

OUTCOME OF FRACTURE OF INTRAARTICULAR DISTAL FEMUR TREATED WITH DISTAL FEMUR LOCKING COMPRESSION PLATE

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ABSTRACT

BACKGROUND

The most challenging fractures faced by orthopaedic surgeons are the distal fractures of femur, especially the intraarticular distal femoral fractures. These fractures have been classified according to Orthopaedic Trauma Association (OTA) 33-C3. Distal femoral fractures account to 4-7% of all femoral fractures and are less common compared to hip fractures.

The aim of the study is to study the functional outcome of fracture of intraarticular distal femur treated with distal femur locking compression plate.

MATERIALS AND METHODS

This study is a prospective study, which comprised of 30 patients of intraarticular distal femur fracture AO classification 33-C3 who were treated by locking compression plate at Jorhat Medical College and Hospital, Jorhat, Assam. This study was conducted during February 2015 to April 2017. The functional outcome was studied using Neer's score, outcome of radiology and complication with fracture fixation using LCP.

RESULTS

Out of 30 patients, 22 were males (73.3%) and 8 were females (26.7%). 18 patients had fracture right hand side and 12 patients had left-handed fractures. A 19 years old was the youngest patient and 72 years was the oldest patient. About 70% patients had sustained road traffic accidents and 10% had sustained fall from a height. Four days was the average trauma to operative interval, 22 patients were operated extensile lateral approach and 8 patients were operated by swashbuckler approach. 12 weeks was the average weightbearing duration, 21 weeks was average time for fracture healing. 10 patients had C1 (33.3%), 12 patients had C2 (40%) and 8 patients had C3 (26.7%) type of fracture according to AO classification. Among 30 patients, 13 patients have shown excellent results, 7 patients have good results, 5 fair results and 5 poor results. Primary bone grafting was done in 4 patients for severely comminuted type C3 fracture. Secondary bone grafting was done in 2 patients who had delayed union at 4 month, 1 patient showed sign of union on 9th month, 1 patient showed nonunion treated with secondary bone grafting at 9th month with signs of union at 12 months. Two patients developed infection on 4th postoperative day, which was resolved with antibiotics. Four patients developed knee stiffness.

CONCLUSION

The locking compression plates with option of locked screws has provided the means to increase the rigidity of fixation in intraarticular distal femoral fractures. Better functional outcome was achieved using locking compression plate for intraarticular distal femoral fractures with proper physiotherapy.

KEYWORDS

Intraarticular Fracture, Distal Femur, Locking Compression Plate.

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BACKGROUND

The most challenging fractures faced by orthopaedic surgeons are the distal fractures of femur, especially the intraarticular distal femoral fractures. These fractures have been classified according to Orthopaedic Trauma Association

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(OTA) 33-C3.¹ Distal femoral fractures account to 4-7% of all femoral fractures and are less common compared to hip fractures. During recent decades, the incidence of distal femoral fractures has significantly increased. The incidence of femoral distal fractures is more in women when compared to men, older than 70 years, and in adolescent boys, and in men of age 15 to 24 years. In femoral distal fractures, because of damage to the soft tissue, involvement of articular surface, injury to the extensor mechanism functional outcome is poor.¹ For anchoring the implant, extreme osteoporosis becomes a problem in elderly patients. No method of management singly could overcome all the problems associated with these injuries. Internal fixation becomes difficult to achieve stability due to thin cortices, osteoporosis, short articular segment, involvement of articular surface and

comminution.² The traditional plating techniques that require compression of the implant to the femoral shaft, which constitute for operative treatment are blade plate, non-locking condylar buttress plate, dynamic condylar screw, retrograde nailing, external fixation, antegrade nailing fixation and submuscular locked internal fixation. The introduction of locking compression plates was the next step in the evolution in plating of intraarticular distal femur fractures.³ Using dynamic compression, as a pure internal fixator using locking head screws, LCP can be used as a conventional plate, which provides the surgeon with multiple variations. The LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness or pullout resistance as seen in unlocked plates.^{4,5} Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilisation, avoidance of stress shielding and induction of callus formation. Internal fixation with locking plates creates a toggle free, fixed angle construct. The introduction of plates with the option of locked screws has provided the means to increase the rigidity of fixation in the presence of periarticular or juxta-articular fractures with a small epiphyseal segment.⁶ The implant offers multiple points of fixed-angle contact between the plate and screws in the distal part of femur, theoretically reducing the tendency for varus collapse that is seen with traditional lateral plates.

MATERIALS AND METHODS

This study is a prospective study, which comprised of 30 patients of intraarticular distal femur fracture AO classification 33-C3 who were treated by locking compression plate at Jorhat Medical College and Hospital, Jorhat, Assam. This study was conducted during February 2015 to April 2017. The functional outcome was studied using Neer's score, outcome of radiology and complication with fracture fixation using LCP.

Inclusion Criteria- All patients of age of 18 years or above both males and females. According to AO classification, closed or open grade fractures.

Exclusion Criteria- Patients who were bedridden or non-ambulatory, who had life-threatening severe medical problems, pathological fracture, periprosthetic fracture, vascular injury.

Combined spinal and epidural anaesthesia was used for operation under ipsilateral hip. Patients were placed in supine position on operating table slightly elevating the affected side with a sand bag. Over a small sand bag or a triangular frame, knee is placed in slight flexion. Povidone-iodine and spirit was applied on the skin of the operating site and the area from the buttock to the knee was draped. The approach of extensile lateral and swashbuckler was used. Swashbuckler approach consists of a modified anterior approach to the distal femur is presented. The approach allows surgical exposure of the entire articular surface of the distal femur. The quadriceps muscle bellies are spared

during the approach. The skin incision used will not interfere with subsequent total knee arthroplasty, if posttraumatic arthritis develops and arthroplasty is necessary. Articular reduction is maintained by using lag screw and LCP, reduction of articular surface was done anatomically and they were stabilised with K wires. Proper size of plate was selected. After proper placement of plate place, the fixation screws in accordance with the biomechanical principal of fixation, placing screws close to and far away from the fracture, insert minimum 5 screws including lag screws and locking head screws in distal fragment and minimum 4 screws in proximal femoral segment. For bone loss and severe comminution, autologous cancellous bone grafting was done. Joint capsule arthrotomy was closed with absorbable sutures. 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. Antibiotics were administered postoperatively, anti-inflammatory and analgesics were also given after 48 hours. The suction drain was removed and x-ray of the limb was taken. Once the drain was removed, patients were allowed to sit. From immediate postoperative day, knee range of movements, active quadriceps, hamstring exercises were started as soon as the patient could tolerate pain. Until fracture union, patients were followed up every month, subsequently at 3rd, 6th, 9th and 1 year. Patients were assessed clinically, radiologically and functionally by Neer's criteria during followup.

RESULTS

This study is a prospective study, which comprised of 30 patients of intraarticular distal femur fracture AO classification 33-C3 who were treated by locking compression plate at Jorhat Medical College and Hospital, Jorhat, Assam. This study was conducted during February 2015 to April 2017. Out of 30 patients, 22 were males (73.3%) and 8 were females (26.7%). 18 patients had fracture right hand side and 12 patients had left-handed fractures. A 19 years old was the youngest patient and 72 years was the oldest patient. About 70% patients had sustained road traffic accidents and 10% had sustained fall from a height. Four days was the average trauma to operative interval, 22 patients were operated extensile lateral approach and 8 patients were operated by swashbuckler approach. 12 weeks was the average weightbearing duration, 21 weeks was average time for fracture healing.

AO Classification	No. of Patients	Percentage
C1	10	33.3%
C2	12	40%
C3	8	26.7%
Total	30	100%

Table 1. Shows AO Classification of Fracture

Table 1 shows 10 patients had C1 (33.3%), 12 patients had C2 (40%) and 8 patients had C3 (26.7%) type of fracture according to AO classification.

Neer's Score	No. of Patients	Percentage
Excellent (>85)	13	43.3%
Good (70-84)	7	23.3%
Fair (50-69)	5	16.7%
Poor (<50)	5	16.7%

Table 2. Shows Neer's Score

Table 2 shows among 30 patients, 13 patients have shown excellent results, 7 patients good results, 5 fair results and 5 poor results.

Complications	No. of Patients	Percentage
Infection	2	6.7%
Nonunion	1	3.3%
Knee stiffness	4	13.3%
Delayed union	2	6.7%

Table 3. Shows Complications

Table 3 shows primary bone grafting was done in 4 patients for severely comminuted type C3 fracture. Secondary bone grafting was done in 2 patients who had delayed union at 4 months, 1 patient showed signs of union on 9th month, 1 patient showed nonunion treated with secondary bone grafting at 9th month with signs of union at 12 months. Two patients developed infection on 4th postoperative day, which was resolved with antibiotics. Four patients developed knee stiffness.

Knee ROM	No. of Patients	Percentage
<90	4	13.3%
90-110	6	20%
>110	20	66.7%

Table 4. Shows Knee ROM

Table 4 shows that 110 degrees was the average range of motion of knee.

DISCUSSION

In the present study, out of 30 patients, 22 were males (73.3%) and 8 were females (26.7%). 18 patients had fracture right hand side and 12 patients had left-handed fractures. 19 years old was the youngest patient and 72 years was the oldest patient. About 70% patients had sustained road traffic accidents and 10% had sustained fall from a height. Four days was the average trauma to operative interval, 22 patients were operated extensile lateral approach and 8 patients were operated by swashbuckler approach. 12 weeks was the average weightbearing duration, 21 weeks was average time for fracture healing, 10 patients had C1 (33.3%), 12 patients had C2 (40%) and 8 patients had C3 (26.7%) type of fracture according to AO classification. Among 30 patients, 13 patients have shown excellent results, 7 patients have good results, 5 fair results and 5 poor results. Primary bone grafting was done in 4 patients for severely comminuted type C3 fracture. Secondary bone grafting was done in 2 patients who had delayed union at 4th month, 1 patient showed sign of union on 9th month, 1 patient showed nonunion treated with secondary bone grafting at 9th month with signs of union at 12 months. Two patients developed

infection on 4th postoperative day, which was resolved with antibiotics. Four patients developed knee stiffness. Dr. Rajnikanth Machhi et al⁷ have done a prospective study of 20 patients of intraarticular distal femur fracture AO classification 33-C treated operatively with locking compressive plate at SSG Hospital and Medical College, Baroda, during January 2014 to March 2016. We have studied functional outcome using Neer's score, radiological outcome and complication associated with fracture fixation using LCP. Out of 20 patients, 14 were males and 6 were females. The youngest patient was 18 yrs. old and the oldest 70 yrs. Four patients had C1, 10 patient had C2 and 6 patients had C3 type of fracture. According to AO classification, 12 patients were operated with extensile lateral approach. Eight patients were operated using swashbuckler approach. In 3 patients, primary bone grafting was done for severely comminuted type C3 fracture. Secondary bone grafting was done in 1 delayed union case at 4 month. Patient shows sign of union at 9 months. One patient developed nonunion treated with secondary bone grafting at 9 months with signs of union at 12 months. One patient developed infection on 4th postoperative day resolved with surgical debridement and antibiotic. The average duration of weightbearing was 12 weeks. Average time for fracture healing was 20 weeks. Average range of motion of knee was 110 degrees. Among 20 patients, there were 9 excellent results, 5 good results, 3 had fair results and 3 had poor results. The LCP acts on the internal fixator principle as screws once locked to the plate do not pull the fracture towards the implant, and hence, there is no displacement of the fracture once reduced. Distal femur locking plate provides angular stability and provides multiple options to secure fracture fragments, both metaphyseal and articular. In our study, we get better functional outcome using locking compression plate for intraarticular distal femoral fracture. Along with anatomical reduction and rigid fixation, early mobilisation and aggressive physiotherapy are key for better functional outcome. In present study, better functional outcome achieved using locking compression plate for intraarticular distal femoral fracture along with aggressive physiotherapy. Dr. Sarabjeet Kohli et al⁸ conducted a study to assess the functional and radiological outcomes following fixation of intraarticular distal femur fractures with Locking Compression Plate (LCP). The study period dated from June 2013 to December 2015 included a total of 27 cases of distal femur fracture (AO/OTA classification type C2 and C3) treated with locking compression plate. The patients' age ranged from 20 to 77 years and all patients were followed up according to postoperative follow up protocol. The minimum follow up period was 1 year and patients were assessed for functional outcome and radiological signs of fracture healing every month in the outpatient department. Of the 27 patients treated with distal LCP, 24 patients (90%) showed radiological union within 20 weeks. Three patients had delayed union and implant failure. Average time for union was 16.1 weeks (excluding the cases of implant failure). Average flexion in this study was 113 degrees with more

than 20 patients having knee range of motion more than 90 degrees. Out of these 20 patients, 10 had a range more than 110 degrees. The functional outcome was measured using Neer's scoring system with 59% of the study group having excellent results. The complications encountered during the study period involved one superficial skin infection treated by debridement, shortening of 0.5-2 cms in three patients, which was associated with the extensive comminution at the fracture site. There were two patients who at the end of year of follow up showed varus angulation of 7 degrees. Three patients had an implant failure treated with bone grafting and reapplication of LCP. One patient developed fat embolism. The results showed a better functional and radiological outcomes when compared to other published studies done on these intraarticular fractures using other implant options, namely distal femoral nail, dynamic condylar screw and Less Invasive Stabilisation System (LISS). The locking compression plates with option of locked screws has provided the means to increase the rigidity of fixation in intraarticular distal femoral fractures. However, this is a technically demanding procedure considering the severity of these injuries. This study concluded that this method of fixation is especially suited for fractures where achieving congruency of the articular surface would be difficult with less invasive modalities like retrograde nailing and LISS. Vishwanath C et al⁹ conducted a study to examine the short-term clinical and radiological results particularly early complications and healing rate of distal femur fracture treated with DF-LCP. The study was conducted in patients treated for distal femur fracture (type A, B and C - AO classification) at Adichunchanagiri Institute of Medical Science, BG Nagar, from the month of November 2013 to May 2016. Fifty distal femur fracture patients were taken into the study. All were fixed with DF-LCP with bone grafting where the distal femur fractures were associated with extensive bone loss. Patient's age ranged from 22 to 74 years with a mean of 44. The sample consisted of fifty patients with 32 males and 18 were females. The patients' ages ranged from 22-74 years with a mean age of 44 years. The causes of fractures were motor vehicle accident in 33 patients and fall in 17 patients. There were no sports or industrial accidents. 33 fractures involved the right side and 17 involved the left. The average length of hospitalisation was 15 days with a range of 10 to 20 days. The average number of days from injury to surgery was 5 days with a range of 2 to 8 days. The operative time ranged from 60 minutes to 180 minutes. Patients were followed up from 1 to 24 months. Functional outcome was rated as per Neer's rating score. We got excellent results in 19 cases, good in 20, fair in 8 and poor in 3 patients. The DF-LCP is a good implant to use for fractures of the distal femur. However, accurate positioning and fixation are required to produce satisfactory results. It is recommended that use of this implant in type A, B, C and osteoporotic fractures. Our early results were encouraging, but long-term studies are needed to prove definitively acceptable outcomes, so that the technique can become part in the armamentarium of the orthopaedic trauma surgeon. Dr. B.S. Sahoo et al¹⁰ 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 analyse 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) consecutive 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 years. 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 mobilisation. 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 nonunion and delayed unions. Jagandeep Singh Virk et al¹¹ aimed to study the functional and radiological outcome of distal femoral fractures in skeletally mature patients treated by open reduction and internal fixation with distal femur locking plate.

This was a prospective study conducted from January 2012 to March 2014 at the Government Medical College and Hospital (GMCH) with a 2-year followup. Twenty five skeletally mature patients with posttraumatic distal femur fractures were included. Patients with open grade 3B and 3C distal femur fractures according to the Gustilo-Anderson classification and pathological distal femur fractures were excluded from the study. Patients with any fracture other than the distal femur in the ipsilateral limb were excluded from the study. Followup at 3 months, 6 months, 1 year and 2 years was carried out and evaluation was done according to the Neer scoring system. The statistical data analysis was carried out using SPSS version 20 (IBM, Chicago, USA). The p-value <0.05 was considered significant. Following all principles of fracture reduction, union was achieved in all patients with mean time to radiological union being 19 weeks. The mean Range of Motion (ROM) was 109 degrees with 20 patients having a Neer score graded as excellent to satisfactory.

Our study had 9 cases, which required additional surgeries. Out of these, all 9 cases required bone grafting, 3 also required antibiotic cement bead insertion initially. Three patients developed complications in the form of infection (2 cases) and malunion (1 case) during the course of our study, but were completely treated by the end of the study. Positive results can be obtained by distal femur locking plate alone as it is the main implant of choice for distal femur fractures of all varieties. Best outcome is expected, if fracture fixation is done following all the basic principles of fracture fixation and taking benefit of the mechanical properties of a locking plate.

CONCLUSION

The locking compression plates with option of locked screws has provided the means to increase the rigidity of fixation in intraarticular distal femoral fractures. Better functional outcome was achieved using locking compression plate for intraarticular distal femoral fractures with proper physiotherapy.

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