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Distal femur fracture fixation by LCP- 2 year experience

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Abstract
Distal femur fractures have always posed a therapeutic challenge to orthopaedic surgeons. Different implants and modalities of fixation have been developed over the years for management of these fractures. The aim of this study was to analyze the complications and clinical outcomes following fixation with LCP as the treatment for distal femoral fractures. This is a prospective study in which thirty four (34) consecutives cases of fracture of distal femur, aged 18-70 years, irrespective of sex were subjected to open reduction and internal fixation with locking compression plate and follow up for 2 year. Mean time for fracture union was clinically 16.34 weeks and radiologically 28.64 weeks. At the latest follow up ROM > 110 is noted in 10 patients, 90–110 in 16 patients, and 75–90 in 5 patients and <75 in 3 patients. In our study 10 patients had excellent result, 16 had good, 5 had fair and 3 had poor result according to Pritchett rating system. Locked plating of DF fractures permits stable fixation and early mobilization. However, careful understanding of its basic principles and identification of appropriate fracture pattern for use of LCP are essential to avoid complications of infections and non-union and delayed unions.

Keywords: Distal femur, LCP, Pritchet rating system, fracture

1. Introduction
Fractures of the distal end of femur especially comminuted, intra-articular extension (AO type 33-C3) remain some of the most challenging fractures facing orthopaedic surgeons. These are serious injuries having the potential to produce significant long-term disabilities. Distal femoral fractures reportedly account for less than 1% of all fractures and comprise between 4–6% of all femoral fractures [1, 3]. If fractures of the hip are excluded, 31% of femoral fractures involve the distal portion [4]. There is bimodal distribution of these fractures. Most high energy fractures caused by motor vehicle accidents, sports and pedestrian accidents occurs in male between 15 & 50 years; while in women above 50 years, with osteoporosis, fractures occurs due to low velocity trauma following a ground level fall on a flexed knee [2].
These fractures remain difficult to treat successfully as they are often communitted, unstable, with intra-articularn extension. These are associated with severe soft tissue injury to the quadriceps mechanism and ligament disruption of knee joint. Both articular and extraarticular distal femur fractures require anatomical reduction in order to restore the functional and mechanical axis of the extremity. A stable internal fixation is required in order to start early range of movements to avoid stiffness of knee joint.
Before 1970, the majority of distal femoral fractures were treated conservatively where traction achieved acceptable results but exposed patient to the risk of prolonged bed rest, and immobilization, persistent angulatory deformity, knee joint incongruity and loss of knee motion [4]. These often contribute to a poor outcome [6].
With the development of improved internal fixation devices by the AO group, treatment recommendations began to change. Operative treatment is recommended for most of these fractures. The goal of operative treatment are anatomical reduction, stable internal fixation, early rapid mobilization of adjacent joints, early functional rehabilitation of the knee. Early surgical stabilization facilitate care of the soft tissue, permit early mobility and reduces the complexity of nursing care [7]. Preservation of blood supply facilitase early fracture union several internal fixation options are available such as 95 degree angled blade plate,

condylar buttress plate, dynamic condylar screw with 95 degree side plate, locking compression plate, Less invasive stabilization system (LISS) and ante grade/retrograde intramedullary nails [8]. Understanding the characteristics of distal femoral fractures, the principles and challenges of management are important in optimizing outcomes. There is no consensus on the ideal implant due to variable fracture patterns, comminution, and intra-articular extension in the distal femoral fractures.

The purpose of this study is to evaluate the rate of union, functional outcome and complications with open reduction and internal fixation with a distal femoral locking compression plate.

2. Materials and methods

The study was conducted in the department of Orthopaedics, Veer Surendra Sai Institute of Medical Sciences and Researches (VIMSAR), Burla, Odisha, for a period of two years from January 2015 to December 2016. This is a prospective study in which thirty four (34) consecutives cases of fracture of distal femur, aged 18-70 years, irrespective of sex were subjected to ORIF with locking compression plate fixation after obtaining written informed consent.

2.1 Inclusion criteria

1. The fractures of the distal femoral metaphyseal, metaphysiodiaphysial with or without intraarticular extension.
2. Closed fractures.
3. Age>18 yr

2.2 Exclusion criteria

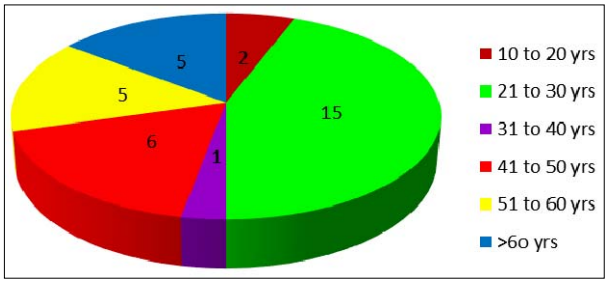
1. Fracture in patients of age <18 years.
2. Any pathological fracture (except due to osteoporosis)
3. Compound fractures
4. Medical comorbid condition

2.3 Surgical technique

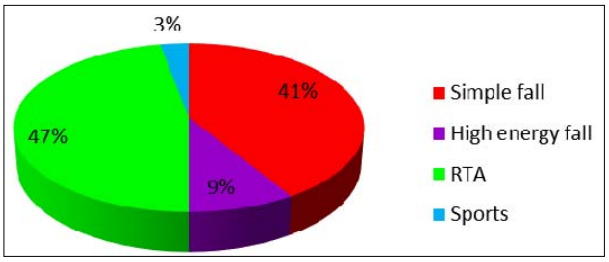
Patients were positioned supine slightly elevating the affected parts with a bolster under the knee. Sand bag was placed posterior to the trochanter to keep the thigh in neutral rotation. Sandbag on lateral position. Skin was prepared with povidone iodine (10%) solution and the part and the operating field from the buttock to the upper calf was draped. Fracture site was approached through a lateral incision. A convenient incision was made over the lateral femoral condyle curving distally to the tibial tuberosity. Iliotibial band incised along the same plane. Vastus lateralis is elevated or split through the rent in the muscle developed due to trauma and lateral arthrotomy performed. Care taken not to injure the lateral collateral ligament. Intercondylar type fractures were converted to a single condylar block under direct vision, temporary fixation was achieved using Krischner wires. We used fixation of fracture with 4.5 mm DF-LCP locking plate. Fracture site reduced under direct visualization using bone holder and manual traction and fixed with 4.5 mm DF-LCP locking plate of adequate length. The intraarticular fracture reduction, plate length, axial and rotational alignment were checked and confirmed using image intensification. Fixation of fracture attained adhering to AO – LCP technique. Per op ROM, stability, alignment and limb length checked and recorded. The wound was closed in layers after attaining haemostasis with suction drain. Pre operative intravenous broad spectrum antibiotic was started and continued the same till 5th day of surgery. The suction drain was removed after 48 hrs and check X-ray (AP/Lat) of the limb was taken. Patients were put on static quadriceps exercises from the next day of surgery. Active assisted and active ROM along with active quadriceps and hamstring strengthening exercises were added from the 5th day of surgery. Sutures were removed on 14 days and patients were allowed non-weight bearing crutch walking for 6 weeks. Patients were followed up at regular intervals clinically and radiologically. Radiological assessment were done according to Schimt criteria. Clinically assessment were done according to Pritchet criteria evaluating pain, stiffness and deformity.

3. Results

A total number of 34 patients were taken up for study. The maximum age of the patient in the present study was 70 years and the minimum being 18 years, with mean age of 31.5 years. The incidence of distal femoral fractures shows male preponderance (Graph-1). 47% of the fractures were because of Road traffic accident, 41% of fractures were because of fall, 9% due to high energy fall and only 3% was due to sports activity.(Graph-2) Road traffic accident constituted the major cause of these fractures in < 50 years of age whereas fall mainly resulted in fractres in >50years of age.

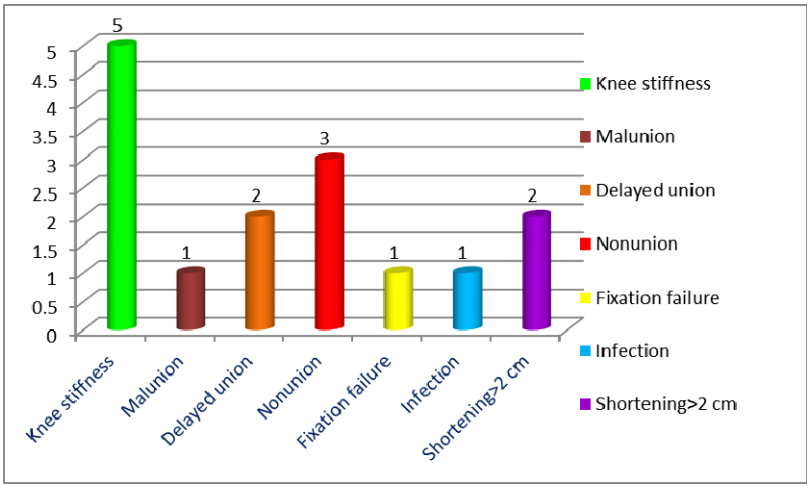


Graph 1: Age Distribution of Patients

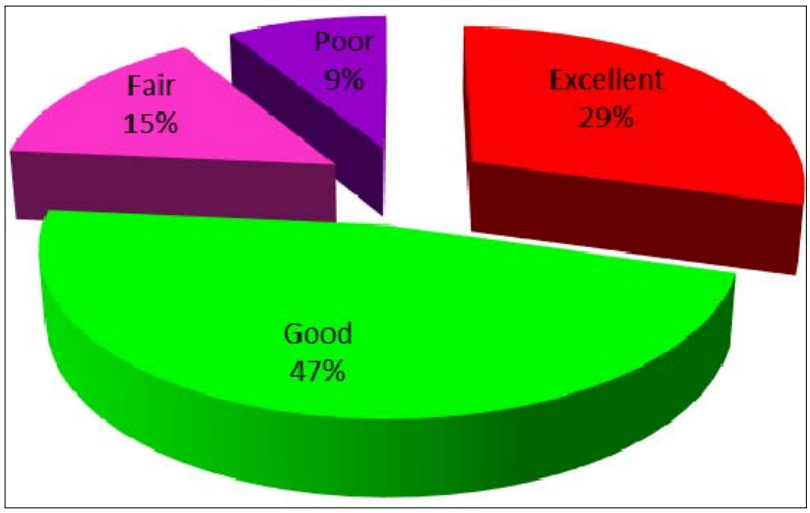


Graph 2: Mode of Injury of the Patients

7 hole plate in 2 (46.6%), 8 hole in 14 (26.6%) and 9 hole in 8 (26.6%) and10 hole plate in 10 patients were used. The mean duration of hospitalisation for all patients was 15days (range, 12 – 20days). Radiological union was considered to be established when there was radiological obliteration of the fracture line with bridging callus using Schmit`s criteria. Radiologically, bridging callus was seen at 12-16 post-operative weeks and the mean time to complete radiological union was 28.64 weeks (range, 22 – 42 weeks). There were no intra-operative and immediate post-operative complications. There were 3 cases (8.8%) of nonunion. One case required autogenous iliac crest bone grafting and the other case required bone grafting along with implant removal and using longer plate due to breakage of proximal screws. One patient required implant removal due to severe restriction of movement and hardware prominence. 2 patients had limb length discrepancy of >2 cm



Graph 3: Complications in our series



Graph 4: Functional outcome in our series

At the latest follow up ROM > 110 is noted in 10 patients(29%), 90–110 in 16 patients(47%), and 75–90 in 5(15%) patients and <75 in 3 patients. In our study 10(29%), patients have excellent result, 16(47%) have good,5(15%) have fair and 3(9%) have poor result.(Graph-4)

Case 1

Case 2

4. Discussion

Minimally invasive plating techniques have been developed for the fixation of distal femoral fractures to maintain the fracture biology and to minimize the soft tissue trauma. The main goals of this techniques is to maintain the important anatomy and vascularity to promote early fracture healing. The LCP is a single beam (fixed angle) construct where 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 as in unlocked plates. It acts as an 'internal fixator', functions by splinting the fracture rather than compression and hence allows a flexible stabilization, avoids stress shielding and induces callus formation [12, 13]. Locking plate systems such as the LISS [15] have been extensively used for distal femoral fractures. LISS has a lower risk of early implant loosening than the dynamic condylar screw and promotes early mobilization and rapid healing without bone grafting with low risk of infection and less blood loss [9]. The LCP differs from the LISS in that the LCP has combination holes and does not have a jig [15] Pain over lateral aspect of the distal femur following fixation with LISS has been attributed to the jig [15]. Previous studies have demonstrated successful early results and relatively low complication rates using minimally invasive plating techniques for the fractures of distal femur [10, 12]. In this study minimally invasive plate fixation technique using standard lateral approach for the fixation of simple intra-articular fractures (C1) has been done. However, more extensive approaches are needed for fixation of complex intra-articular fractures (C2/C3). These fractures requires lateral parapatellar arthrotomy for direct reduction of joint surface. This articular block was fixed to the femoral shaft using indirect plate fixation technique. The recommended screw ratio is 0.4 to 0.5 for bridging fixation with three to four screws on either side of the fracture gap [16, 17]. Ricci recommended at least five screws proximally but required an adequate plate length to maintain screw density below 60% [16]. In our study, these recommendations were followed. More than 82% had three to five proximal screws and only 52% of the proximal holes were filled. This may be the reason why we did not see differences in these parameters for nonunion or hardware failure. As reviewed by Miclau *et al*. Bone grafting rates for supracondylar femur fractures ranged between 0% and 87%. Relatively low rate of bone grafting in our series is probably due to improved surgical technique with better soft tissue handling. Another important complication is infection. Neer *et al* has reported 20% infection rate [10]. M Silisky *et al* reported 5.7% infection. In this study 1 case (3%) devloped infection. Relatively low incidence of deformity may be attributed to improved surgical technique with better understanding of fracture anatomy. Outcome has been previously defined by reduction quality, range of motion, and pain [13-15]. Historically, different classification systems have been utilized. Our study showed 92.8% good flexion according to Cain [15] and 75.7% of the patients had acceptable flexion following the criteria of Kristensen [13]. Utilizing the more strict criteria of Pritchett [14] only 45.9% excellent or good results were achieved. The results of our study suggest that use of standard lateral approach for simple intra-articular distal femoral fractures (C1) and transarticular/minimally invasive techniques for complex intra-articular fractures (C2/C3) results in improved exposure of the knee joint and better union rates with low incidence of bone grafting. However randomized trials are needed to assess this technique.

5. Conclusion

Locking Compression Plate osteosynthesis acts as an extra-medullary load bearing device, stabilizing fracture fragments and ensuring early bony union. The DF-LCP has shown excellent to satisfactory results in majority of intra-articular fractures (AO type C). One of its greatest applications is in osteoporotic fractures where it may provide a solution to the problems of screw pull out, late collapse, and malalignment since the stability of the construct does not entirely depend on the quality of the bone. It also shows shorter post operative stay, faster recovery, faster union rates and excellent functional outcome compared to alternative procedures in other studies The locked plate-screw system produces a rigid screw-bone fixation which prevents malrotation or shortening. Early return of joint functions and weight bearing is easily achieved concurrent with fracture healing. No implant can stabilize every fracture type; however, for best results, the device chosen must provide fixation rigid enough for early motion.

We conclude that this method of fixation is especially suited for fractures where achieving congruence of the articular surface would be difficult with less invasive modalities like retrograde nailing and LISS. With an excellent functional outcome, early clinical and radiological union, it can be done on a routine basis with a minimum of complications. However, careful understanding of its basic principles and identification of appropriate fracture pattern for use of LCP are essential to avoid complications of infections, non union and delayed unions.

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