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Pawan Kuamr
M.B.B.S., Resident Doctor,
Department of Orthopaedics,
Dr. SN Medical College,
Jodhpur, Rajasthan, India

Gaurav Nain
M.B.B.S., Resident Doctor,
Department of Orthopaedics,
Dr. SN Medical College,
Jodhpur, Rajasthan, India

Akhilesh Kumar Sharma
M.B.B.S., Resident Doctor,
Department of Orthopaedics,
Dr. SN Medical College,
Jodhpur, Rajasthan, India

Kavita Verma
M.B.B.S., Resident Doctor,
Department Of Medicine,
SP Medical College,
Bikaner, Rajasthan, India

Corresponding Author:
Akhilesh Kumar Sharma
M.B.B.S., Resident Doctor,
Department of Orthopaedics,
Dr. SN Medical College,
Jodhpur, Rajasthan, India

Functional outcome analyse following dual plating for AO Type C2 and C3 distal femur

Pawan Kumar, Gaurav Nain, Akhilesh Kumar Sharma and Kavita Verma

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Abstract
Introduction: Lateral locking plate fixation has become an accepted standard treatment for the fixation of distal femur fractures owing to the improved fixation and increased stiffness provided by the fixed angle construct. Extensive metaphysical commination, either AO C2 or C3, is complicated by high rates of varus collapse with medial commination, loss of fixation, and non-union. However, studies have reported various rates of non-union following treatment with LCP, these rates ranging from 0% to as high as 20%. Dual plating of distal femur fractures with a lateral plate and a medial plate has been used to improve fracture alignment and stabilization when a single plate has not been adequate.
So additional support of distal femur fracture stabilization by using double-plating technique similar to that used in two column fractures of acetabulum, distal humerus and tibial plateau has been done in this study, based on failed cases encountered with single lateral plating in the past and literature support on double plating of distal femur fractures.
The purpose of this study is to evaluate the outcome of surgical treatment, for fresh distal femur fractures, treated with dual plating.
Materials and Methods: Study Type: Hospital-based interventional study was conducted in tertiary care fascility, Jodhpur from December 2020 to march 2023.
Result: Our study result with union rate of 94% and average healing time between 18-24 weeks both clinically and radiologically and a mean healing time of 20.9 weeks (5 months) with no cases of varus deformity. Two case of non-union. 63% of patients had good-excellent functional outcome in our study with 70% of patients having range of motion more than 90.

Keywords: Intraarticular fractures, plating, distal femur, internal fixation.

Introduction
Fractures within 15cm from articular surface of distal femur i.e. between articular surface and junction of metaphysis to femoral diaphysis are defined as distal femoral fractures.
Distal femur fractures account for only 0.4% of all fractures and 4–6% of all femoral fractures [1-6].
These fractures are frequently associated with high velocity trauma, comminution, soft tissue injury, instability and articular surface extension. Most of these fractures are complicated by severe comminution, poor bone quality, a distal segment that is too short for adequate fixation, substantial soft tissue injury, blood loss and increased mortality fractures [1-5].
Anatomical Reconstruction of articular surface, restoring rotational and axial alignment, stable fixation early mobilization and functional rehabilitation are main goals of surgical treatment.
Before 1970's, majority of distal femoral fractures were managed conservatively with traction resulting in prolonged confinement to bed with complications of recumbency [7-8].
Despite the recent advances in techniques and implants, the treatment of multi-fragmentary metaphyseal and intra-articular distal femoral fractures remains a challenge.
The perioperative complications associated with distal femur fractures, whatever the choice of fixation, include delayed union or nonunion, infection, implant failure and mal-union [9-11].
Factors leading to complications include metaphysical and intra-articular comminution, bone loss, poor bone quality, open fracture and inadequate fixation [1, 5-6, 12].

Lateral locking plate fixation has become an accepted standard treatment for the fixation of distal femur fractures owing to the improved fixation and increased stiffness provided by the fixed angle construct [10, 14, 16].

Extensive metaphysical comminution, either AOC2 or C3, is complicated by high rates of varus collapse with medial comminution, loss of fixation, and nonunion [12-15].

However, studies have reported various rates of nonunion following treatment with LCP, these rates ranging from 0% to as high as 20% [13, 17, 19-21].

Dual plating of distal femur fractures with a lateral plate and a medial plate has been used to improve fracture alignment and stabilization when a single plate has not been adequate [20, 22-26].

Lateral locking plates are now the choice of internal fixation and have replaced common blade plate in distal femur fractures. Retrograde nails were recently developed with more stability and better biomechanical performance for distal femur fractures not having much 2 condylar comminution. Common association of distal femur fractures with diabetes, open fractures and infection resulted in delayed fracture union, malunion and proximal implant failure commonly varus collapse.

Muscular forces acting on distal femur, weight bearing and gravity all affects fracture stabilization. When there is short distal fragment and metaphyseal comminution with defect in medial cortex, chances of varus collapse due to increased bending tendency caused by vertical load are common in internal fixation of distal femur fracture with single lateral locking plate alone.

So additional support of distal femur fracture stabilization by using double-plating technique similar to that used in two column fractures of acetabulum, distal humerus and tibial plateau has been done in this study, based on failed cases encountered with single lateral plating in the past and literature support on double plating of distal femur fractures.

The purpose of this study is to evaluate the outcome of surgical treatment, for fresh distal femur fractures, treated with dual plating.

Materials and Methods

Study Type: Hospital-based observational study.

Study Period: From approval of study till sample size is achieved (expected in a year).

Sample Size: Sample size was calculated at 95% confidence interval to verify an expected 86% prevalence of excellent to good functional outcome post-operative (as per reference article) 25 at relative allowable error of 15%. Sample size was calculated using the formula for sample size for estimation of proportion is 30

Inclusion criteria

1. Patients with closed AO C2 and -C3 distal femur fractures treated with open reduction and internal fixation by dual plating.
2. Patients with open (Gustilo-Anderson grade I and II) AO C2 and C3 distal femur fractures treated with wound debridement primarily and open reduction and internal fixation by dual plating.
3. Patients with minimum of 6 months follow-up available.

Exclusion criteria

1. Patients with high surgical risks due to medical or anaesthetic reasons.
2. Patients with concomitant medical or surgical comorbidities that may affect outcome.
3. Polytrauma cases, Grade III Gustilo-Anderson with multi-system involvement.
4. Peri-prosthetic distal femur fractures.
5. Pathological distal femur fractures.
6. Revision surgery
7. Arthritic knees.
8. Patients not willing for follow up.

Discussion

Treatments of distal femoral fractures is a cumbersome subject. There have been changing principles towards surgical treatment for supra condylar fractures of femur. Close management of these fractures was the treatment of choice until 1970. This was mainly due to lack of proper techniques and appropriate implants. Conservative methods at any age may be complicated by knee stiffness, malunion and nonunion. Early surgical stabilization will facilitate care of the soft tissue, reduces bedridden period and the complexity of nursing care.

Open reduction and internal fixation using angled blade plate, Rush rods, Ender nails, DCS, condylar buttress plate and interlocking nails, locking compression plate. The conventional plates are associated with demerits such as screw pullout, implant failure and less rigid fixation requiring postoperative immobilization. Locking plate will decrease the screw-plate toggle and also the motion at the bone- screw interface thereby provides more rigid fixation. In cases where fracture fragments in the medial side were severely comminuted or having massive bone defect, single lateral plate fixation may fail to stabilize fracture sites, resulting in knee varus deformity, breaking of plates and screws and nonunion. One such case was included in this study where the patient undergone single lateral fixation for comminuted distal femoral fracture resulted in varus collapse and implant failure after two months of surgery.

Implant removal was done and redo surgery with bicolumn plating was done for that patient. At the end of one-year follow-up, patient had bony union with more than 100 degrees of knee flexion. In cases involving single lateral plating, the rates of varus collapse and non-union were high but in our study the addition of medial plating has not yielded any case of varus deformity or malunion. Bone grafting either autograft/allograft or bone graft substitutes not done in our study except in one case where cancellous iliac bone autograft was done. In our study the average time taken per patient to complete the surgery is 143 minutes. Particularly in patients with associated injuries, timing of surgery extends to more than 3 hours for completing surgery, since we have to fix more than one fractures in these patients. Risk of infection and anesthesia complications increase exponentially with increase in operating time. Even after double plating 3 shattered distal femur fractures of C3 type were on POP for 4 weeks during post-op period in this study due to severe comminution and segmental bone loss. Nail-plate combination technique for stable, balanced fixation allowing immediate weight bearing and early mobilization and Intra-osseous plating technique for cases with intra-articular comminution or segmental bone loss of far(medial) cortex were intramedullary nails cannot be used. These two techniques are promising in improving the quality of life in severely comminuted intra-articular fractures (type C3) patients in future were even double plating is not sufficient to give stable fixation. In bicolumn fracture fixation of the distal femur fractures with comminution, the prognosis factors include age, method of treatment, intra articular involvement

and timing of joint mobilization, etc. For all these patient early rehabilitation, physiotherapy and aggressive postoperative protocol should be followed for better functional outcome. Major contributing factors are: 1. Improper fixation may be due to complexity of fracture comminution 2. Elderly patient with less motivation to begin exercise and low osteogenic potential. 3. Delay in surgery causing increase in interval between injury and surgery 4. Open/closed fractures. In 2018 Imam *et al*. [17] did a prospective study on 16 patients with distal femoral fractures of Muller type C3. These patients were treated using dual plating and analyzed the outcomes including clinical and radiological outcomes and postoperative complications. Their results shown 66.66% of the studied patients had good-excellent functional outcome with 66.66% of patients having range of motion (90^0 – 120^0) during follow-up. The mean time of radiological union in their study was 6.0 +3.5 months with a range of 3-14 months. There is no postoperative varus or valgus deformity in their study. Our study also had a similar result with union rate of 94% and average healing time between 18-24 weeks both clinically and radiologically and a mean healing time of 20.9 weeks (5 months) with no cases of varus deformity or malunion. 63% of patients had good-excellent functional outcome in our study with 70% of patients having range of motion more than 90^0.

Limitations

1. Our Study comprises of relatively small number of patients and not a strict random controlled trial design.
2. Repair of injured ligaments of knee joint not done during acute phase along with fracture fixation in our study.
3. Stainless steel plates are used in both medial and lateral sides due to economic constraints which limits the use of MRI for the evaluation of ligament injuries of the joint during follow-up.

Result

Our study result with union rate of 94% and average healing time between 18-24 weeks both clinically and radiologically and a mean healing time of 20.9 weeks (5 months) with no cases of varus deformity. Two case of non-union. 63% of patients had good-excellent functional outcome in our study with 70% of patients having range of motion more than 90^o.

Conflict of Interest

Not available

Financial Support

Not available

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