affected than females. Age group was compared with other studies. Mean age in our study was found to be 46.23 years. Siliski *et al.* found the mean age of their study population as 42.2 years. It is almost comparable with our study findings. The minimum follow up period in our study was 6 months. It was found that there is only 2% infection rate. The patient having superficial infection was treated successfully with oral antibiotics. We had one case of varus collapse due to early weight bearing and no case of implant failure. Comparing with other studies, in a study by Kregor *et al.* [17]. The knee ROM was 2 to 103 degrees where as in a study by Weight and Collinge [18] the knee ROM was 5 to 114 degrees and Yeap *et al.* [19] found knee ROM from 1 to 107 degrees, our study had a ROM of 113 degrees. Union was achieved in all cases in our study within 12-16weeks. Krettek *et al.* observed average time of bone healing as 11.6 weeks in 80% patients using osteosynthesis with DCS. Outcome score was assessed by. Dunlop in his study found outcome score (Neer) as 22 (85%) excellent and satisfactory 2 (7.5%) unsatisfactory 2 (7.5%) failures. Bolhofner discovered outcome score (Schatzker) as 84% good and excellent, 11% fair, 5% poor. Ostrum also found outcome score (Neer) as 16 (86.6%) excellent. Our study findings are less comparable to above mentioned study findings. In our study according to Neer's score by the end of 18 months 9 cases had an excellent outcome,19 cases satisfactory and 2 cases had an unsatisfactory outcome. Our study concludes that fixation of distal femur fracture with locking compression plate (LCP) showed excellent functional outcome with early union and good knee ROM, early weight bearing and return to normal activity without any major complications.

Conclusion

Based on observation and discussion the following conclusions were drawn from this study. Locking compression plate is one of the ideal implants for fixation of supracondylar fracture of femur. Postoperative distal femoral alignment is well maintained and there is no collapse of articular surface. LCP provides stable construct especially in cases with metaphyseal comminution and enables early mobilization. Despite increasing severity of trauma union occurred in all cases and mean

time of union was 12-16 weeks in 90% patients. No complication was noted in 90% cases. Satisfactory results can be achieved only with open reduction and rigid internal fixation followed by early range of movement over knee joint. Thus in our study we conclude that open reduction and internal fixation of supracondylar fracture by locking plate in perspective of increasing severity of trauma has a peculiar advantage over other modalities of surgical intervention in terms of nil or occasional pain, early mobilization and weight bearing, good range of motion, minimal limitation of activity, less deformity, early union radiologically, minimal limb length discrepancy. Orthopedic.

surgeons experience with locking compression plating technique will find the locking compression plate a useful technique, but requires attention to prevent complications. To conclude, Locking Compression Plate is an important amentariumin treatment of fractures around knee especially when fracture is severely comminuted and insinuations of osteoporosis.

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