International Journal of Research in Medical Sciences
Hashim SM et al. Int J Res Med Sci. 2023 Feb;11(2):578-583
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20230167

Original Research Article

Functional outcome of the distal femur fractures using plate osteosynthesis

Shingati Muhammed Hashim, Sachin Sahuji*

Department of Orthopaedics, Raja Rajeswari Medical College and Hospital, Bangalore, Karnataka, India

Received: 08 January 2023
Revised: 22 January 2023
Accepted: 23 January 2023

***Correspondence:**
Dr. Sachin Sahuji,
E-mail: sahuji60@gmail.com

ABSTRACT

Background: Distal femoral fractures are a catastrophic event with bimodal distributions. Despite the advances in techniques and the improvements in surgical implants, treatment of distal femoral fractures still remains a challenge in many situations. The purpose of this study is to evaluate the rate of union, functional outcome and complications of these fractures treated by open reduction and internal fixation via plate osteosynthesis. Objectives were-1. Whether fractures reduction and fixation with plate will give acceptable results in the distal femur fractures treated in our setup. 2. To study the clinical outcome associated with this treatment modality and 3. What are the potential associated complications

Methods: This is a prospective, randomized observational study of 17 patients, with distal femur fractures (Muller classification type 33 A, C) who were treated with DFLCP at department of orthopaedics, Raja Rajeswari medical college hospital, Bangalore from January 2021 to July 2022. The study sample was 17 patients and all these patients were included with predefined inclusion and exclusion criteria in this study. Minimum of 2 months and a maximum of 12 months follow up was done. The functional and radiographic results were recorded according to Neer's criteria.

Results: In this study, most of the patients in this study were patients in the age group 61-75 years. The 53% of the cases were Muller type A and 47% were type C. The shortest follow up period was 2 months and longest period was 12 months, average union time was 18 weeks. Most common complications are knee stiffness, infection and shortening. In this study, there were two cases with excellent results, nine cases with good results, four cases with fair results and no cases went for failure.

Conclusions: We conclude that using locking plates is a safe and reliable method although careful preoperative planning and case selection and taking up cases for surgery as soon as possible are important factors which determine the final outcome.

Keywords: Neer's criteria, Knee stiffness, Plate osteosynthesis

INTRODUCTION

The femur is the largest tubular bone in the body connecting tibia and pelvic bone. It is surrounded by the largest mass of muscles, having proximal, middle and distal third portions. The distal femur (supracondylar and intercondylar) comprises the distal 10 to 15 cm of the bone.[1] Supracondylar area is defined to be the zone between the femoral condyles and the junction of the metaphysis with the femoral diaphysis.[2]

Femur is almost mostly cylindrical in length and also bows with a forward convexity.[3] It is narrowest in the mid shaft, when traced upwards it expands a little and widens appreciably near the lower end of the bone.[4] Supracondylar fracture is also known as (Muller's type -

A subgroup of extra-articular fractures of distal femoral fractures).[5]

Distal femoral fractures comprise about 7% of all femoral fractures.[6] These fractures have got a wide variety of fracture patterns and are commonly found associated with injuries such as open wounds, ligament disruption and fractures of acetabulum, femoral neck and shaft, tibia, patella etc. Such injuries possess the potential to produce significant long-term disability, especially when found associated with extensive articular cartilage damage, marked bone comminution, and severe soft tissue injury.[7]

Distal femoral fractures are a catastrophic event with bimodal distributions. They are found mostly in elderly women after a low-energy fall and in young men after high energy trauma.[1,4] Most common causes of such severe trauma are road traffic accidents (RTA), falls from height and gunshot injuries whose incidences are rising due to increasing vehicular accidents and rapid urbanization. The management of distal femoral fractures have seen a paradigm shift through time from non-operative measures in 1960 to biological fixation, evolution of modern implants and specific techniques available in current era.[8] Several methods of treatment are available now and the choice of a particular method is determined by the type, location, degree of comminution, age of the patient, surgeon's expertise and the availability of implants and instruments.

Surgical goals of treatment are anatomic reduction of fracture, restoration of limb alignment, length, and rotation, bone grafting for extensive bone loss and stable fixation that allows for early mobilization. For conventional plate fixation, metaphyseal comminution is always challenge. Among operative managements, plate osteosynthesis provides one of best clinical results especially in highly comminuted and osteoporotic fractures, intramedullary fixation cannot be applied due to presence of very short distal fragment.[9-11]

Locking compression plates ensures both locking and compression screw fixation of the femur shaft. The pull-out strength of locking screws is much higher than that of conventional screws, and it is difficult for one screw to fail unless all adjacent screws do. Thus, they offer a better hold in osteoporotic bones. The preservation of osseous viability using indirect reduction methods has increased the fracture union rates without the need for supplemental bone grafting procedures. Plates are designed to apply in minimally invasive fashion to preserve local biology and to avoid problems with fracture healing and infection. Locking plates form a fixed angle construct. They enable placement of the plate without any contact to the bone as such.[12-15]

Despite the advances in techniques and the improvements in surgical implants, treatment of distal femoral fractures still remains a challenge in many situations. Purpose of this study is to evaluate rate of union, functional outcome and complications of these fractures treated by open reduction and internal fixation via plate osteosynthesis.

METHODS

This is a prospective, randomized observational study conducted in department of orthopedics, Raja Rajeswari medical college and hospital patients with distal femur fractures who met our inclusion criteria were selected.

Consecutive patients admitted in department of orthopedics from January 2021 to July 2022.

Selection criteria

Inclusion criteria

All distal femur fractures (AO classification type 33A, C) in skeletally mature patients were selected, all patients with open and closed distal femur fractures and all patients with polytrauma and with ipsilateral or bilateral distal femur fractures and patient who willing to give consent were included.

Exclusion criteria

Distal femur fracture with AO Muller classification type 33 B, patients with tibia plateau fractures, skeletally, immature patients, non-union, malunion distal femur fractures, patient with pathological distal femoral fractures, patients who terminally ill, with life threatening diseases, who were not fit for surgery were excluded.

Implant used

Indian made locking plate and screws manufactured from 316L stainless alloy were used with locking head drill sleeves. The locking compression plates are available from 4 holed to 14 holed. With 4.5 mm thickness plate for lower end of femur. Anatomically pre-contoured plate head with soft edges. Locking screws in the head of the plate for a secure support.

The head of the locking screw is threaded which gets locked to the plate as it is tightened. LCP combi-holes in the plate shaft-intraoperative choice between angular stability and/or compression.

Figure 1: The 4.5 mm locking compression plates and locking screws.

Routine protocol

The study was approved by the institutional ethical committee (IEC) of Raja Rajeswari medical college, Coimbatore. After sorting out the patients on the basis of the already defined inclusion and exclusion criteria, patients were selected for the study and were briefed about-The nature of the study and the different surgical options available to them and a written informed consent in their own language was obtained.

Further detailed data of the patients involved in the study was obtained by interviewing them and based on clinical examination findings. These data were recorded on a standard predesigned proforma.

History involving nature, mechanism of injury, history of significant past or family history and associated injuries was recorded. Patients were locally examined to find if there was any swelling, deformity or any open injuries. Neuro-vascular status was also assessed. Routine lab investigations and concerned X-rays were taken after stabilizing and immobilizing the patient

Surgical technique

Anesthesia given was spinal anesthesia.

Position

Patient was positioned supine, with a sand bag under the ipsilateral buttock to allow slight internal rotation at the hip. The thigh is draped free and the iliac crest prepared and draped in case bone grafting was required. A sterile sand bag or rolled towel is placed under the knee to facilitate exposure and reduction and to control the flexion of the distal fragment by the pull of the gastrocnemius. Tourniquet was not used because it interfered with the placement and extension of the proximal incision. Broad spectrum antibiotics were given just after spinal anesthesia and continued postoperatively for 7 days.

Figure 2: Sandbag under thigh to offset pull of gastrocnemius.

Incision

Lateral incision with a curve that runs from the tibial tuberosity just distal to the middle of the thigh. An approach from the lateral parapatellar side disclosed the knee joint.

Exposure

The vastus lateralis is split along the skin incision and retracted anteriorly, and the Facia Lata is incised in line with the skin incision. To see the intra-articular fragmentation, lateral parapatellar arthrotomy is performed.

Reduction

Intraarticular fracture fragments fixed provisionally with K wires or cancellous screws. Then plate fixation is carried out.

Plate fixation

Under C arm control and after achieving perfect intraarticular reduction using with reduction forceps and with or without k wires if needed, the fracture is fixed using a locking compression plate of sufficient length as per principle first 6.5 mm condylar locking screw is inserted and then 5 mm locking cancellous screws distally and 5 mm locking cortical screws proximally.

Closure

The split vastus lateralis is closed using interrupted absorbable sutures, the fascia Lata is closed using continuous sutures, and the skin is closed in layers with an absorbable suture material and surgical staples over a no. 14 suction drain.

Figure 3: Closure with drain *in situ*.

Post-operatively, patient care was done as per hospital protocol which includes antibiotics, analgesics, monitoring of urine input and output and vitals and foot end elevation. Blood transfusion was given depending

upon intraoperative blood loss. Static quadriceps exercises and hamstring strengthening exercises were started from the 2nd postoperative day onwards. Gentle hip and ankle mobilization was encouraged. Knee active mobilization exercises were started as pain tolerated from the 2nd day onwards. Non weight bearing with crutches or walker support was initiated in the first week if the fixation was stable. Partial weight bearing was allowed at 8 weeks, full weight bearing was allowed only after evidence of radiological evidence of union at the fracture site.

Functional and radiological assessment of the knee. Functional assessment is by the Neers rating system. Radiological outcome is assessed by serial x rays.

RESULTS

This series consists of 17 cases fractures of the distal femur treated by open reduction and internal fixation using locking plate osteosynthesis.

Nine patients were males and 8 patients were females. The median age was 57 years ranging from 18-75 years. The 11 of the fractures was caused by road traffic accidents and 6 were due to fall. The 10 patients were with fracture on right side and 7 on left side.

Table 1 shows, 2 were Mullers type A_1; 3 were Mullers type A2; 5 were Mullers A3; 1 was Mullers type C_2 and remaining 6 were Mullers type C_3.

1 patient had associated injury. He had comminuted fracture of patella on same side. Two patients had died during course of study.

All patients were operated within 9 days. Average time duration of surgery was 101 minutes with shortest duration being 80 min and longest being 130 min.

The size of plate was selected based on the type of fracture. Five and 6 holed plates were used more commonly.

Table 2 shows, of 17 patients, 11 patients (73%) showed radiological UNION within 18 weeks. No patients had implant failure. Table 3 shows 60% of patients continued the same work as before post fixation.

Average flexion in this study was 104 degrees with more than 50% patients having knee range of motion more than 110º.Average knee extensor lag in this study was 5.55 degrees.

Table 4 shows that out of 17 patients, 3 had shortening and 8 had stiffness.

In this study, very few patients had significant varus/ valgus malalignment with 2 patients had deep infection which was treated with debridement and antibiotics The duration of follow-up ranged from 3 months to 12 months.

Table 1: Type of fracture (Muller's).

Type	N	Percentage (%)
A 1	2	11.76
A 2	3	17.64
A3	5	29.41
C1	0	-
C2	1	5.88
C3	6	35.29
Total	17	100

Table 2: Time for radiological union.

Union (weeks)	N	Percentage (%)
<16	Nil	Nil
16-18	11	73
19-20	4	27
21-22	Nil	Nil
Delayed union	Nil	Nil
Non-union	Nil	Nil

Table 3: Work capacity post-surgery.

Variables	N	Percentages (%)
Same as before accident	9	60
Regular but with handicap	4	27
Alter work	1	6
Light work	1	6
No work	0	-

Table 4: Complications.

Complications	N	Percentage (%)
Knee stiffness	8	47
Infection	2	12
Nonunion	0	-
Bent implant	0	-
Shortening	3	18

Table 5: Functional outcome.

Gradings	N	Percentage (%)
Excellent	4	24
Good	7	41
Fair	4	24
Failure/poor	-	-

Figure 4 (A-D): Post operative Xray-1 month follow up X-ray, 3 month follow up X-ray and 6 month follow up Xray.

Figure 5: Post operative follow up images showing complete improvement of range of movements.

DISCUSSION

In this study, out of the 17 patients, 9 were males and 8 were female. Most were old patients in the age group 60-75 years. The Main cause of injury is attributed to high energy trauma (RTA) and all patients presented within 12 hours of injury.

The side distribution showed marginally a greater number with fracture on the right side than on the left. We could find no specific reason for this data.

In this study 11 patients were injured as result of a VA (Vehicular Accident) and 6 patients sustained injury due to accidental fall. The 35% of the cases were Muller type C3 and 29 % were type A3.

One patient had an associated fracture of patella on same side which was treated with tension band wiring. Two patients died during the course of this study.

Bone grafting was done for five patients (29%), 19% cases Schutz et al.[17]

Shortest follow up period was 1 month and longest period was 12 months, avg 6 months (Raghuvanshi et al, Gaines et al).[16,18]

Table 4 shows that the complications included postoperative knee stiffness in almost 47% of the patients, 18% shortening and 15% of the cases got infected. Limb length discrepancy in the form of shortening less than 2.5 cm was seen in three patients.

There were no cases of implant failure in our study, 5% cases (Kregor et al) 8% cases (Henderson et al).[19,20]

In this study by the analysis of the results using the Neer's rating criteria taking into account pain, knee range of motion, angulation and functional ability, as per Table 5, there were 2 cases with excellent results, 9 cases with good results, 4 cases with fair results and no cases went for failure.

The good outcome seen in our study can be attributed to more or less equal proportion of type A and C fractures, which usually show favorable results.

In our study, radiological union (Table 2) was seen at an average of 18 weeks which is comparable to study of LCP by Kayali et al, that averages 15 weeks.[21] Radiological union (18 weeks), 15 weeks (Raghuvanshi et al), 12 weeks (Henderson et al).[16,20]

As from Table 5 and Figure 5, we had 65 % good to excellent outcome as per Neer score in our study, compared to Ketterel et al (90%) and Hann et al (86%).[22,23]

CONCLUSION

Anatomically pre-shaped plates make it easier for surgeon to select from the different combinations possible for internal fixation for each segment of the skeletal system. Thus, helping to reduce the incidence of complications which were observed in the early years of management of these fractures. Rigid internal fixation permits early functional rehabilitation of the patient and

decreases the incidence of malunion, nonunion and loss of fixation. To conclude, the locking compression plate for distal femur 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, so its implant of choice in dealing with osteoporotic distal femur fracture as majority of patients in our study had osteoporotic bones.

Limitations

Our study was limited by its small sample size and time duration but it brings the important message that fixation in osteoporotic bone in a geriatric population does present great difficulty. RCTs are necessary to address the issue as to whether LISS is superior to traditional implants.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Koval KJ, Zuckerman JD. Handbook of fractures. 3rd ed. Philadelphia: Lippincott Williams and Wilkins. 2006.
2. Mahesh DV, Gunnaiah V. Management of Distal Femur Fracture by Locking Compression Plate. Int J Heal Sci Res. 2014;4(5):235.
3. Dalley AF II. Frank H Netter's Atlas of human anatomy. 2nd ed. East Hanover: Novartis. 1996.
4. Bucholz RW, Jones A. Current Concepts Review: Fractures of the Shaft of the Femur. J Bone Joint Surg Am. 1991;73:1561-66.
5. Muller ME, Allgöwer M. Schneider Manual of Internal Fixation; 2nd ed. New York, Springer-Verlag. 1979.
6. Hoffmann MF, Jones CB, Sietsema DL. Clinical outcomes of locked plating of distal femoral fractures in a retrospective cohort. J Orthop Surg Res. 2013;8:43.
7. Walling A, Seradge H, Spiegel. Injuries to the knee ligaments with fractures of the femur. J Bone Joint Surg. 1982; 64:1324-7.
8. Terry CB. Campbell's Operative orthopaedics, 12th edition. 2015;55(3):2690.
9. Greiwe RM, Archdeacon MT. Locking plate technology: current concepts. J Knee Surg. 2007;20(1):50-5.
10. Yeap EJ, Deepak AS. Distal Femoral Locking Compression Plate Fixation in Distal Femoral Fractures: Early Results. Malaysian Orthop J. 2007;1(1):12-7.
11. Banks HH. The Healing of Intraarticular Fractures. Clin Orthop Relat Res. 1965;40:17-29.
12. Neer CS II, Grantham SA, Shelton ML. Supracondylar Fracture of the Adult Femur-A Study of One Hundered and Ten Cases. JBJS Am. 1967;49-A(4):591-613.
13. Anderson RL. Conservative treatment of Fractures of the Femur. JBJS Am. 1967;49-A(7):1371-5.
14. Wardlaw D, McLauchlan J, Pratt DJ, Bowker P. Biomechanical study of Cast-Brace treatment of Femoral Shaft Fractures. JBJS Br. 1981;63-B(1):7-11.
15. Olerud S. Operative treatment of Supracondylar Fractures of Femur-Technique and Results in Fifteen Cases. JBJS. 1972;54-A(5):1015-32.
16. Raghuwanshi G, Aggarwal S. Use of LCP in Supracondylar Femur Fracture. JRMDS. 2015;3(2):122-6.
17. Schutz M, Muller M, Krettek C. Minimally invasive fracture stabilization of distal femoral fractures with the LISS: a prospective multicenter study. Results of a clinical study with special emphasis on difficult cases. Injury. 2001;32:SC48-54.
18. Gaines RJ, Sanders R, Sagi JC. Titanium versus stainless steel locked plates for distal femur fractures: is there any difference? Paper presented at: OTA Femur Denver. 2008.
19. Kregor PJ, Stannard J, Zlowodzki M. Distal femoral fracture fixation utilizing the Less Invasive Stabilization System (LISS): the technique and early results. Injury. 2001;32(3):SC32-47.
20. Henderson CE, Bottlang M, Marsh JL. Does locked plating of periprosthetic supracondylar femur fractures promote bone healing by callus formation? Two cases with opposite outcomes. Iowa Orthop J. 2008;28:73-6.
21. Kayali C, Agus H, Turgut A. Successful results of minimally invasive surgery for comminuted supracondylar femoral fractures with LISS: comparative study of multiply injured and isolated femoral fractures. J Orthop Sci. 2007;12:458-65.
22. Ketterl K. 5-Year results of supracondylar femoral fractures, managed with the dynamic condylar screw (DCS) Zentralbl Chir. 1997;10.
23. Se-Ang J, Young-Soo B, In-Ho H, Dongju S Medial Plating of Distal Femoral Fracture with Locking Compression Plate-Proximal Lateral Tibia. J Kor Fracture Society. 2016;29(3):206-12.

Cite this article as: Hashim SM, Sahuji S. Functional outcome of the distal femur fractures using plate osteosynthesis. Int J Res Med Sci 2023;11:578-83.