

## STUDY OF FUNCTIONAL OUTCOME OF DISTAL FEMORAL FRACTURES MANAGED WITH LOCKING COMPRESSION PLATE

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### ABSTRACT

#### BACKGROUND

We reviewed a series of 30 displaced supracondylar and intercondylar fractures of the distal end of the femur that were treated over a 2 years period by open reduction and internal fixation using the distal femur LCP. A strict rating scale incorporating subjective data and objective motion of the involved knee was used for the results. At a mean follow-up of 2 years, the results in 8 patients were rated excellent, the results in 12 were rated as good, the results in 4 as fair and the results in 1 as poor. Complications were found in 2 patients (6.66%). Complications included postoperative osteomyelitis in one and superficial infection and wound haematoma in one patient.

#### MATERIALS AND METHODS

In this study, we have included consecutive 30 supracondylar and intercondylar fractures of femur (both Muller's type 'A', type 'B' and type 'C' fractures) and treated with open reduction and internal fixation by locking compression plate in the Department of Orthopaedics, ACSR GMC, Nellore, from August 2015 to November 2017.

#### RESULTS

At a mean follow-up of 2 years, the results in 8 patients were rated excellent, the results in 12 were rated as good, the results in 4 as fair and the results in 1 as poor. Complications were found in 2 patients (6.66%). Complications included postoperative osteomyelitis in one and superficial infection and wound haematoma in one patient.

#### CONCLUSION

The goals of treatment are anatomic reduction of the articular surface, restoration of limb alignment, length and rotation and stable fixation that allows for early mobilisation. Nonetheless, internal fixation of the distal femur can be difficult for several reasons- thin cortices, a wide medullary canal, compromised bone stock and fracture comminution that make stable internal fixation often difficult to achieve.<sup>3,4</sup> Although, better methods of fixation have dramatically improved clinical results, the operative management of these difficult fractures is not uniformly successful. This paper includes detailed study on behaviour of fractures of distal femur after internal fixation and an attempt is made to manage these fractures with early ambulation and least disability. Technique of open reduction and fixation of LCP provides biomechanically stable construct. Several clinical studies have established with LCP as a biologically friendly and technically sound methods of fixation.

#### KEYWORDS

Locking Compression Plate, Supracondylar Fractures, Open Reduction, Intraarticular Fractures.

**HOW TO CITE THIS ARTICLE:** Naidu MC. Study of functional outcome of distal femoral fractures managed with locking compression plate. J. Evid. Based Med. Healthc. 2017; 4(95), 6011-6016. DOI: 10.18410/jebmh/2017/1211

#### BACKGROUND

Prior to 1970, most supracondylar fractures were treated non-operatively; however, angulatory deformities, knee joint incongruity, loss of knee motion, as well as the complications of recumbency led to better methods of treatment.<sup>1,2</sup>

During the past 40 years, operative techniques and implants have dramatically improved and internal fixation is

recommended for most displaced distal femoral fractures in adults.

In the supra and intercondylar fractures of femur particularly with intra-articular extension, patient may develop stiffness of knee, shortening, rotational deformities, internal derangement of knee with instability, varus and valgus deformities, which affect patient's routine lifestyle.

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Although, better methods of fixation have dramatically improved clinical results, the operative management of these difficult fractures is not uniformly successful. This paper includes detailed study on behaviour of fractures of

*Financial or Other, Competing Interest: None.*

*Submission 12-11-2017, Peer Review 20-11-2017,*

*Acceptance 06-12-2017, Published 23-12-2017.*

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*DOI: 10.18410/jebmh/2017/1211*



distal femur after internal fixation and an attempt is made to manage these fractures with early ambulation and least disability.

### MATERIALS AND METHODS

In this study, we have included consecutive 30 supracondylar and intercondylar fractures of femur (both Muller's type 'A', type 'B' and type 'C' fractures) and treated with open reduction and internal fixation by locking compression plate in the Department of Orthopaedics, ACSR GMC, Nellore, from August 2015 to November 2017.

**Inclusion Criteria-** Age- 19-80 years supracondylar fracture with or without intercondylar extensions.

**Exclusion Criteria-** Below 19 and above 80 years. Among them, 5 patients were lost for follow up due to various reasons and leaving 25 fractures from 25 patients.

There are 18 males and 7 females and age ranging from 19 years to 80 years with an average of 44.6 years. Average age for males is 28.9 years and average age for females is 25 years. 18 fractures were due to road traffic accidents and 5 cases are due to fall from varying heights. One case due to bullet injury (classified as Gustilo Anderson type IIIA as it's a high velocity ballistic injury with minimal soft tissue damage).

Among 25 cases, there are 3 compound fractures 12%, and in them, 1 case was type I 33% and 1 case was type II 33%, another case was type IIIA. For classification of open fracture, we have used Gustilo-Anderson classification.

There were no associated ligamentous injuries of knee, but there were ipsilateral fractures of both bones of leg, fracture of humerus and fractures of both bones forearm.

No vascular injuries were noted in this series. All these patients were involved in high energy trauma like road traffic accidents or fall from height and most of the patients came within hours of accidents (maximum was 2 days).

All the patients were immediately admitted and in detail general examination were done for complete assessment like head injuries, spine, chest, abdomen, pelvis and limbs.

In patients with severe blood loss and in hypovolaemic shock, it was corrected with intravenous fluids and blood.<sup>5</sup>

After resuscitation, haemodynamically stable patient was shifted to x-ray department and were taken proper anteroposterior and lateral views of affected limb. With the help of x-ray, diagnosis was made and classified according to Muller's classification.

Limb was placed in Bohler-Braun splint and skin traction or skeletal traction was given with 4-6 kg weight till surgery was planned.

In case of compound fractures, grading was given according to Gustilo's classification and wound was debrided thoroughly and wash was given with saline, hydrogen peroxide, Betadine and if wound was smaller, primary closure was done.

All compound fractures were administered tetanus toxoid injection, combination of antibiotics consisting of cephalosporins, aminoglycosides and metronidazole and this

regimen effectively prevented infection. For simple fractures, antibiotic regimen was started 12 hours before surgery parenterally and continued till third postoperative day from then till tenth to fifteenth postoperative day. Oral antibiotics were given.

Patient was kept in postoperative ward for first 48 hours and then shifted to respective general ward. On second postoperative day, wound was dressed and drain was removed. Postoperative chest x-ray was taken.<sup>6</sup>

Assisted quadriceps exercises were started from first postoperative day and knee range of motion was started on second postoperative day. Suture removal was done on tenth postoperative day and patient was discharged with advice of strict non-weightbearing and active quadriceps exercises and knee range of motion exercises. Follow up was 3 weekly until time of radiological union and 3 monthly till the end of follow up.

During the follow up, patients were received in outpatient department once in every 3 weeks and fracture union was clinically and radiologically. Full weightbearing was allowed at the end of third, fourth or fifth month after confirming the clinical and radiological union of the fracture.

For functional evaluation of the results, we have taken the criteria of two functional scoring systems, which were used by previous workers.

1. Neer's functional scoring system.
2. Sanders functional evaluation scale.

The scoring system described by Neer's et al gives points for pain, function capability for work, gross anatomy and radiographic appearance. This system was developed specifically for the evaluation of fractures of the femur.

The Sanders evaluation scale assessed ROM, pain walking ability, return to work, previous level of activity and ligament and shortening as measured on radiographs. A. Malunion was defined as greater than 5 degrees varus, valgus, recurvatum, procurvatum or shortening greater than 2 cm. Supine position knee flexed 300; B. Lateral/anterolateral approach to the distal femur; C. Skin incision; D. Division of the iliotibial band; E. Elevation of vastus lateralis; F. Correction of hyperextension deformity; G. Position of LCP 5, 6 on the lateral femoral cortex; H. Distal screws insertion; I. Less invasive stabilisation system.<sup>7,8,9</sup>

### Surgical Technique of LCP for Distal Femoral Fractures



**Figure 1. Skin Incision**



**Figure 2. Vastus Lateralis Muscle Incised**



**Figure 3. Pillow below the Knee Joint Neutralises the Gastrocnemius Muscle Action**



**Figure 4. Locking Plate Fixation**

## OBSERVATIONS AND RESULTS

**Observations-** Total numbers of cases treated in the Department of Orthopaedics, King George Hospital from August 2014 to September 2016 were 30. Among them, 25 fractures from 25 cases were followed up till union occurred. All cases were unilateral.

There were no associated vascular injuries.

**Type of Injury-** 18 fractures were due to high velocity road traffic accidents in the form of direct collision of vehicles or fall from moving vehicles or hitting to stationary objects like trees. Six cases were due to fall from various heights like tree and steps. One case was due to bullet injury.

**Type of Fractures-** According to Muller's classification, there were 6 cases of A1 type (24%), 5 cases were A2 type (20%), 3 cases were A3 type (12%), 4 cases were C1 type (16%), C2 type cases were 2 (8%), type C3 1 case (4%), type B1 was 1 case (4%), and type B2 were 3 cases (12%). In brief, type 'A' 56%, type 'B' 16% and 'C' were 28%.

Among 25 cases, there were 3 cases of compound fractures of various grades (12%). There were 2 cases of Gustilo's type 1 (8%) and 1 case of type IIIA (5%), compound fracture 15 cases were in right femur (60%) and 10 cases were in left femur (40%).

Age incidence- 6 cases were in 20-30 group (24%). Among them, 1 was a female and 5 were males. Nine cases were between 31-45 years (36%) among which 3 were females and 6 were males. Six cases were in 46-60 years (24%), 5 were males and 1 was a female. Four cases were above 60 years, among which, 3 were females and 1 was a male.

**Time for Healing-** All cases showed radiological and clinical union between 12 weeks to 24 weeks. Muller's A1 type fractures took an average time of 14.7 weeks, maximum of 16 weeks, and minimum of 14 weeks; A2 type fractures took an average of 17.6 weeks, maximum of 24 weeks, and minimum of 18 weeks; and A3 type fractures took average 17 weeks, maximum of 18 weeks, and minimum of 15 weeks for healing. One case of B1 healed by 12 weeks, 3 cases of B2 healed by 13.4 weeks with maximum of 14 weeks, and minimum of 12 weeks C1 fractures took 15.5 weeks with minimum of 14 weeks and maximum of 18 weeks, C2 type fractures took average time of 17 weeks, maximum of 18 weeks and minimum of 16 weeks and for C3 type fractures have taken time of 18 weeks.<sup>7,8</sup>

An average total 'A' type fractures has taken 17.43 weeks for healing (14 out of 25), Muller's type B fractures took 12.7 weeks (4 out of 25) and Muller's 'C' type fractures has taken 16.24 weeks of average time (7 of 20 cases) and 25 cases has taken average time of 15.7 weeks for healing. Range is 12 weeks to 24 weeks.

According to age group, 20-30 age group took 15.7 weeks for average healing (maximum of 24 weeks and minimum of 12 weeks), 31-45 age group took 13.7 weeks (maximum 24 weeks and minimum 14 weeks), 46-60 age group took 15.6 weeks (maximum 22 and minimum 14) weeks and above 60 years took 16.2 weeks for radiological union.

**Infection-** In one case of Muller's C2 fracture fixed with locking compression plate, superficial infection was noticed. The infection was controlled with appropriate antibiotic and daily dressings. Delayed union was noticed.

Longest follow up case was 24 months and least follow up was 5 months. According to fracture type and knee ROM- 12 cases of 'A' type fractures average knee ROM achieved was 105.7 degrees, 4 cases of 'B' achieved 95 degrees and for 7 cases of 'C' achieved 95 degrees and total average for this study was 92.60.

According to individual type of fracture- For 6 A1 type fracture, average knee ROM is 1040 (maximum 1200 and minimum 900); for 5 A2 type fractures, it is 96.250 (maximum 1100 and minimum 800); for 4 A3 type fractures, it is 950 (maximum 1000 and minimum 900); for 4 C1 type fracture, average ROM is 96.250 (maximum 1000 and minimum 950); for type B1, ROM achieved is 110 degrees; type B2, ROM achieved 96.7 degrees; for C2 type fractures, average ROM is 92.50 (maximum 800 and minimum 800); and for C3 type fracture, ROM is 90 degrees.

Average time of partial weightbearing is 8.24 weeks and full weightbearing is 15.5 weeks.

Cases which were treated with locking compression plate average partial weightbearing allowed at 7.2 weeks and full weightbearing was allowed at 14.8 weeks.<sup>9</sup>

In 8 cases, there is a shortening of less than 1 cm. In one case has 50 of varus angulation noticed.

In 14 cases, out of 25 patients had pain-free knee joint, and except in 1 patient, all have normal gait. In only 2 patients, walking was painful after 30 minutes.

Out of 25 patients, 18 returned to their preinjury job, 5 patients had returned to their job with mild difficulty, 2 patients lost their employment. Regarding stair climbing, 19 patients had free stair climbing and 4 patients hold the side rails while climbing and two patients can climb the steps with one step with each attempt.

According to the fracture type and average time of partial weightbearing and full weightbearing- 6 cases of type 'A1' fractures has taken average partial weightbearing of 6.5 weeks and 12.5 weeks for full weightbearing. Of the type 'A2' fractures, average partial weightbearing at 6 weeks and full weightbearing at 13.5 weeks. In 'A3' fractures, average partial weightbearing time of 8 weeks and 13.9 weeks for full weightbearing.

In type B fractures, B1 took 6 weeks for partial weightbearing and 12 weeks for full weightbearing, and B2 fractures took 6.5 weeks for partial weightbearing and 12 weeks for full weightbearing.

In type C1 fractures, partial weightbearing started at 7.5 weeks and full weightbearing at 15 weeks. In 2 type C2 fractures, partial weightbearing has taken 7 weeks and 15.3 weeks for full weightbearing. In type C3 fractures, 1 fracture has taken 16 weeks for partial weightbearing and 17 weeks for full weightbearing.

For 25 cases, average full weightbearing has taken 13.5 weeks. The average time gap between date of injury and date of surgery is 7.33 days. For functional evaluation, we have followed both Neer's and Sanders scoring system. With locking compression plate using Neer's criteria, there were 8 excellent results (32%), 12 good results (48%), 4 fair (16%) results, and 1 poor (4%). Sander's showed 7 excellent (28%), 11 good result (44%), 6 fair (24%) results and 1 poor result (4%).

Fracture Type	Number of Cases	Average Time of Healing (in Weeks)	Minimum	Maximum
A1	6	14.7	14	16
A2	5	17.6	14	24
A3	3	17	15	18
B1	1	12	-	-
B2	3	13.4	12	14
C1	4	15.5	14	18
C2	2	17	16	18
C3	1	18	-	-

**Table 1. Average Time of Healing Different Type of Fractures**

Criteria	Excellent	Good	Fair	Poor
Neer's	8	12	4	1
Sander's	7	11	6	1

**Table 2. Results**

**DISCUSSION**

In the present study, 25 patients with distal femur fractures treated with open reduction and internal fixation with locking compression plate. Its behavior, results and functional outcome evaluated.

There are 18 males and 7 females in this study. There are 2 compound fractures including one grade I and one grade IIIA type fractures. The locking compression makes accurate reduction and fixation easier particularly when the fractures are intra-articular. The locking screws holds better even in osteoporotic bone.

In a previous study by Rancho et al, the following complications were observed with internal fixation of supracondylar and intercondylar fracture of femur. Firstly, supracondylar fracture tends to collapse in varus. During the

application of cortical screw, the shaft of the femur pulled often laterally displacing the line of weightbearing lateral to anatomic axis of the condyles. This creates an abnormal mechanics at the fracture site that causes the distal fragment to displace into varus. Secondly, the presence of osteoporotic bone in the distal femur, which is very common in elderly population, especially in females who suffer this fracture frequently lead to fixation failure with conventional screws and plates cutting out a soft bone.

All fractures in the study united by maximum 24 weeks, average of 19 weeks (range 12-24 weeks).

In the present series, there are a total of 25 cases with 18 males and 7 females. There are 6 'A1' type (Muller's), 5 'A2' type, 3 'A3' type, 1 'B1' type, 3 'B2' type, 4 'C1' type, 2 'C2' type and 1 'C1' type cases. Among them, 2 were compound fractures.

In fractures with intra-articular comminution, additional cancellous screws and Kirschner wires were used. In one case with large metaphyseal butterfly fragment, interfragmentary screws were used.



According to Neer's functional scoring system, excellent-to-good results were achieved in 84% of cases and fair-to-poor results in 16% of cases. Similar results were achieved with Sanders functional scoring system.

In our study, there are no cases of nonunion. We have done primary bone grafting in one case of A3 type. In one case, superficial infection was present, which was treated effectively with antibiotics.

Several rating systems for supracondylar and intercondylar fractures of femur were reported in literature. The evaluation score developed by Sander et al and Neer et al are chosen because they emphasise on the most important patient outcome factors like pain and ROM knee. The confounding variable in the present study was the pre-existing arthritic condition of knee joint in one cases. This can lead to lower scores despite regaining preinjury knee function.

In our study, there are 8 excellent results, 12 good results, 4 fair results and 1 poor were results obtained (as per Neer's et al and Sanders et al functional scoring systems). Regarding the poor result in 2 cases, which had good union, the patient is not regular to follow up and developed knee stiffness due to lack of physiotherapy, other was a compound fracture bullet injury, so it took long time for rehabilitation.

Average ROM in our study in 97.28°, for type 'A' fractures 97.3°, for type B fractures 95°, and type 'C' fractures 90.3°. This indicates knee ROM is better in extra-articular fractures than intra-articular fractures. In 8 cases, there is shortening less than 1.5 cm, and in 1 case, there is 5° of varus angulation. There is only one superficial infection in our series that was controlled with good wound care and antibiotics. In our study, average knee ROM is 97.28° and range is 50°-120°.

Out of 20 cases, 8 healed with shortening of less than 1.5 cm and 1 case healed with a varus angulation of 5°, but did not influence the final outcome score.

There are no cases with instability of knee in our series. All incisions healed well. There were no implant failures in the study.

The result in this series presented here indicates the values of stable internal fixation and anatomical reconstruction of the distal end of the femur. There by providing the requirements for practically normal articular mobility and reducing the risks of post-traumatic arthritis due to incongruity of articular surfaces. Postoperative infection may be disastrous, but if it is dealt with rapidly and adequately, it should be controlled until bone healing has occurred.

Optimal operative treatment of supracondylar and intercondylar fracture of femur should provide rigid internal fixation for immediate ROM and should minimise soft tissue dissection to enhance bone healing.

Result of this study suggests that locking compression plate is the optimal tool for many supracondylar and intercondylar fractures of femur. As they provide rigid internal fixation in a region of the femur where there is a wide canal, thin cortices and frequently poor bone stock in

elderly osteoporotic patients makes fixation difficult. It also decreases the need for bone grafting in severely comminuted fractures.

In open supracondylar and intercondylar fractures of femur studies indicate that the functional outcome is largely determined by the degree of accompanying soft tissue injury. The presence of an open fracture leads to a higher incidence of infection, but in the presence of good preoperative antibiotics and sterile surgical techniques and stable fixation, infection can be brought under control and a good outcome achieved.

Locking compression plate still holds as a good device in fractures with intraarticular extension and also where there is sagittal extension of fractures and no entry point for fixed angle devices in too distal fractures when other systems fail as in the case of any intraarticular fractures like C1, C2, C3 especially. Partial weightbearing is not allowed until fracture union is seen on radiographs since there is tendency for varus collapse. In present study, no varus collapse occurred significantly.

The 'C3' type fracture, an articular multifragmentary fracture, particularly if severely comminuted and displaced has a much worse prognosis than the simple complete articular fractures.

The presence of osteoarthritis is not a contraindication to internal fixation of these fractures as shown in case 12 in spite of pre-existing osteoarthritis, good result was achieved.

LCP along with isolated 6.5 mm cannulated cancellous screw system are best suited for with unicondylar fractures of distal femur in young patient with good bone stock. Results are excellent and 50% comparable with Manfredi et al study.

Because of improved imaging facilities, results are far better than those treated with long periods of traction on bed with accompanying complications.

Overall, results are comparable with review on study of distal femoral fractures by Forster MC, Komarsamy B, Davison.

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