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## Management of distal femur fractures with locking compression plate: A prospective study

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#### Abstract

**Background:** Fractures distal femur are one of the commonest fractures encountered in high velocity trauma which are associated with high morbidity and mortality. Isolated fracture can itself lead to complications such as ARDS and pulmonary embolism. This necessitates early stabilization of fractures. Internal fixation is the choice of treatment in fractures distal femur and Locking Condylar plate. Plate has shown to give one of the best results in terms of recovery, fracture union, return to work and the functional outcome.

**Methods:** This prospective study reviewed 25 cases of distal femoral fractures surgically managed with distal femoral locking compression plate between JANUARY 2017 and January 2018 at, SSG Hospital and Medical College Baroda. Fractures were categorized according to OTA classification by Muller.

**Results:** 21 out of 25 patients had closed injury. Type A2 Muller's fracture was the most common fracture type 8 out of 25 patients (32%). Out of 25 patients 19 were male and 6 were female. The mean follow up period in this study was 6 months. The average range of knee flexion achieved was about 110. Out of 25 patients 14 had excellent, 8 had good, 2 had fair and 1 had poor result.

**Conclusions:** The locking compression plate is the treatment of choice in the management of comminuted distal femoral fractures especially Type A fractures where we have found higher Neer scores.

**Keywords:** distal femur fractures, locking compression plate, neer's functional score

#### Introduction

Distal femur fractures comprise of 6% of the fractures involving femur approximately <sup>[1, 2]</sup>. Bimodal age distribution is seen. Peak incidence is seen in patients below 40 years of age, commonly males, experiencing high-energy trauma. Incidence again rises in patients >50 years, commonly females, with osteoporosis, who experience relatively low energy trauma. Frequent mechanism of injury is axial load to femur and less frequently rotational forces lead to distal femoral fractures <sup>[2]</sup>. Distal femur fractures are complex injuries that involve distal 15 cm of femur both supracondylar and intercondylar, whose management is an arduous task, as these have an inherent tendency for high morbidity.

The purpose of surgical management is to restore articular congruency, limb alignment and early mobilization. Impairment can nevertheless occur in fractures with considerable articular surface involvement significant bone comminution, and serious soft tissue injury <sup>[3, 4]</sup>. Locking compression plate is the integration of compression plating, locked plating and bridge plating, causing minimal soft tissue damage and periosteal vessels are preserved. Hence it functions like a closed external fixator <sup>[5]</sup>.

The objective of this study is to appraise the outcome of distal femur fractures management with locking compression plate in terms of relief of pain, regain of flexion, and return to function, residual anatomic deformity and radiographic parameter.

#### Methods

This prospective study evaluated 25 patients with distal end femur fracture. All patients were treated at SSG Hospital and medical college Baroda, between January 2017 to January 2018 and followed for a minimum of 6 months.

The method used for fracture fixation was open reduction internal fixation or minimally invasive plate osteosynthesis with locking compression plate. All fractures in this prospective study were post-traumatic. No pathological fracture (excluding osteoporosis) was included. Fractures treated conservatively or operated with other fixation systems are not included.

The following clinico-radiological evaluation was observed for patients with fracture lower end of femur in casualty.

A detailed history is taken, to ascertain the mode of violence and to correlate the fracture pattern and to anticipate hidden complications.

Evaluation of patients in terms of: a) age b) sex c) mode of trauma d) period between injury and arrival.

Stabilization of patient with intravenous fluids, oxygen and blood transfusion as and when required. Thorough examination is done to rule out any head/chest/ abdominal/spinal or pelvic injury. In polytrauma, local examination of ipsilateral hip, knee, leg and ankle is done. Examination of involved limb is done to rule out neurovascular deficit. Limb is temporarily stabilized in Thomas splint to shift the patient for anteroposterior and lateral radiographs of affected extremity. Traction views may be helpful; 45 degree oblique views can better delineate intercondylar involvement. Radio-graphic evaluation of the entire involved lower extremity is warranted, as concomitant injuries are common. Contralateral views may help with comparison and may serve as a template for preoperative planning. In case of open fracture, thorough irrigation and lavage of associated compound injuries was done with at least 9 liters normal saline followed by dry or burn mesh dressings followed by giving I.V. antibiotics, tetanus toxoid and tetanus antitoxin (if needed). Neer's functional scoring was used to assess the outcome of surgery, for adult distal femoral fractures [6, 7].

### Patient selection

#### Inclusion criteria

Inclusion criteria were patients admitted to SSG Hospital Vadodara with fracture lower end of femur fixed with LCP; all skeletal mature patients (>18years); patients with closed or Open distal femur fractures up to Gustilo - Anderson's classification type I, II, patients with osteoporosis; patients willing to give consent.

#### Exclusion criteria

Exclusion criteria were patients with Gustillo Anderson type IIIA, IIIB open fracture and Muller's OTA classification type C; patients with associated tibial plateau fractures; age of patient less than 18 years of age or open growth plate; patients managed conservatively; fractures with distal neurovascular deficit; patient with pathological fracture.

#### Preoperative investigation

Complete blood picture, random blood sugar, renal function tests, serum electrolytes, blood group and Rh typing, coagulation profile, electrocardiograph, 2D ECHO, chest X ray PA view and any additional investigations as advised by anesthetist.

#### Surgical technique

- All Patients were operated under combined spinal and epidural anaesthesia.
- Patients were placed in supine position on operating table slightly elevating the affected side with a sandbag under ipsilateral hip. Knee is placed in slight flexion over a small sand bag or a triangular frame.

- Skin at the operating site was prepared by povidone iodine (10% w/v) solution and spirit and the operating field from the buttock to the knee was draped.
- We have used extensile lateral and Swashbuckler approach for most intra articular distal femoral fracture.
- Swashbuckler approach midline incision from above the fracture laterally to across the patella. Fascia overlying quadriceps is incised longitudinally. Further laterally fascia over quadriceps becomes confluent with iliotibial band. Lateral parapattellar arthrotomy is performed. Proximally arthrotomy incision is made between vastus lateralis muscle and lateral retinaculum of knee using trapezoid shape incision. Proximal release of vastus lateralis fibers from lateral intermuscular septum allow further mobilization of quadriceps.
- Anatomical reduction of articular surface done for intraarticular fractures and provisionally stabilize them with k wires. Articular reduction maintained using lag screw and LCP.
- Proper size of plate selected. After proper placement of plate place the fixation screws in accordance with the biomechanical principal of fixation, placing screws close to and far away from the fracture, Insert minimum 5 screws including lag screws and locking head screws in distal fragment and minimum 4 screws in proximal femoral segment.

#### Post-operative care and rehabilitation

- Antibiotics was administered as per hospital protocol. Anti-inflammatory, analgesics and other supportive measures were also given as per individual requirements. The suction drain was removed after 48 hrs and check x- ray of the limb was taken.
- Patients were allowed to sit once the drain was removed. Knee range of movements, active quadriceps and hamstring exercises were started, as soon as patient could tolerate pain from immediate post-operative day. Mobilization with Non weight bearing was started from the first post-operative week till 6-8 weeks depending on the fracture pattern and then partial weight bearing after confirmation of beginning of healing process till fracture union.
- Patients were followed up every month upto 6 months. During follow up patients were assessed clinically, radiologically and functionally by Neer's criteria.

#### Results

In our study of 25 patients, 19 were males and 6 were females. The age of the patients ranged from 20 years to 70 years, with mean age of 42 years. The most common mode of injury was road traffic accident in 17 patients (68%) against domestic fall in 7 patients (28%).

In our study, 16 (64%) patients sustained injury to the femur and 9 (36%) patients to the left femur, showing there was right sided predominance.

Meticulous clinical examination was made in all patients and associated injuries were treated with proper documentation.

Of the 25 cases, according to Muller's classification 3 (12%) fractures were of type A1, 8 (32%) type A2, 1(4%) type A3, 3(12%) type B2, 4(16%) type C1, 5 (20%) type C2, 1 (4%) were of type C3 fractures. Of the 25 cases 21 were closed fractures and 4 were open fractures. Out of 25 cases 18 (72%) were operated in open reduction and internal fixation technique and 7 (28%) through minimally invasive technique.

## Complications

Early complications were encountered in 4 patients and these were superficial wound infection, wound gaping. Late complications were observed like mal-union with varus in 1 patient, Plate breakage in 1 patient, knee stiffness in 2 patients. When evaluated for pain, 14 of 25 patients had no pain (56%), 9 patients had intermittent pain (36%), 2 patient had pain with fatigue. (8%).

In our observation, 9 out of 25 (36%) patients gained knee flexion of 135° or normal, 13 (52%) patients gained upto 100° and Remaining 3 patients regained a knee flexion upto 80°.

**Table 1:** Grading of outcome as per Neer's score - overall rating.

<b>Excellent</b>	Above 85 units	14
<b>Good</b>	70-85 units	8
<b>Fair</b>	55-69 units	2
<b>Poor</b>	Below 55 units	1

Overall results were excellent in 14(56%) out of 25 cases and were good in 8 (32%) cases, 2(8%) had a fair result and 1 (4%) patient had a poor result.

## Discussion

Distal femur fractures have been documented as hard to treat as they are unstable due to the pull of the distal fragment by the muscles. These fractures often have a potential for long term disability and potential to develop infection. Our study comprised of 25 patients with distal femur fractures who were treated by locking compression plate (LCP) using open reduction (ORIF), and minimally invasive (MIPPO) technique when appropriate. The final outcome was determined in terms of pain relief, regaining the lost knee function, anatomical and radiological outcome using Neer's score and compared with other studies.

In our study 78% were males. The mean age was 42years (range 20 to 70 years). Mode of injury was domestic fall in 28% patients against road traffic accidents in 68% of patients. Domestic fall was the most common cause of injury for distal femur fractures in elderly females. We found a right sided preponderance in our study with 64% of right sided and 36% of left sided involvement. The average range of flexion achieved was about 110°.

Muller's comprehensive classification system was used to classify the fractures, type A (48%) and C (40%) account for most of the fractures. The good outcome seen in our study can be attributed to more of type A fractures (48%), which usually show favorable results. we had only 16% of open fractures.

We had one case of varus collapse due to gross comminution. One case had an implant failure (Plate breakage) due to early weight bearing. Cases needing hardware revision is 5% comparable to Kayali *et al* study at 4% as opposed to 20% in Fankhauser *et al* and Vallier *et al*.<sup>[12-14]</sup>

In our study we had no nonunion which is comparable to Fankhauser *et al*, Weight *et al*, Kayali *et al*.<sup>[9, 12, 13]</sup> In our study, there is no delayed union was seen which is comparable to Markmiller *et al*.<sup>[8, 9, 14, 15]</sup>

Locking compression plate outcomes are favourable in osteoporotic bone and in fractures associated with marked comminution due to rigidity of plate screw construct<sup>[16]</sup>. The locking compression plate offer multiple points of fixed plate to screws contact, create greater stability and thereby minimize the susceptibility of varus collapse<sup>[17]</sup>.

In our study, radiological union was seen at an average of 18 weeks which is comparable to study of LCP by Kayali *et al*. in

2005, which averages 15 weeks. Overall results were excellent in 14 out of 25 cases and 8 were good and 2 were fair and 1 was poor. The overall average Neer's score in our study was 81.17, in contrast with 67.7 by Schandelmaier *et al*.<sup>[18]</sup>

We can opine that all the excellent results were from type A fracture and good results were seen in type A, B, C and fair results seen in type C and A and 1 poor result was in type C. The difficulty in managing distal femoral fractures with osteoporosis, extensive comminution and revision surgeries following failed implant can be addressed effectively using locking condylar plate<sup>[17]</sup>. We assume that locking plates are an effective improvement in fracture management. Yet the deficiencies of this new technology and indications for its use have not been completely elucidated and the long- term results are awaited.

Nevertheless, locking compression plates can break when physiological loads are external to plate-design parameters<sup>[19]</sup>. The locked screws can loosen from the plate consequential to failure of the screw to seat into the plate congruously, as a result of cross-threading or when insufficient screw torque is used to engage the screw threads into the plate threads<sup>[19]</sup>.

## Conclusion

The LCP condylar plate is the treatment of choice in the management of distal femoral fractures especially type A fractures where we have found higher Neer's scores.

Good planning and execution of surgery in these complex fractures results in better functional outcomes on par with other means of fixation even in intra-articular injuries. If we do a proper anatomical restoration and alignment in these fractures functional outcome is better. LCP is better implant in comminuted I/A fractures of distal end of femur and in elderly patients with osteoporotic bone. The use of LCP decreases the chances of implant failure and screw backing out. Early passive mobilization of the knee is possible due to stable fixation even in osteoporotic fractures.

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