CLINICAL STUDY OF LOCKING COMPRESSION PLATE FIXATION IN SUPRACONDYLAR FRACTURES OF FEMUR IN ADULTS

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ABSTRACT

Supracondylar fractures of femur are a challenge to treating surgeon, as they are associated with significant morbidity and complication rates. Internal fixation is the choice of treatment in supracondylar fractures of femur. Complications such as joint stiffness, malunion, delayed union, infection, need for bone grafting, nonunion and early degenerative arthritis occur frequently with these fractures. Internal fixation using Locking Compression Plate (LCP) has given good results in terms of recovery, fracture union, return to work and good functional outcome. Current generation of locking compression plates are precontured to the anatomy of lateral distal femur and forms a stable angular construct when used along with locking screw. We did a prospective clinical study in twenty cases of Supracondylar femoral fractures treated by open reduction and internal fixation with LCP at our institute from July 2008 to August 2010. All were fresh fractures. The median age was 47 years ranging from 28-70 years. 15 of the fractures were caused by road traffic accidents and 3 were due to fall, 2 were due to assault. All fractures were fixed through lateral subvasutus approach using LCP. 14 of 20 fractures (70%) united by 18 weeks. None had nonunion or implant failure. The functional outcome was evaluated using NEER’S Score. Using Neer’s scoring system we had excellent outcome in 65%, good outcome in 15%, fair is 20% and none had poor outcome. ORIF of fractures of lower end of femur using locking compression plate is one of the best modalities of treatment available to treat Supracondylar femoral fractures.

KEY WORDS: Supracondylar Femur Fracture, Locking Compression Plate (LCP), Open Reduction, Internal Fixation, Neer’s Scoring System.
INTRODUCTION

4% - 6% of femoral fractures are supracondylar fractures. With increase in road traffic accidents the incidence of supracondylar fractures of femur also has increased in the young, which are predominantly high energy injuries. Similarly with increase in elderly osteoporotic population there is also increase in supracondylar femoral fractures. These periarticular/Intraarticular fractures pose a great challenge to the treating surgeon especially in presence of comminution, osteoporosis, crushed soft tissue envelop, exposed/lost bone fragments. Higher incidence of complications with conservative treatment and failure of earlier implants instrumentations lead to invention of plate by AO group. Locking compression plate has the advantage of combination of conventional compression plating and locked plating techniques along with unicortical fixation also. Anatomically precontoured build reduces soft tissue problems and with locking heads of screw it gives angular stability and acts as an internal fixator.

Introduction of locking compression plate in treatment of supracondylar femoral fractures reduced many complications as joint stiffness, delayed union, need for bone grafting, malunion, nonunion and infection.

We conducted a prospective clinical study to evaluate the results of locking compression plate in the treatment of supracondylar fractures of femur using an Indian made implant after ethical clearance from the ethical committee of our institute.

Patients who presented to our hospital emergency department were identified by the attending orthopaedic surgeon. The patients were then screened for suitability, and, if they met our study criteria, they were approached for enrolment in the study group and informed consent was obtained for study participation.

Patients included in our study were adults (skeletally mature), Patients who had closed supracondylar fracture & grade 1 compound fractures, with or without comminution, with or without osteoporosis. patients who were not candidates for intramedullary nailing ( both antegrade or retrograde ).

Patients were excluded if they are skeletally immature, if they can be managed by osteosynthesis with intramedullary nailing. Patients with segmental fractures, compound fractures (grade2 &3), Concomitant other fractures in the same limb, fracture tibial plateau. Patients with pathological fracture, delayed presentation, prior osteoarthritis of knee joint, inflammatory arthritis of knee, cancer, renal failure, hemophilia, or a medical contraindication for surgery, head injury and Periprosthetic fracture.
Patients were evaluated and fractures were classified according to AO- Muller’s classification\textsuperscript{26}. Radiographs were supplemented with CT scan if articular comminution was expected. Clearance for surgery was obtained from physician and anesthetist.

**Surgical technique\textsuperscript{26}**

All the surgeries were done within 3 days after admission. Preoperative planning started with help of radiographs; routine AP & LATERAL views. CT scan was used for planning surgery in patients with joint comminution. All the patients were administered prophylactic antibiotic before surgery\textsuperscript{7}. Most of the patients were operated under spinal anesthesia, with or without tourniquet control & under image-intensifier control. Through debridement was done in compound fractures at the earliest\textsuperscript{9}.

Through lateral incision, subvasutus approach, fracture site was exposed. Guide wires were placed before provisional plate placement. Articular congruity was established by reduction of condyles and provisional K- wire fixation followed by either separate lag screw or screw through the plate. Once plate was secured to condyles metaphyseal reduction was done and plate was fixed to shaft. Our technique of metaphyseal reduction relied heavily on the principles of ligamentotaxis with manual traction. Fractures with impacted, depressed, comminuted fragments were reduced, provisionally held with k wires, later replaced with independent compression screws or screws in the plate itself. Plate was applied to condyles under imageintesifier control and fixed to the shaft of femur bypassing the comminution. No bone grafts were used at index surgery. Wounds were closed over suction drain in layers.

Postoperative Management: Quadriceps drill and knee bending was started after drain removal from first post operative day. Non weight bearing / partial weight-bearing was allowed from second / third postoperatively day as tolerated by patient with knee brace. Full weight bearing was allowed only after union noted in at least three cortexes. Patients were evaluated clinically and radiologically in OPD every six weeks from time of discharge until fracture union. After union they were evaluated every six months.

**RESULTS**

In our study 20 distal femoral fractures were treated. All cases were fresh fractures, 13 patients were males and 7 patients were females. The median age was 47 years ranging from 28-70 years. 15 of the fractures were caused by road traffic accidents and 3 were due to fall, 2 were due to assault. Road traffic accident was the major cause of fracture in both young (less
than 50 year) and old (above 50 years) patients. 12 patients were with fracture on right side and 8 on left side. Of the 20 fractures two were Muller’s type A1, two were Muller’s type A2; three were Muller’s type C1; nine were Muller’s type C2 and four were Muller’s type C3. Two patients had associated injuries. Of them, 1 patient had comminuted fracture of patella on same side and 1 had ipsilateral distal radius fracture. 11 of the fractures were grade 1 compound fracture. Two of these developed superficial infection which settled with debridement and antibiotics.

All patients were treated with open reduction and internal fixation. All patients were operated within 3 days. In our study third generation cephalosporin was administered intravenously before commencement of surgery and for 3 days after surgery and converted to oral antibiotics till sutures removal. Compound fractures received intravenous antibiotics up to suture removal. Average time duration of surgery was 101 minutes with shortest duration being 80 min and longest being 130 min. Type C3 fractures accounting for longest surgical time.

The length of plate was selected based on the type of fracture and comminution. A minimum of four fully threaded cancellous screws in condyles distally and a minimum of eight cortical purchases was achieved in proximal fragment. Screw holes opposite the comminution were left unfilled to increase the working length of plate. Of 20 patients, 14 Patients (70%) showed radiological union within 18 weeks. Remaining united by 28 weeks. None had implant failure or nonunion. Average knee flexion was from neutral to 104° with more than 60% patients having knee range of motion from neutral to 110°. Average knee extensor lag was 5 degrees. Out of 20 patients nine had shortening; 8 patients with shortening of 2cm and 1 patient with shortening of 3cm. patient with 3 cm shortening was managed with heel raise. One patients had 15 degree varus malalignment, which was in our initial part of study. This patient refused for any further surgical intervention as it was not causing any hindrance in his daily activity. 2 patients out of eleven type one compound fractures had signs of early post operative infection which settled with redebridement and intravenous antibiotics. All patients were discharged after suture removal and followed up every 6 weeks clinically and radiologically as outpatient. The duration of follow-up ranged from 13 months to 24 months.

Final outcome of the surgical management of fracture lower end of femur using locking compression plate was assessed in terms of regaining the lost knee function using NEER’S Score. According to NEER’S Score 13 patients (65%) showed excellent result.
Patients (15%) showed good outcome, 4 patients (20%) showed fair outcome and none showed poor outcome.

Fig (a,b) Pre-operative radiograph. AO/OTA-type C1 supracondylar fracture femur.

Fig (c,d) Healed fracture with good alignment.

Fig (e,f) Excellent clinical outcome.
LCP have been used extensively for supracondylar femoral fractures with goals of restoring anatomy and function. Locking plates are typically indicated in patients with osteoporosis, fractures with metaphyseal comminution where the medial cortex cannot be restored, or a short articular segment. Several case series have evaluated the use of locked implants in the treatment of distal femur fractures. LCP has many advantages compared to DCS. Several biomechanical studies have compared conventional fixed-angle implants and locking plates in supracondylar fracture models. Marti et al compared the LISS plate with unicoartical locking screws to the dynamic condylar screw and condylar buttress plate in axial loading and cyclic axial loading to failure in a cadaveric 1-cm fracture gap model. The LCP had more reversible and less irreversible deformation when compared to the other two constructs, which they attributed to the titanium composition and the unicoartical screws. Zlowodzki et al compared the LCP plate with unicoartical locking screws to the 95° blade plate in axial, torsional, and cyclic axial loading in a cadaveric 1-cm fracture gap model. Higgins et al in their study concluded that the locking construct had a significantly higher load to failure and less permanent deformation with cyclic loading. Locking plates with unicoartical or bicortical diaphyseal fixation have adequate axial stiffness but more flexibility when compared to conventional fixed-angle implants. Studies have shown that the distal fixation in locked implants is typically maintained while conventional fixed-angle implants have a higher rate of distal cutout from the femoral condyles.

Markmiller et al prospectively compared the outcomes of LCP and retrograde intramedullary nailing. They concluded both implants are equally useful and at 12 months, no statistically significant differences were noted for nonunion, fixation failure, infection and secondary surgical procedures. Vallier et al noted the reduced risk of implant failure with locking plates, they recommended accurate fracture reduction and fixation along with judicious bone grafting, protected weight bearing, and modifications of the implant design.

In our series of 20 patients, 14 Patients (70%) showed radiological union within 18 weeks. Remaining 6 (30%) united by 28 weeks. Which is well documented time taken by these fractures to unite. For normal daily activity knee flexion of 110 degree is required. Average flexion in our study was 104 degree with more than 60% patients having knee range of motion from neutral to 110°. Average knee extensor lag in our study was < 5 degrees.
initiation of knee bending and quadriceps strengthening exercises resulted in good recovery of knee function. Soft tissue management is more important in achieving good outcome \(^1\). At most care is required to avoid deep infection in compound fractures. In our series we had 11 type I compound fractures. These patients were put on third generation cephalosporins from time of admission. Through debridement was done at earliest, before proceeding for internal fixation. Two of these compound fractures developed signs of early post operative infection, which was treated aggressively with Redebribement and continued intravenous antibiotics. In both cases infection settled and proceeded to bony union. Through debridement, proper early antibiotic coverage, early recognition of infection and redebridements prevented deep seated infection in our series.

The average hospital stay for the patients in the present study was 11.3 days, ranging from 9 days to 18 days. The duration of follow-up ranged from 8 months to 22 months. All fractures united in our study without need of bone graft. Non-requirement of bone graft decreases the morbidity associated with donor site. Miclau et al \(^3\) opined that the need for bone graft as 0 to 87% in these fractures. Improved surgical technique, better handling of soft tissue, prevention of distraction at fracture site might have helped fracture union in our series.

In our study, outcome in the form of regaining the lost knee function is assessed using NEER’S Score. We had 65% excellent, 15% good, 20% fair and none had poor outcome, which are well within acceptable limits as shown by many studies \(^1\)-\(^4\),\(^13\)-\(^15\),\(^20\),\(^27\)-\(^28\),\(^32\)-\(^34\).

**CONCLUSION**

Locking compression plate (LCP) is a good fixation system for supracondylar fracture femur. Locking plate provides good angular stability, prevents secondary collapse until fracture healing. It is of great use in elderly patients with severe osteoporotic bone. Open reduction with subvasutus approach there is less soft tissue trauma and less post-operative stiffness. Soft tissue management is more important in achieving good outcome. Through debridement, proper early antibiotic coverage, early recognition of infection and redebridements prevented deep seated infection. Early surgery, and early post-operative knee mobilization are essential for good union and good knee range of motion. Thus, looking compression plate is the optimal implant for supracondylar fractures of femur which has a wide medullary canal, thin cortices and frequently poor bone stock. Surgical exposure for
anatomically contured plate placement requires significantly less periosteal stripping and soft tissue exposure than that of other techniques.

To conclude, Locking Compression Plate is an important implant in the treatment of supracondylar femoral fractures especially when fracture is associated with comminution and osteoporosis.

Further long term studies are required to comment regarding late complications as secondary osteoarthritis in these patients. Small number of patients and exclusion of type 2 &3 compound fractures and short duration of study are few shortcomings of our study.

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