

## A 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 the fractures of distal end of femur and the mechanism of injury in distal end femur fractures, the advantages and disadvantages of open reduction and internal fixation of distal end femur fractures by distal femoral locking compression plate osteosynthesis and to analyse the outcome in terms of range of Knee motion, time to union, and limb shortening.

#### RESULTS

The mean age of patient is 44 years, 85% are males, road traffic accidents account for majority (80%), right side involved in 70%, Muller's type C fracture is common, good range of movements is seen 90% of cases and union occurred in 95% in 5 months. The results were assessed using Neer's score, seven (35%) patients had excellent results, eight (40%) patients had good results, four (20%) patients had fair results and one (5%) patient had poor result.

#### CONCLUSION

From our study, we conclude that DF-LCP is a safe and reliable implant and has shown excellent to satisfactory results in majority of intra-articular fractures (AO type C). Fixation with locking compression plate showed more effectiveness in severely osteoporotic bones, shorter operative stay, faster recovery, faster union rates and excellent functional outcome.

#### KEYWORDS

Distal Femur, Fractures, DF-LCP (Distal Femur Locking Compression Plate).

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**INTRODUCTION:** Distal femoral fractures reportedly account for less than 1% of all fractures and comprise between 4%-6% of all femoral fractures.<sup>1</sup> Supracondylar femoral fractures occur commonly among two populations, young patients involved in high-energy accidents (Including motor vehicle and motorcycle accidents and sports trauma) and older patients, often osteoporotic, sustaining low-energy fall fractures. Except in extreme circumstances, operative treatment for supracondylar femoral fractures is the standard, while nonsurgical treatment has largely fallen out of favour as the result of further advances in technique and implants. Standard implants used for other types of distal femoral fractures like condylar blade plate and supracondylar nails are not helpful in articular surface reduction and fixation. In setting of medial comminution and short distal segment, there is high incidence of loss of fixation and varus collapse. Anatomic reduction of the articular surface, restoration of limb alignment, and early mobilisation have been shown to be effective ways of managing most distal femoral fractures.<sup>2</sup>

Surgical fixation has consistently demonstrated better outcomes than nonsurgical management mainly based on fixed angle devices starting with the blade plate, dynamic condylar screw and nail resulting in the advent of locked plating. The current trend is toward periarticular distal femoral locking plates which can be inserted submuscularly as a minimally invasive procedure to preserve blood supply, fracture haematoma, and avoid extensive soft tissue damage.

Definitive treatment of distal femoral fractures requires maintenance or restoration of distal femoral alignment to preserve the function of the extremity. Additionally, early knee motion is central to the management of distal femoral fracture. Knee stiffness and loss of range of motion (ROM) may develop with immobilisation, and these often contribute to a poor outcome.<sup>3</sup>

Supracondylar fractures, intra-articular in particular, are difficult to treat to successful union without complications. Similar nonunion rates of 0%-20% for conservative treatment or internal fixation methods have been described. Therefore, the purpose of this study was to analyse the clinical outcomes of distal femoral fractures managed by distal femoral locking compression plate osteosynthesis utilising Neer's Score evaluating on Range of Knee motion, Time to union, Pain in the knee, walking status and Limb shortening.

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**MATERIALS AND METHODS:** In this study, 20 patients with supracondylar fracture femur were studied. All the cases were treated at Government General Hospital, Kurnool, between 1-09-2013 & 30-4-2015 and followed for a minimum of 6 months. The method used for fracture fixation was open reduction and internal fixation with locking compression plate. The duration of followup ranged from 6 months to 18 months. Inclusion Criteria includes Patients admitted to Government General Hospital, Kurnool with fracture of lower end of femur fixed with DF- LCP, age between 20 to 70, history of trauma due to RTA, fall from height and assault, both closed and open distal femur fractures up to type I, patients willing to give consent. Exclusion criteria includes Patients with open distal femoral fractures Type II, III, Patients with associated tibial plateau fractures, Children with distal femoral fractures with growth plate still open or less than 20 years of age, Patient with pathological distal femoral other than osteoporosis and Patients lost in followup.

Patients typically present non-ambulatory with pain, swelling and variable deformity in the supracondylar region of the femur. Gross mobility may be present at the fracture site with crepitus. Immediate assessment of neurovascular status is mandatory. The proximity of neurovascular bundles to the fracture site is an important consideration. Any clinical suspicion of compartment syndrome must be followed by monitoring compartment pressures and assessing haemodynamic instability. Examination of ipsilateral hip, knee, leg and ankle, are warranted, especially in the polytraumatised patient. In cases in which a distal femoral fracture is associated with an overlying laceration or puncture wound, saline or methylene blue may be injected into the knee in a sterile fashion to determine continuity with the wound. Anteroposterior and lateral radiographs of affected extremity should be taken. Traction views may be helpful; 45-degree oblique views can better delineate intercondylar involvement. Computed tomography portrays the distal femur in cross section, which helps to identify fracture lines in the frontal plane. All routine investigations are done and all patients are operated with DF- LCP.

**RESULTS:** In our study, 20 fractures of the supracondylar femur were treated. All cases were fresh, 17 patients were males and 3 patients were females. The mean age was 44 years ranging from 23-65 years. 16 of the fractures were caused by road traffic accidents and 4 were due to fall. 14 patients were with fracture on right side and 6 on left side. Of the 20 'Lower end of Femur' fractures, 13 patients had Muller's type c fractures. Among them, 4 were C1, 3 were C2 and 6 were type C3 Muller's. In this study 16 cases were closed fractures and 4 were open fractures (Type I). In this study, 7 patients had associated injuries. Of them, 2 patients had fracture of ipsilateral distal radius. 1 patient had fractures of the humerus, one patient had fracture of contralateral patella, 2 patients had ipsilateral metacarpal fracture and one had contralateral tibia fracture. All patients were operated within 8 days. Average time duration of surgery was 110 minutes.

The size of plate was selected based on the type of fracture. Ten to Twelve holed plates were used more commonly. Of 20 patients, 19 Patients (90%) showed radiological union within 18 weeks. One patient went for delayed union. Infection was encountered in 2 cases. They were early infections treated with saline wash, debridement and higher antibiotics as warranted by culture report. The fractures went on to heal uneventfully. Average flexion in this study was 100 degrees. Average knee extensor lag in this study was 3.5 degrees. Out of 20 patients, 2 had shortening, one of them had shortening of 15 mm and 1 patient had shortening of 10 mm. The duration of followup ranged from 3 months to 18 months. Outcome analysed by using Neer's score. Out of 20 patients, 7 had excellent result, 8 had good result, 4 had fair and one with poor outcome.



**Fig. 1: Preoperative, Postoperative and Followup Radiographs of Case 1**



**Fig. 2: Preoperative, Postoperative and Followup Radiographs of Case 2**



**Fig. 3: Preoperative, Postoperative and Followup Radiographs of Case 3**

**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.<sup>4</sup> The prognostic factors for supracondylar fracture included age, intra-articular involvement, methods of treatment, timing of joint motion, etc.<sup>5</sup> The Locking Compression Plate (LCP) system offers a number of advantages in fracture fixation combining angular stability through the use of locking screws with traditional fixation techniques.

However, the system is complex, requiring careful attention to biomechanical principles and good surgical technique. The 'Angular Stability' provided by LCP at the plate-screw interface, allows extra-periosteal fixation of the plate to the bone. By preserving periosteal blood supply to the bone it addresses the importance of the biological factors involved in fracture healing. The principles of flexible fixation are employed where the goal is for indirect healing with the formation of callus. Although the LCP system offers a number of advantages in fracture management, its successful use requires careful preoperative planning, consideration of biomechanical principles, and the use of the appropriate plate and screws combined with good surgical technique. Failure to address these issues can lead to potential pitfalls in terms of implant breakage or non-union. LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness and pull-out resistance in unlocked plates. Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilisation, avoidance of stress shielding and induction of callus formation.<sup>6</sup>

In this study, twenty cases of distal femoral fractures with or without intra-articular extension treated by DF-LCP at Department of Orthopaedics, Kurnool Medical College were included. Study was done from September 2013 to April 2015. In our study of 20 patients, the mean age of the patients was 44 years and there were 17 males (85%) and 3 females (15%). Yeap and Deepak, conducted a retrospective review of 11 patients who were fixed with titanium Distal femur locking compression plate and reported higher incidence in males compared to females and the mean age in their study was 44 years.<sup>7</sup> Mongkon Luechoowong, 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.<sup>8</sup>

In our study, most of the injuries were caused by road traffic accidents affecting mostly males. We had 16 (80%) RTA injuries and 4 (20%) fall. There were no sports or industrial accidents. Yeap and Deepak, reported higher incidence of RTA (7 patients) than Falls (4 patients). In our study of 20 patients, two patients belonged to A1, two to A2, one to A3, one to B1, one to B2, four to C1, three to C2 and six to C3 type fractures respectively. Majority of fractures belonged to type C fracture which was 65% and 25% belonged to type A fractures. This indicates that type C fractures occur more commonly than type A. Yeap and Deepak, reported 4 patients of A1, 2 of A3, 1 of C1, 1 of C2 and 3 of C3 type fractures.

Yang Teng-Heng, Zhong Zhi-Nian, Lao Ji-Yi, 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.<sup>9</sup> This signifies that most of the distal femoral fractures are caused by high energy trauma. They are associated with severe comminution and are unstable. Majority of them in our study belonged to type C fracture configuration. Average duration of hospitalisation in our study was 2.71 weeks (19 days), increased because of other

associated injuries and the need for the strict postoperative physiotherapy which affected the course of treatment and rehabilitation. The majority of patients preferred to stay in hospital till the sutures are removed due to social reasons.

Yeap and Deepak, reported average duration of hospitalisation of 17.2 days with a range of 8 to 34 days. The average time to union was 4.07 months (16.3 weeks) with a range of 3.6-6.2 months (14-25 weeks). Successful fracture union was defined as complete bridging callus in three cortices, together with painless full weight-bearing. Radiological union of the fracture i.e. characterised by cortex to cortex healing and bridging callus of the fracture in both AP and lateral views of followup x-rays, is considered as satisfactory union. Time to union in Type C fractures generally was found to be longer compared to Type A fractures. There was significant delay in union rate and considerable decrease in postop knee movements if surgery was delayed > 1 week. Yeap and Deepak, reported average time to union to be 18 weeks with a range from 6 weeks to 36 weeks excluding one patient. Mongkon Luechoowong, reported average time to union as 17 weeks with a range of 12-38 weeks. Kim KJ, Lee SK, Choy WS, Kwon WC, Lee DH, reported mean time to union at postoperative 15 weeks with a range of 13-20 weeks.<sup>10</sup>

We conclude that time to union in distal femoral fractures are generally longer than usual fracture union due to high incidence of comminution and osteoporosis. Type C fractures took longer time to unite compared to Type A fractures. We had superficial infection in 2 patients out of 20 patients who completed the study. None had deep infection. The infection subsided completely after debridement and course of IV antibiotics. It may be attributed to better soft tissue handling and proper antibiotic cover. We used a combination of third generation cephalosporin (cefotaxime 1 g) and an aminoglycoside (Gentamicin 80 mg) one hour prior to surgery and 3 days postoperatively. Yeap and Deepak did not report any infection. Mongkon Luechoowong reported one case of infection which subsided after repeated debridement and antibiotics. Kim KJ, Lee SK, Choy WS, Kwon WC, Lee DH, reported two postoperative infections.

In our study, we had no implant failure. Yeap and Deepak report one case of implant failure. Mongkon Luechoowong observed one broken screw caused from slipping. Re-plating was applied and fracture united in 38 weeks. In our study, the mean flexion was 100° (Range 80-115°). It was attributed to the stable and sturdy construct and the early range of motion achieved with DF-LCP. The average knee flexion in Type C fractures was 95° compared to 115° in Type A fractures, which shows that intra-articular fractures lead to intra-articular stiffness and decreased range of motion. Nine of our patients had extension lag which persisted even after physiotherapy. Yeap and Deepak reported mean extension was 1° (range 0° to 5°), with mean flexion 107.7° (Range 40° to 140°). Mean range of motion was from 1° to 107.7°. We conclude ROM around the knee is better in patients treated with DF – LCP.

At the same time, strict postop physiotherapy including CPM and clinical experience plays an important role in

functional outcome. Evaluation according to Neer's score showed a mean Neer's score of 82 with a range of 54 to 92. Out of our 20 patients in the study, seven patients (35%) had excellent results, eight (40%) satisfactory, four (20%) had unsatisfactory and one (5%) failure case. Excellent and satisfactory results accounted for 75% of cases and remaining 25% included unsatisfactory and failure cases. Younger aged patients had better results than older age. There were type C fractures of which 17 (66.7%) showed excellent to satisfactory results and 3 (10%) had unsatisfactory results. Out of 10 type A fractures, 9 (30%) showed excellent to satisfactory results except one (3.3%) which was a failure. Type C fractures took longer time to unite than Type A fractures. Yeap and Deepak reported four excellent results, four good, two fair and one failure. Yang Teng-Heng, Zhong Zhi-Nian, Kim KJ, Lee SK, Choy WS, Kwon WC, Lee DH, reported mean Neer's score of 74.2 with a range of 58 to 97 of which 3 were excellent, 5 satisfactory and 7 unsatisfactory.

**CONCLUSION:** From our study, we conclude that DF-LCP is a safe and reliable implant. 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). Fixation with locking compression plate showed more effectiveness in severely osteoporotic bones, shorter operative stay, faster recovery, faster union rates and excellent functional outcome compared to alternative procedures in other studies.

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