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Dr. Jay Dhariwal
Post-Graduate Student, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Dr. Ashok Kumar
Professor, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Dr. Anurag Chhabra
Senior Professor and Head, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Dr. Sunil Yadav
Post-Graduate Student, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Dr. Mayank Dutta
Post-Graduate Student, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Dr. Vishnu Mittal
Post-Graduate Student, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Dr. Vivek Sahu
Post-Graduate Student, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Correspondence
Dr. Jay Dhariwal
Post-Graduate Student, Department of Orthopedics, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana, India

Clinical and functional outcomes of surgical management of distal femur fractures using distal femur locking compression plate

Dr. Jay Dhariwal, Dr. Ashok Kumar, Dr. Anurag Chhabra, Dr. Sunil Yadav, Dr. Mayank Dutta, Dr. Vishnu Mittal and Dr. Vivek Sahu

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Abstract
Distal femur fractures are reported to be less than 1% of all fractures and between 4 to 6 percent of all femoral fractures. Knowledge of anatomy of articular block with trapezoidal shape on axial section and anterior bowing of femur shaft is critical for operative treatment of distal femur fractures. In this prospective study, distal femoral locking compression plate was used for surgical management of these fractures to evaluate the clinico-radiologic and functional outcomes. 40 patients having 41 distal femur fractures were managed with open reduction and internal fixation using distal femur locking compression plate as per standard AO technique during period of July 2014 to September 2016. Patients were followed up for a minimum of 6 months. Average time of union was 18.23 weeks. Complications seen were delayed union in 2 cases, plate bending in one case who had an episode of seizure, was reoperated & union achieved later on and implant breakage in one case. Superficial infection was seen in 2 cases. Results were found to be excellent in 70%, good in 15%, fair in 12.5% and poor in 2.5% of the patients.

Keywords: Distal femur fractures, distal femur locking compression plate

1. Introduction
Distal femoral fractures are reported to be less than 1% of all fractures and comprise between 4-6% of all femoral fractures. These fractures are seen commonly among two populations, young patients involved in high energy trauma and older patients sustaining low energy fall fractures [1, 2].

Open injuries with considerable comminution of condyles and metaphysis is seen in high energy trauma patients. The problem is to restore the function in a destroyed knee joint. Complex knee ligament injuries usually occur in addition to extensive cartilage injuries. In older patients with severe osteoporosis frequently periprosthetic fractures are seen. Severe osteoporosis poses problem of anchoring the implant [3].

Operative repair is the standard for all such fractures, whether open or closed, intra-articular or extra-articular. Nonoperative management of these injuries should only be done in exceptional circumstances or for absolutely nondisplaced injuries. It should be noted that nonoperative management might actually be more risky than surgery because of the need for immobilization of the entire lower limb and the related risk of thromboembolism, pressure sores and other risks of prolonged recumbency [4].

Over the years orthopaedic surgery has evolved, still the treatment of distal femur fractures has not achieved clinical results with a quality comparable to the rest of the femoral fractures. The presence of thin cortices, osteoporosis, wide medullary canals, and fracture comminution make it difficult to obtain and maintain a stable fixation. The goal of the treatment of these fractures is anatomical reduction of the articular surface, restoration of the limb length, alignment and rotation, as well as allowing for an early limb mobilization to avoid articular stiffness and the loss of muscle mass [5].

Current generation of distal femoral locking compression plates is precontoured based on the average bony anatomy of the adult population and they form a fixed angled construct.

The pull-out strength of locking screws is higher than the conventional screws and is particularly useful in osteoporotic bones. These plates are designed to apply in minimally invasive fashion to preserve local biology and avoid problems with fracture healing and infection [6, 7].
This study was carried out to evaluate the clinical and functional outcomes of management of distal femur fractures by Distal Femur Locking Compression Plate.

2. Materials and Methods: The prospective study was conducted on 40 patients having 41 distal femur fractures. One patient had plate breakage and was lost to follow up so results were calculated in 39 patients with 40 fractures. All patients gave the informed consent prior to being included in the study and the study was authorized by the local ethical committee and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki as revised in 2000. Fractures of less than 6 weeks duration, open upto grade IIIA, age above 18 years with stable hemodynamic status and general condition were included in the study. In every case a detailed history regarding the mode, duration and nature of injury was taken. Personal history regarding smoking, previous history of chronic illness and other relevant medical history was obtained. A thorough examination of the affected lower limb was conducted. Knee joint was assessed for any dislocation or instability. Radiological examination was carried out for knowing the type of fracture. Fractures were then classified according to the AO classification system depending upon the degree of comminution.

2.1 Operative Technique: Patients were operated under spinal/general anesthesia, as per requirement. Patients were positioned in supine position on a simple C-Arm compatible orthopaedic table. Cleaning and Draping was done adequately. A roll was placed under the knee. A midline incision was made from above the fracture laterally to the patella. The length of incision was according to the length of implant to be used. Quadriceps fascia was dissected off the vastus lateralis muscle laterally to its inclusion with the iliotibial band. Iliotibial band and fascia was retracted laterally continuing the dissection down to the linea aspera. The lateral parapatellar retinaculum was incised separating it from the vastus lateralis. A lateral parapatellar arthrotomy was done to expose the femoral condyles. Vastus lateralis and medialis was retracted to expose the distal femur and displacing the patella medially. The perforting vessels were ligated and vastus lateralis elevated exposing the entire distal femur. Fixation was carried out using distal femoral locking compression plate as per standard protocol and as per fracture anatomy and cannulated cancellous screws were used for intercondylar fractures.

2.2 Post operative management
Hip, Knee and Ankle mobilization exercises were started on the same day of surgery. Post operative X-Ray thigh with knee (AP and lateral views) were done on 1st post-op day. Ambulation with non weight bearing over operated limb with help of walker was started as per tolerability of patient (if tolerable to patient, then from 1st post-op day).Sutures were removed on 10th to 12th post operative day. Patients were called on regular follow ups at 6 weeks, 3 months and 6 months.

2.3 Scoring: Scoring was done using knee society score. Grading of score is considered excellent with score >80, good 70-79, fair 60-69 and poor <60.

Knee Society

Knee Society Rating	Points	Patient Score
Pain (50 points)		
None	50	= 50
Mild or occasional	45	
Stairs only	40	
Walking and stairs	30	
Moderate occasional	20	
Moderate continual	10	
Severe		
Range of Motion5 degrees = 1 point	25	= 25
	0	
Anteroposterior Stability (maximum movement in any position)		= 10
<5mm	10	
5-10mm	5	
10mm	0	
Medial lateral Stability		= 15
<5 degrees	15	
6-9 degrees	10	
10-14 degrees	5	
15 degrees	0	
Deductions		= 0
Flexion contracture		
5-10 degrees	2	
10-15 degrees	5	
16-20 degrees	10	
>20 degrees	15	
Extension lag		
<10 degrees	5	
10-20 degrees	10	
>20 degrees	15	
Alignment		
5-10 degrees	0	
0-4 degrees	3 points each	
11-15 degrees	3 points each	
Other		
Function Rating		
Walking		= 50
Unlimited	50	
>10 blocks	40	
5-10 blocks	30	
<5 blocks	20	
Housebound	10	
Unable	0	
Stairs		= 50
Normal up and down	50	
Normal up; down with rail	40	
Up and down with rail	30	
Up with rail; unable down	15	
Unable	0	
Deductions		= 0
Cane	5	
Two canes	10	
Crutches or walker	20	

Score
Knee Rating= 100
Function= 100
(Adapted from: Insall JN, CORR 1989;248:12)

3. Results

Table 1: Age Distribution

Age (Years)	Cases	Percentage
10-19	3	7.69%
20-29	12	30.7%
30-39	9	23.07%
40-49	2	5.12%
50-59	9	23.07%
60-69	3	7.69%
70-79	1	2.56%

Table 2: Gender Distribution

Sex	Number of cases	Percentage
Male	35	89.47%
Female	4	10.26%
Total	39	100%

Table 3: Mechanism of Injury

Mechanism of Injury	Number of cases	Percentage
Road Traffic Accident	30	76.92%
Fall from Stairs	1	2.56%
Fall from height	4	10.26%
Fall of heavy object on thigh	2	5.12%
Assault	1	2.56%
Slip and fall while walking	1	2.56%
Total	39	100%

Table 4: Side Affected

Side Affected	Cases	Percentage
Right	23	58.97%
Left	15	38.46%
Bilateral	1	2.56%
Total	39	100

Table 5: AO Classification

AO classification	No of fractures	Percentage
A1	9	22.5%
A2	1	2.5%
A3	2	5%
B1	1	2.5%
C1	4	10%
C2	12	30%
C3	11	27.5%
Total	40	100%

Table 6: Addiction/ Habit

Habit	Cases	Percentage
Smoking	16	41%
Alcohol	1	2.56%
Both	6	15.38%
Total (out of 39 cases)	23	58.9%

Table 7: Union in Weeks

Union in Weeks	Fractures	Percentage
<12	5	12.5%
12-16	13	32.5%
17-20	9	22.5%
21-24	9	22.5%
Delayed Union	3	7.5%
Non-Union	1	2.5%
Total	40	100%

Table 8: Knee Score outcome

Knee Score	Number of Fractures	Percentage
Poor (<60)	1	2.5%
Fair (60-69)	5	12.5%
Good (70-79)	6	15%
Excellent (80 and above)	28	70%
Total	40	100%

4. Discussion

Concepts in the management of trauma in Orthopaedics are rapidly changing to keep pace with the increasing severity and complexities of the fractures. The management of distal femur fractures is always a challenging problem to orthopaedics surgeon, as they are high energy traumas in young patients with high comminution and in old patients with severe osteoporosis there are problems of implant fixation.

Nayak *et al* [8] in 2011 studied 31 cases of AO type A distal femur fracture fixed with locking plate. Mean age was 42 years. Doshi *et al* [9] in 2013 studied 24 cases of distal femur fractures in patients aged 55 and above. Average age in their study was 73 years. Kumar *et al* [10] in 2014 conducted a study on 44 cases of AO type C distal femur fractures fixed with locking plate. The mean age in their study was 35 years. Yang *et al* [11] conducted a study on 93 patients with distal femur fractures from March, 1979 to March, 1988 and average age was found to be 46.9 years. In the present study mean age was 38.6 years. Except the study of Doshi *et al* [9] which was conducted on patients above age 55 years, other studies including the present study show that younger population are affected more.

In the study by Nayak *et al* [8], Kumar *et al* [10], Yang *et al* [11] and the present study incidence of distal femur fractures was more in males than females and most common cause of injury was road traffic accidents. Doshi *et al* [9] which was a study on elderly patients, females were affected more than males and cause of injury was trivial energy trauma. This shows that younger male population which in more involved in outdoor activities is more prone to these fractures. While in elderly, females are affected more because of obvious reason of senile osteoporosis seen more commonly in females.

Average knee ROM was 1º-107.7º in study of Yeap and Deepak [12], Ramesh *et al* [14] had 111.3º, Nayak *et al* [8] had >120º in all the patients, Kumar *et al* [10] had 98.63º and in our study 118º was the average. In our study average knee ROM was better than other studies except Nayak *et al* [8] who studied only extraarticular fractures. The reason is physiotherapy which was started on the 2nd post op day and patients were encouraged to ambulate with walker as early as possible non weight bearing on operated limb.

Nayak *et al* [8] who studied AO type A distal femur fractures fixed with locking plate average time of union was 15.85weeks. Doshi *et al* [9] studied 24 cases and average time of union was 13.48 weeks. Kumar *et al* [10] conducted a study on 44 cases of AO type C distal femur fracture fixed with locking plate. Average time of union was 14 weeks. Yeap and Deepak [12] reported average time of union to be 18 weeks in their study. Kim *et al* [13] in their study on 14 cases of type C distal femur fractures average time of union was found to be 15. Ramesh *et al* [14] in their study found average union time to be 16.4 weeks. The average time of union in our study was 18.25 weeks which is more than other studies. The possible reasons are (1) percentage of smokers was much higher than other studies, (2) fracture site was opened in all cases except 4 in which minimally invasive plate osteosynthesis was used while in studies by Nayak *et al* and Doshi *et al* MIPO was used for all cases and (3) one patient who was a known epileptic union was achieved in 36 weeks as was reoperated after bending of the plate due to fall by seizure episode. This also increased the overall average time.

The knee score in the present study was found to be lower than the other studies. In one patient the score was 55 as the patient had moderate continual pain because of screw impingement on Medial condyle. In one patient the score was 68 because of varus collapse. In one patient the score was 63 because of open proximal tibia fracture which was initially fixed by external fixator and patella tendon bearing cast was applied, patient started bearing weight without brace against advice. In one patient the score was 67 because patient had bilateral supracondylar femur fracture and was intercondylar on left side. Patient was unable to bear weight for longer duration, which added to osteoporosis and increased pain in already osteoarthritic knee. In one patient the score was 68 because patient had proximal tibia fracture with old malunited fracture of tibia and fibula of same side and also associated with multiple skull and mandible fractures was unable to bear weight and was not fully compliant with the physiotherapy protocol. In another patient the score was 60 as the patient had segmental femur fracture. Function score was comparable to the other studies.

Table 9: Average Knee and Function Score in Various Studies

Series	Knee Score	Function Score
Nayak *et al*. 2011	92.19	85.45
Doshi *et al*. 2013	88.8	76
Kumar *et al*. 2014	90.56	84.27
Present Study	83.8	81


Fig1a: Preoperative


Fig1b: Postoperative


Fig1c: Follow up 13 weeks


Fig1d: 20 weeks follow up



Fig 1e: Knee Function

Fig 1: Showing 33C2 Type Fracture

Fig 2a: Preoperative

Fig 2b: Postoperative

Fig 2c: 20 weeks

Fig 2d: Knee ROM

Fig 3a: Preoperative

Fig 2: Showing 33C3 Fracture

Fig 3b: Postoperative

Fig 3c: At 14 weeks follow up

Fig 3d: Knee ROM

Fig 3: Showing 33C2 Fracture

5. Conclusion

The aim of treatment is to achieve anatomical reduction of articular surface, restoration of the limb length and alignment, as well as allowing for early limb mobilization to avoid articular stiffness and the loss of the muscle mass. Even with newer advances in fracture treatments, the treatment of distal femur fracture has not achieved clinical results with a quality comparable to the rest of femur fractures. Reconstruction of distal femur fractures especially in supracondylar and intercondylar fractures is a challenging task. Use of Distal Femur Locking Compression Plate in distal femur fracture was observed to be a reliable tool for allowing better reconstruction in distal femur fractures and allows stable fixation which leads to good knee function but on early weight bearing there can be varus collapse. The anchoring of distal femur locking compression plate in the condyle is very reliable even in osteoporotic bones.

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