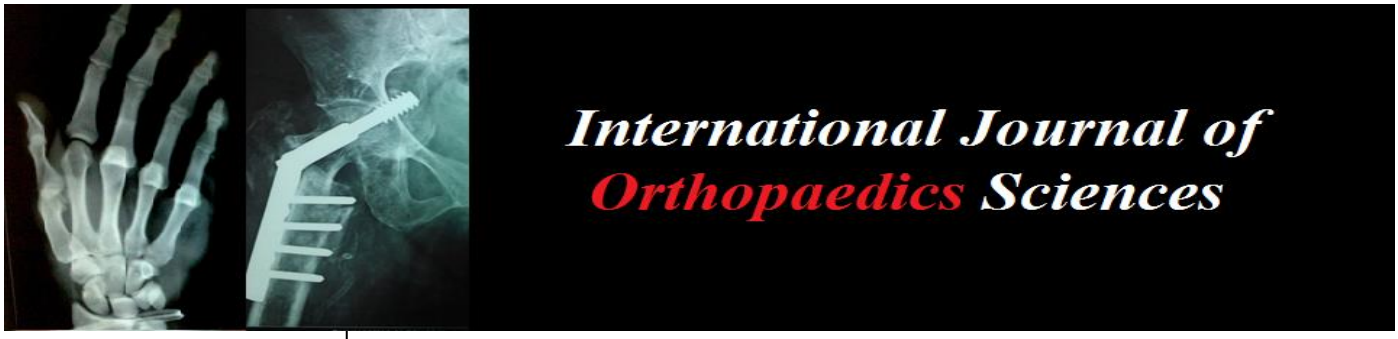

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Clinical results after open reduction and internal fixation in distal femoral fractures with distal femoral locking compression plate (DF-LCP) using swashbuckler approach

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Abstract
Various treatments have been described for the treatment of distal femoral fractures (extra- and intra-articular). We present our experience with locking compression plate in the management of distal femoral fractures at SGT Medical College Hospital and Research Institute, Gurugram. Methods: This study was conducted from May 2015 – January 2019 and included 30 patients of fracture lower end of femur who presented to the department for treatment. Follow up was done for a minimum period of 12 months. All those patients who were above 20 years of age, and were having closed fracture of the distal femur were included in the study. The purpose of this study was to evaluate functional outcome in terms of knee pain, range of knee movements, knee stability, alignment, weight bearing status and union
Results: All the fractures united in the meantime of 17 weeks with two cases of delayed union. The mean operating time was 70 minutes. At the end of follow up period of 12 months, 80% of the patients had excellent results and 20% had good results on evaluation by Knee Society Score.
The use of distal femoral locking compression plate (DF-LCP) in fractures of the distal femur had good functional outcomes with early recovery as it provided early mobilization and rehabilitation.

Keywords: Distal femoral locking compression (DF-LCP) plates, distal femoral fractures, internal fixation, swashbuckler approach

Introduction
Fractures of the distal femur if treated by non-operative methods are reported to have inadequate reduction, loss of weight bearing capacity and mobility while the surgical treatment has been associated with high rates of re-operation for failure of fixation and non-union [1-3]. Improvements in the implant designs have taken place which and the newer implants can effectively stabilize these fractures. The operative treatment now has a significantly reduced the poor results. The locking plate fixation is now considered as standard method of treatment for the fixation of these fractures. The implant (DF-LCP) is stronger than a fixed angle blade plate and can be applied simply [20]
There are different plating techniques for the fractures of the distal femur and they have evolved from 95° blade plate, dynamic condylar plates to pre-contoured LCP with change of design over several generations. [4]
The distal femoral fractures occur at approximately 1/10th of the rate of proximal femoral fractures and make upto 6% of all the femur fractures. [5]
Most high-energy distal femur fractures occur in males between 15-50 years while most low-energy fractures occur in osteoporotic women more than 50 years. [5]
We present our experience with the use of distal femoral locking compression plate in the management of distal femoral fractures.
The goal of this article is to present the implant related problems, discuss their consequences, highlight operative strategies to avoid them and present our results as per Knee Society Score. [8]

Material and Methods

This study was conducted at SGT Medical College Hospital and Research Institute, Gurugram from May 2015 – January 2019. A total of 30 patients having fracture of distal femur were included in the study. These patients were 20 years and above in age. The patients with pathological fractures, open fractures and medical comorbidities were excluded from this study. After admission to the hospital, anteroposterior and lateral radiographs of the affected area were taken and the fractures were classified as per the AO classification system.

Mono-axial, pre-contoured stainless steel distal femoral locking compression (DFLP) plates were used in all the cases.

Pre-operative intravenous Cefuroxime 1.5gm was administered half an hour before the operation in all the cases.

Tourniquet was used in all the cases with pressure of 280-300mmHg.

The Swashbuckler, a modified anterior approach to the distal femur was used. [6] After proper exposure, the fracture was reduced anatomically in coronal and sagittal planes under the guidance of image intensifier. The leg length was maintained by traction. Both direct and indirect methods of reduction were used.

The operation was done with the patient under spinal/epidural anaesthesia on a radiolucent table in a supine position with knee joint in 20^0-30^0 flexion

After the fracture reduction, the plate of appropriate size (6-12 holes) was slid in the distal to proximal direction over the lateral aspect of distal femur (Fig 1).

Fig 1: Per operative picture- reduction of fracture fragment and application of plate

The length of the plate (number of holes) was determined intra-operatively after the reduction of the fracture. A minimum of 4 screws were inserted proximal to the fracture with bi-cortical purchase and distally the plate did not extend beyond the joint line [7]. All proximal screws were bi-cortical and for distal fixation at least 3 distal metaphyseal locking screws were used and these screws did not violate the intercondylar notch. The threaded drill sleeve enabled accurate drilling of the screw holes and therefore proper alignment of the screws (Fig 2).

Fig 2: DF-LCP with drill sleeve

Post-operatively, operated limb was elevated on a splint/pillow with knee in 10-15° of flexion. Active hip and knee mobilization and quadriceps sitting exercises were started on post-operative day 2. A knee brace was applied if the patient had pain.

The brace was usually worn by all the patients till the sutures were removed. Initially the patient remained on partial weight bearing depending upon the radiological evidence of callus formation. The partial weight bearing was allowed on post-operative day 2 with active movements of the knee and quadriceps exercises. Full weight bearing was not permitted till the complete consolidation of fractures. The progress of healing was assessed radiographically at 4 weeks interval upto 24 weeks, then every 3 months upto 1 year. Bony union was defined as bridging callus across the fracture site on both antero-posterior & lateral radiographs and clinically no pain at the fracture site during weight bearing. The clinical and functional outcomes were assessed using Knee Society Scores [8].

Results

We studied 30 patients as per the inclusion criteria mentioned in material and methods. There were 25male and 5 female patients in our study. The age group was as under-

18-30 years (n=13, 43.33%)

31-40 years (n=15, 50%)

Above 40 years (n=2, 6.66%)

The mean age was 30.7 years. The commonest mode of injury was road traffic accidents (n=26, 86.66%), followed by fall (n=4, 13.33%).

The fractures were classified as A2 (n=5, 16.66%), A3 (n=6, 20%), C1 (n=4, 13.33%), C2 (n=10, 33.33%), C3(n=5, 16.66%)

Fig 3: Pre-Operative and Post-Operative X-ray AO-C3

The time interval between injury and surgery was 7 days and the mean operating time was 70 minutes (range- 60-90minutes). All the patients were operated under tourniquet and the tourniquet was released after the fixation and final closure of the wound and all the superficial and deep bleeding vessels were either ligated or cauterized, this helped to prevent the haematoma formation. The mean time for the fracture union was 17 weeks. There were 2 cases of delayed union. No case of deep sepsis was observed in this study however 5 cases (16.66%) developed superficial infection which healed by regular dressing, antibiotics according to culture and senstivity. The range of motion of the knee at the end of the follow up period was 0-120 degree in 73.33% of our patients. (n=22 cases). (Fig 4)

Fig 4: Showing knee flexion/extension

The Knee Society Score [8] evaluated at the end of the follow up period was excellent (80-100) in 80% of the patients and good (70-79) in 20% of the patients.

Discussion

Different types of operative treatments have been described in the literature including condylar plates, dynamic condylar screws, condylar buttress plates, retrograde nails and external fixation [9]. Retrograde intramedullary nail has biomechanical properties suggesting that a multi-planar locked retrograde nail has the greatest stability (compared with locking compression plate and DCS) for Type-A fractures of the distal femoral shaft with stastically higher stiffness and significantly lower micro motion across the fracture gap with axial compression [10]. The good fixation outcomes depend on the bone quality, fracture complexity and surgical techniques. In our experience, a single lateral locked plate can give enough stability even in the presence of comminution and if a DF-LCP is used we do not feel the need for double plating and bone grafting [21].

Fixation with dynamic condylar screw requires at least 4cm of uncomminuted bone in the femoral condyles above the intercondylar notch [11]. This limit its use in the more distal extra-articular fractures. Soft-tissue stripping during conventional plating leads to biologic insult. Metaphyseal comminution and osteoporotic bones may lead to poor outcomes such as non-union, implant failure, malunion and infection [12].

The distal femoral locked nailing involves the opening of the knee joint and is associated with protrusion of the nail into the joint [11] and joint pain [13, 14]. The intraarticular entry could lead to knee stiffness, knee sepsis and patello-femoral pain [11], and is associated with high rate of surgery for the removal of implant [14]. Distal femoral locking plate systems such as less invasive stabilization system(LISS) [15], have been extensively used for the distal femoral fractures [16, 17] LISS has a low risk of early implant loosening than the dynamic condylar screw and promotes early mobilization [18, 19] and rapid healing with low rates of infection [18, 19] with less blood Loss [19].

Non-operative treatment of supracondylar fractures of femur is used only in selected cases by plaster cast or traction where the displacement is minimal or the patient is not fit for surgery as with prolonged illness there is risk of joint stiffness, pressure sores, chest infection and venous thrombosis.

The potential pitfall of this procedure is incorrect placement of the plate in the distal femur which can be in excessive valgus, plate too anterior or posterior, plate too distal, plate is too much flexed, plate is too much extended or the plate is too far from the bone and this should be avoided.

In our opinion, open reduction and fixation by DF-LCP, in skilled hands can achieve normal anatomy of the articular surfaces, allows early ambulation and joint mobilization. We allowed protected weight bearing until the fracture has united.

Conclusion

The DF-LCP is considered as a safe and effective fixation device and showed no early failure rate. There was good to excellent functional outcome even in C3 type distal femur fractures fixed with DF-LCP using swashbuckler approach.

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