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Original Research Article

Study of functional outcome of muller type C distal femur fracture treated with locking compression plate

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ABSTRACT

Background: To evaluate the functional outcome of Muller type C distal femur fracture treated with locking compression plate (LCP).
Methods: This prospective study was carried out at Al-Ameen medical college and hospital, Vijayapura. Forty patients (24 males and 16 females) with Muller type C distal femur fractures were enrolled in our study. Patients were treated with open reduction and internal fixation with LCP. They were followed up for 9 months with clinical examination and serial x-rays. The functional outcome was evaluated using Neer's scoring system.
Results: Forty patients who completed follow up of 9 months were included. There were 18 muller type C1, 14 muller type C2 and 8 Muller type C3 fractures. The functional evaluation with Neer's scoring system was excellent in 8 patients, good in 20 patients, fair in 8 patients and poor in 4 patients. Complications observed were difficulty in reduction, superficial infections, knee stiffness and limb length discrepancy.
Conclusions: The LCP is a safe and effective tool to manage these difficult fractures as we had no incidence of implant failure, delayed union, non-union and revision surgery except that we had knee stiffness as commonest complication which can be tackled by early surgery, surgical expertise, meticulous soft tissue handling and vigorous early knee mobilisation.

Keywords: Distal femur fracture, LCP, Knee range of movement, Neer's scoring system, Muller classification

INTRODUCTION

The incidence of distal femur fractures is around 37/1,00,000 patients per year.[1] Intra-articular distal femoral fracture makes up to 6% of all femur fractures and present a huge surgical challenge. Two different mechanisms are responsible for such trauma, where high energy (RTA) is seen commonly in young adults and low energy or trivial trauma in osteoporotic population mainly in elderly woman. Pain, decreased range of motion and compromised function of the knee joint is a common problem arising out of articular incongruity and improper fixation of articular fragments in such fractures.[2] In elderly patients, extreme osteoporosis also creates a hurdle for anchoring the implant.[3]

During the past 30 years, operative techniques and implants have dramatically improved, and internal fixation been recommended for most displaced distal femoral fractures in adults. Though good internal fixation results have already been reported with these fractures over 30 years ago; the number of revisions for non-union, implant failure and loss of reduction is also high.[3] The operative interventions available are conventional plating techniques that require compression of the implant to the femoral shaft (blade plate, dynamic condylar screw, non-locking condylar buttress plate), antegrade nailing fixation, retrograde nailing, sub muscular locked internal fixation, and external fixation.[4]

The main therapeutic principle for management of intraarticular fracture is anatomical reduction, minimal

soft tissue dissection, stable internal fixation and early mobilisation. LCP has advantage of combination of compression plating, locked plating and bridge plating.[5,6] The principle of the LCP is to have rigid fixation close to bone and under soft tissue envelope which can be applied without stripping periosteum which is very much essential for fracture healing. Screw and plate in LCP will act as single beam construct, which gives biomechanical advantage in osteoporotic patients. Internal fixation with locking plates creates toggle free, fixed angle construct.[7] The introduction of plates with the option of locked screws has provided the means to increase the rigidity of fixation in osteoporotic bone/in presence of periarticular/juxta-articular fractures with small epiphyseal segment.[7] Implant offers multiple points of fixed-angle contact between plate and screws in distal part of femur, theoretically reducing the tendency for varus collapse that is seen with traditional lateral plates.[7] DF-LCP is further development from LISS which was introduced in the mid to late 1990's. The main difference between the DF-LCP and the LISS is that the LISS utilizes outrigger device for shaft holes, functioning essentially as a locking guide jig, which is attached to the distal part of the plate and guides the placement of the proximal locking screws. Shaft holes on DF-LCP are oval allowing for the options of a compression screw/ locking screw. This leads to more precise placement of plate, as it is able to be compressed more closely to the bone.[3,8]

The ideal treatment method for distal femur fracture is still debatable. Double plating, and more recently, locked plating techniques have been advocated. However, double plating results in extensive soft tissue and periosteal stripping on both sides of the femur, resulting in decreased blood supply and increased chances of non-union and failure of the implants.[3,9,10] But recent studies have shown good functional results with surgical treatment of intraarticular distal femur fracture treated with LCP. The present study is undertaken to assess the functional outcome of internal fixation of muller type C distal femur fracture managed surgically by LCP.

METHODS

This prospective study was carried out at Al-Ameen medical college and hospital, Vijayapura from August 2020 to October 2022. Forty patients (24 males and 16 females) with Muller type C distal femur fractures were enrolled in our study. Patient were treated with open reduction and internal fixation with LCP. They were followed up for 9 months with clinical examination and serial x-rays. Data regarding intraoperative findings, complications, time for union, functional outcome and post-operative complications were collected. Functional outcome was evaluated using Neer's scoring system.

Inclusion criteria

Patients with age >18 years, Muller type C distal femur fractures, closed fractures and grade I open fractures were included in study.[11,12]

Exclusion criteria

Patients with age <18 years. Muller type A and B distal femur fractures. Patients managed conservatively for other medical reasons, distal femoral fracture associated with tibial plateau fractures and grade II and III open fractures were excluded.

Surgical techniques

Patients were placed in supine position on operating table slightly elevating affected side with sandbag under ipsilateral hip. Knee is placed in 30^0 of flexion. Skin at operating site was prepared by povidone iodine (10% w/v) solution and spirit and operating field from buttock to knee was draped. We have used lateral approach for C1 type and Swashbuckler approach for C2, C3 type of intra articular distal femoral fracture. In Swashbuckler approach midline incision from above fracture laterally across patella. Fascia overlying quadriceps is incised longitudinally in line with skin incision. Lateral para-patellar arthrotomy is performed. Proximally arthrotomy incision is made between vastus lateralis muscle and lateral retinaculum of knee. Proximal release of vastus lateralis fibers from lateral intermuscular septum allow further mobilization of quadriceps. Anatomical reduction of articular surface done and provisionally stabilized them with k-wires.

Proper size of plate selected. After proper placement of plate place the fixation screws in accordance with the biomechanical principal of fixation, insert minimum 5 screws including lag screws and locking head screws in distal fragment and minimum 4 screws in proximal femoral segment.

Whenever severe comminution primary bone grafting was done.

We closed joint capsule arthrotomy with absorbable suture. Fascia of vastus lateralis and iliotibial band and subcutaneous tissue closed with absorbable suture. The skin wounds were closed over a negative suction drain after thorough washing with copious amount of sterile saline solution and sterile dressings applied over the limb.

Depending upon fixation and the bone quality, immediate post-op knee range of motion (ROM) was started. Patients are asked to come every month for follow up till fracture union. Patient was kept non-weight bearing for 12 weeks. Partial to full weight bearing started at 16-24 weeks.

NEER'S score is used as criteria for evaluation of patients.

Data were analysed using SPSS software v.23 (IBM statistics, Chicago, USA) and Microsoft office 2007.

Ethical approval

The study was approved by the institutional ethical committee.

RESULTS

In the present study, forty cases of fractures of distal end of femur treated with LCP and screws between August 2020 to October 2022 at AL-Ameen medical college hospital, Vijayapura were included.

Our study consisted of simple and compound fractures of which 29 cases (72.5%) were simple fractures and 11 cases (27.5%) were compound fractures. The mean age was 51 years (Table 1) of which 30 patients were due to RTA and 10 patients were due to self-fall. There was a male predominance of 24 patients (60%) and females were 16 patients (40%) (Table 2). The injured limb in most of the patients in our study was right side in 18 cases (45%) and left side was in 22 cases (55%).

In our study, according to mullers classification 18 patients of C1 type, 14 patients were C2 and 8 patients were C3 type (Table 3). The mean duration between admission and time of surgery was 4.4 days. The functional outcome in our study in regards to the range of movements was 107.5 degree±12.92 at 24 weeks since mobilization was started as early as 2nd postoperative day.

All of the cases in our study united with a mean of 5.75 months. Most of cases united by 6 months in 30 patients (75%), by 5 months in 10 patients (25%) (Table 4).

In our study complications like knee stiffness was seen in 14 patients (35%), superficial infection in 4 patients (10%), wound gaping in 2 patient (5%) and limb length discrepancy in 4 patients which is less than 1.5 cm (10%) (Table 5).

The outcome in our study was excellent in 8 cases (20%), good in 20 cases (50%), fair in 8 cases (20%) and poor in 4 case (10%) (Figure 1).

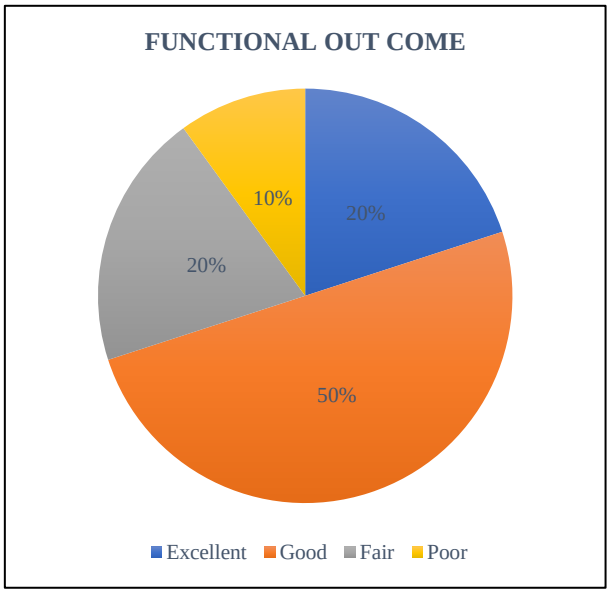

Figure 1: Functional outcome.

Age incidence

In our study the mean age group was 51 years.

Table 1: Age incidence.

Age (in years)	No. of patients	Percentages (%)
20-30	2	5.0
31-40	6	15.0
41-50	8	20.0
51-60	18	45.0
61-70	6	15.0
Total	40	100.0

Mean±SD: 50.95±11.11

Gender distribution of patients

In our study male patients were 24 and female patients were 16.

Table 2: Gender distribution.

Gender	No. of patients	Percentages (%)
Female	16	40
Male	24	60
Total	40	100

Diagnosis in patients (according to Muller's classification for distal end of femur fractures)

Table 3: Type of fracture.

Diagnosis	No. of patients	Percentages (%)
C1	18	45
C2	14	35
C3	8	200
Total	40	100

Time of complete union

In our study, most of the cases united with a mean value of 5.75±0.44 months.

Table 4: Time for complete reunion.

Time of complete union	No. of patients	Percentages (%)
5 months	10	25
6 months	30	75
Total	40	100

Mean±SD: 5.75±0.44

Complications

In our study, knee stiffness was present in fourteen cases, superficial infection in 4 cases, wound gaping in the two case.

Table 5: Complications.

Complications	N	Percentages (%)
Non-union	0	0.0
Superficial infections	4	10.0
Wound gaping	2	5.0
Knee stiffness	14	35.0
Limb length discrepancy	4	10.0

Functional outcome

The outcome in our study was excellent in 8 cases, good in 20 cases, fair in 8 cases and poor in 4 cases.

Case 1

A 43-year old male presented with an AO/OTA-type C2 distal femur fracture (A) and (B); the fracture was treated with distal femoral locking plate. The fracture healed with good alignment (C) and (D) with satisfactory knee movements (E) and (F).

Figure 2: (A and B) shows pre-operative and post-operative X-rays; (C and D) 6 months and 9 months X-rays; and (E and F) Shows clinical pictures at 9 months.

Case 2

A 60-year old male presented with an AO/OTA-type C3 distal femur fracture (A) and (B); the fracture was treated with distal femoral locking plate. The fracture healed with good alignment.

Figure 3 (A and B): Pre-operative CT 3D reconstruction and post-operative X-ray.

DISCUSSION

Various modalities used for the treatment of distal end femoral fracture ranges from conventional plates, dynamic condylar screw to intramedullary nailing. All these various treatment modalities have problems like loss of reduction, excessive soft tissue stripping and violation of joint, joint stiffness, non-union, malunion, implant failure, mal-alignment or infections etc, due to the fact that these require excessive stripping to achieve accurate anatomical reduction and prolonged immobilization due to compromised stability. Distal femoral LCP overcomes both the drawbacks of excessive stripping as it can be done via minimally invasive methods and a fixed locking construct provide stable relative stability which can enhance early joint mobilization and thus prevents these complications, leading to good to excellent functional outcome.

The fractures of the intraarticular distal end of femur were managed surgically by LCP in our institute, which was a study of 40 cases and patients were followed up for a period of 9 months. The functional outcome was assessed by NEER'S scoring system in our study.

Our study consisted of simple and compound fractures of which 29 cases (72.5%) were simple fractures and 11 cases

(27.5%) were compound fractures. The mean age was 51 years of which 30 patients were due to RTA and 10 patients were due to self-fall. There was a male predominance of 24 patients (60%) and females were 16 patients (40%). The injured limb in most of the patients in our study was right side in 18 cases (45%) and left side was in 22 cases (55%).

In our study, according to mullers classification 18 patients of C1 type, 14 patients were C2 and 8 patients were C3 type. The mean duration between admission and time of surgery was 4.4 days. The functional outcome in our study in regards to the range of movements was 107.5 degree ± 12.92 at 24 weeks since mobilization was started as early as 2nd postoperative day. This is in comparison with Kregor et al of 103 cases, was followed up for 14 months, with a knee range of motion of 1 to 109 degrees and in comparison, with Schutz et al study of 99 patients, was followed up for 13.7 months, with a knee range of motion of 0 to 107 degrees.[13,14]

All of the cases in our study united with a mean of 5.75 months. Most of the cases united by 6 months in 30 patients (75%), by 5 months in 10 patients (25%).

In our study complications like knee stiffness was seen in 14 patients (35%), superficial infection in 4 patients (10%), wound gaping in 2 patient (5%) and limb length discrepancy in 4 patients which is less than 1.5 cm (10%).

The outcome in our study was excellent in 8 cases (20%), good in 20 cases (50%), fair in 8 cases (20%) and poor in 4 case (10%). The mean functional outcome assessed by Neers scoring system was 75.4 this is in comparison with Yeap and Deepak et al with functional outcome score of 72.7 and Apostolou et al with functional outcome score of 81.25.[15,16] We had 70% good to excellent outcome as per Neer's scoring system. However, large study sample and long term follow up needed for accurate analysis of functional outcome.

CONCLUSION

LCP is ideal to prevent metaphyseal collapse and to maintain limb length in severely comminuted fractures. This technique has a lesser chance of complications like plate or screw breakage, but careful selection of patients and strict adherence to the basic principles of fracture fixation will go a long way in reducing the complications of fracture fixation. The LCP for intra-articular distal femur fracture is a safe and effective tool to manage these difficult fractures as we had no incidence of implant failure and delayed union and non-union and revision surgery except that we had knee stiffness as commonest complication which can be tackled by taking the patients for surgery as soon as possible and surgical expertise, meticulous soft tissue handling and vigorous early knee mobilisation.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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