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Original Research Article

Double-plating approach in the management of isolated distal femoral fractures

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ABSTRACT

Background: Fractures above 9 cm of the articular surface of distal femur are defined as distal femoral fractures which accounts for an estimated 4%-6% of all femur fractures. Stable fixation can be achieved by dual plating of distal femoral fracture. The indications of a dual- lateral and medial plate medial are comminuted distal femur fractures (AO type C3), medial supra-condylar void and bone loss of more than 3 cm, medial Hoffa fracture, inter-condylar comminuted bicondylar fractures, non-union after failed fixation with single lateral plate, poor bone quality.
Methods: The retrospective research study of 35 cases of distal femoral fractures which were treated with lateral and medial plates in post graduate institute Swasthiyog Pratishthan, Miraj (G. S. Kulkarni Hospital, Miraj). The study period was from September 2020 to May 2022. The average follow-up was 8 months.
Results: 1 year after operation, knee function was evaluated by Oxford knee score along with Mean EQ-5D-5 L score. Functionally the mean oxford knee score was 41.53±1.69, with a maximum Oxford Knee Score of 48. Mean EQ-5D-5 L score was 83.8 (72-82). Average time to union was 9 months (6-12 months). Four (17.4%) cases needed autologous bone graft.
Conclusions: Double incision dual-plating approach for distal femoral fractures is effective and provides stable construct without reduction loss allowing early rehabilitation. Single lateral plating of distal femur fractures was associated with relatively higher failure rate. Addition of medial plate along with lateral plate reduces chances of fixation failure.

Keywords: Dual-plating, Distal femur, Locking compression plate

INTRODUCTION

Following RTA, fall from height and high energy injuries, distal femoral fractures occur. Supracondylar femur fractures are commonly associated with severe comminution and significant soft tissue injury and fractures are often severely comminuted. Inspite of all the advances in orthopaedics, surgeon faces challenge in distal femur intraarticular fractures. Patients with comminuted fracture and complex articular damage faces disability. Geriatric population suffers with osteoporosis resulting in poor bone quality which complicates the fracture with non-union, mal-union and increased mortality. Supracondylar femur fractures treated with locking compression plate is considered as modern and best option with low failure rates. Fixation with only lateral plate resulted in comparatively high failure rates. Addition of medial plate along with lateral plate reduces chances of fixation failure. One case treated with only lateral single plate resulted in fixation failure, which was later treated with addition of medial plate and autologous bone grafting of iliac crest. On follow-up, there was no recurrence of fixation failure observed.

Objectives

Objective of current study was evaluating the functional and radiological outcome in distal femur fractures treated with dual locking compression plate.

METHODS

The retrospective research study of 35 cases of distal femoral fractures which were treated with lateral and medial plates (dual plates) in Post Graduate Institute Swasthiyog Pratishthan, Miraj (G. S. Kulkarni Hospital, Miraj). The study period was from September 2020 to May 2022.

Inclusion and exclusion criteria

Patients willing for consent of the study, patients with skeletally mature, above 18 years of age, majority of fractures with AO type C2-C3 wew included. Patients not willing for participation in study, patients with infected distal femur fracture in non union, compound grade 3 fracture with severe contamination, patient with severe osteoporosis in old age, patient with multiple co-morbidities like diabetes, hypertension, asthma, thyroid disorder, patient with polytrauma injuries with or without head injuries were excluded.

Procedure

The average follow-up was 8 months. Average procedure time was 143 minutes (126-189 minutes). Average time from hospitalisation to intervention was 4.3 days. Double incision approach (lateral, swashbuckler, medial incision) was used. The fracture fragments identified and were reduced and fixed with lateral and medial plates with screws. 12 hr before operation i.e., in pre operative phase, patient was given LMWH (low-molecular weight heparin). Intravenous antibiotics and LMWH was given for 2 days post operatively. Immediately next day after operation, knee mobilisation was started with non-weight bearing (NWB) walk. Follow up of patients were taken sequentially in 1 month, 3 months, 6 months and 1 year. Oxford Knee Score was used for assessment of follow-up patients. A score of more than 40 is scaled as excellent, 30 to 39 as good functional status, 20 to 29 as moderate and score less than 19 as poor functional result. Medical statistics software SPSS 21 was used for analysis of the data.

Pre-operative planning

Compound injury were examined for mainly soft tissue status and all the fractures were examined for any distal neurovascular deficit. Any other injuries over body must be ruled out. Proper radiographs in all planes are must. Proper planning before surgical fixation is important. For better visualisation of fractured fragments and to study the pattern of fracture, computed tomography of the distal femur in all views is necessary.

Figure 1: Comminuted distal femur fracture.

Figure 2: Dual plating providing stable construct and stability.

Figure 3: Comminuted compound distal femur fracture showing medial bone loss with void more than 3 cm.

Figure 4: Dual plating with stimulan insertion.

Proper pre-operative planning is must to understand the need of dual plating in distal femur fractures.[1] Swashbuckler, lateral parapatellar and medial incision approach were used. The fracture fragments identified and were reduced and fixed with lateral and medial plates with screws.

Figure 5: Note stimulan is absorbed completely.

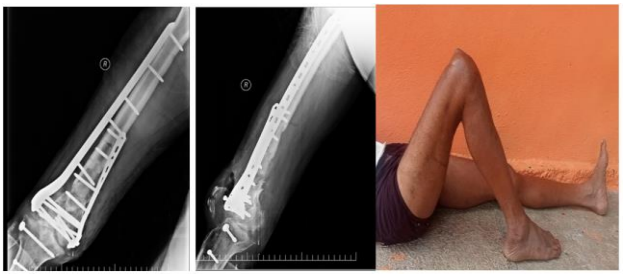

Figure 6: Reconstructed with bone grafting and medial LCP providing stable construct.

Figure 7: Outside operated Single lateral plate application showing non-union and failure of fixation.

Figure 8: Revision with dual plating and bone grafting.

In case of Comminuted distal femur fractures (AO type C2 and C3). Dual plating gives you stable construct. With the help of Dual incision exposure of fracture fragment is good, manipulation is easy and anatomical reduction is achieved.[2] Steinberg et al has shown good union rates with dual plating in AO type C2 and C3 distal femur fractures.[3] Medial supracondylar void and bone loss of more than 3 cm must be fixed with separate medial side plating. Functional loss of medial cortex occurs in distal femur fracture. So, the healing chances are less in such conditions. Inorder to achieve additional stability, addition of medial plate is must.[1,4] Rajasekaran et al found that additional medial plating and bone grafting was needed for non-union distal femur with medial bone loss more than 3 cm.[5]

Figure 9: Outside operated distal femur fracture in non-union.

Figure 10: Revision dual plating.

Articular surface is lost in Hoffa's fracture and anatomical restoration of the articular surface is necessary for it. So in medial Hoffa fragment along with medial void, the application of a medial neutralization plate is necessary to achieve stable fixation. Non-union after failed fixation with single lateral plate. If treated with single lateral plate there is increased risk of non-union in patients with comminuted distal femur fractures.[6] Lujan et al and Henderson et al revealed that using of locking plate constructs with high stiffness achievement may limit the amount of callus, resulting in delayed healing or non-union. It requires non union site stabilization with addition of medial plate and bone grafting at same site.[7-9] Two anatomically contoured locking plates are used. Medially, T-buttress plate can also be used for fixation. 6.5 mm Cancellous screws are used for fractured intercondylar fragment fixation.[10] Data in current study were analysed and calculated by the medical statistics software SPSS 21.2.

Postoperative management

LMWH (anticoagulation) for 2 days and Prevention of infection, analgesia for next 7-10 days were routinely performed. Active knee flexion and extension exercises were suggested, immediately next day after operation. Patients were advised non-weight bearing walking with the help of walker next day after operation. Continuous passive motion (CPM), contraction exercises of quadriceps of the knee were suggested immediately after surgery for rigid internal fixations.

Outpatient follow-up

Plain film was performed every 1 month, 3-months, 6 month and 1 year after operation for monitoring the fracture healing and whether there was loss of reduction and failure of implant placement. Every patient was followed up till the union of fracture. Partial weight bearing was advised depending on sequential follow up of radiographs and condition of patients. Knee function was evaluated by Oxford knee score, one year after surgery.

RESULTS

In our study, total 35 patients were selected which were admitted to our hospital. All patients undergone operative surgical procedure in the form of open reduction internal fixation with dual plating. Out of 35 patients, 25 patients (71.42%) were male patients categorically falling more in age group of 30-49 years.

Table 1: Radiological outcome of patients.

Radiological outcome	N	%
United	32	91.42
Delayed union	2	5.71
Superficial infection	1	2.85

Table 2: Functional outcome of patients.

Result	Excellent	Good	Moderate	Poor	Total
N	24	10	1	0	35
%	36.6	8.6	2.8	0	48
Average 41.53±1.69					

Remaining 10 patients (28.57%) belonged to female group. Among 35, all patients treated with dual plating showed excellent results with good range of motion of knee. Among 35, maximum 31 patients (88.57%) had less than 5 days stay at hospital (i.e., short post operative stay). In all 35 patients, we had good union of fracture site. Swashbuckler, lateral parapatellar and medial incision approach were used. The fracture fragments identified and were reduced and fixed with lateral and medial plates with screws. Functionally the mean oxford knee score was 41.53±1.69, of which 24 were excellent (36.6%), 10 were good (8.6%), 1 was moderate (2.8%) and none show poor results. Mean EQ-5D-5 L score was 83.8 (72-82). No loss of reduction in any of the cases was evident. After 6 months, 22 patients had no pain and 13 had mild pain (Table 2). 30 patients without aids and 5 patients with crutches. Functionally the mean oxford knee score was 41.53±1.69. Mean EQ-5D-5 L score was 83.8 (72-82). No loss of reduction in any of the cases was evident (Table 2). Post operative complications was included in 3 patients accounted 8.6% (Table 3). One patient was superficial infection and two others were pulmonary infection. All of them were treated well before being discharged from the hospital.

Table 3: Post-operative complications.

Complication	N	%
Superficial infection	1	2.9
Cardiovascular	0	0
Lung infection	2	5.7
Die	0	0
Total	3	8.6

DISCUSSION

The aim of the study is to evaluate the result of dual plating in distal femoral fractures. Complication faced are time required for union, reduction quality, radiological outcome and functional too. MIPPO technique using locking compression plates shown better results with higher union rates and are used widely now.[6-11] Early stabilization in open fractures benefits the patient. By considering factors like restoration of skeletal length, preventing further soft tissue injury by mobile fracture fragments, the compound open fractures, Multiple injuries, bad skin conditions were treated with debridement and external fixation.[12-14] 4-6 months was the average recorded time for healing of the fracture with 92.3% of union rate. Soft tissue tethering, pin tract infection and higher inconvenience of patient were major drawbacks of using these methods of fixation.[15-17] Due to all these complications, this method of fixation were decreased in popularity.[15-17]

In fractures type 33-C3, intra-articular element should be stabilised first by interfragmentary screws and so intramedullary nails are not recommended.[18-22] If treated with intramedullary nail, axial loading causes loss of distal fixation leading to nail failure resulting in catastrophic nail penetration of nail in knee joint. Other complications were knee stiffness in about 48% of the cases; anterior knee pain (22%), loss of reduction (7%), breakage of the locking screws (8%).[18-22] Lateral locked plates in management of distal femur fractures are used but single plate resulted into other complications like non-union, mal-union, loss of reduction, rotational deformity and breakage of plate resulting into revision surgery in a rate of 20% to 23%.[22-27] With unique geometry of the distal femoral condyles with a 25^0 of inclination in the medial femoral condyle and 10^0 of the lateral femoral condyle, risk increases with MIPPO technique causing Rotational mal-alignment. This mal-

rotation alignment affects mainly patella-femoral articulation leading to anterior knee pain and aggravates osteoarthritic changes.[18,28]

In current study, we implicated the column theory that was described in different intra-articular fractures with double plating techniques like in distal humerus, acetabulum, tibial plateau, and plafond fractures. Addition of medial plate to lateral plate in management of distal femur fractures provides better stability for fracture fixation.[29] The average union rate was 9 months (6-12 months). Bone grafting was needed in 10 patients. Surgical debridement was done for 1 case which had superficial skin infection. The majority had good to excellent functional and radiological outcomes. In a biomechanical study done by Prayson et al it was found that the supplementation of the medial column by medial plate must be considered to prevent varus collapse, especially in highly comminuted meta-physeal fractures with bone loss.[30]

Limitations

Sample size was smaller and follow up period was shorter are the factors taken into consideration as limitations. Larger study of population and Meta analysis are needed for verification of data. Besides this, all patients were selected without randomization which can cause bias and confounding factors. Inspite of this, our study provides statistically significant data regarding outcome of patients with distal femur fractures treated with dual plating.

CONCLUSION

High incidences of distal femur fractures are seen in young patients with high velocity injuries and accidental falls in older patients. The new concept of Dual Plating with option of locked screws has provided the means to increase the rigidity of fixation and is a reliable and effective modality of treatment. Dual 4.5 anatomically contoured locking plates is a good implant to use for fractures of the distal femur. Properly placed accurate positioning and fixation are required to produce good results. It improvises the fracture stability and patients achieve early rehabilitation with good range of motion, strengthening muscle exercises, early weight bearing and mobilisation of patients. Single lateral plating of distal femur fractures was associated with relatively higher failure rate. Addition of medial plate along with lateral plate reduces chances of fixation failure. It must be emphasized that if no signs of radiological healing noticed within 6 months postoperatively and every 3 months afterward, autologous bone graft shall be considered.

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REFERENCES

1. Chapman J, Henley M. Double plating of distal femur fractures: indications and technique. Tech Orthop. 1994;9:210-6.
2. Imam MA, Torieh A, Matthana A. Double plating of intra-articular multifragmentary C3-type distal femoral fractures through the anterior approach. Eur J Orthop Surg Traumatol. 2018;28:121-30.
3. Steinberg E, Elis J, Steinberg Y, Salai M, Ben-Tov T. A double-plating approach to distal femur fracture: a clinical study. Injury. 2017;48:2260-5.
4. Gwathmey W, Jones-Quaidoo S, Kahler D, Hurwitz S, Cui Q. Distal femoral fractures: current concepts. Am Acad Orthop Surg. 2010;18:597-607.
5. Rajasekaran RB, Jayaramaraju D, Palanisami D, Agraharam D, Perumal R, Kamal A, et al. A surgical algorithm for the management of recalcitrant distal femur nonunions based on distal femoral bone stock, fracture alignment, medial void, and stability of fixation. Arch Orthop Trauma Surg. 2019;139:1057-68.
6. Pie´tu G, Ehlinger M. Minimally invasive internal fixation of distal femur fractures. Orthop Traumatol Surg Res. 2017;103(1S):S161-9.
7. Lujan TJ, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, Bottlang M. Locked plating of distal femur fractures leads to inconsistent and asymmetric callus formation. J Orthop Trauma. 2010;24(3):156-62.
8. Henderson CE, Bottlang M, Marsh JL, Fitzpatrick DC, Madey SM. 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.
9. Hutson JJ, Zych GA. Treatment of comminuted intraarticular distal femur fractures with limited internal and external tensioned wire fixation. J Orthop Trauma. 2000;14(6):405-13.
10. Chapman J, Henley M. Double plating of distal femur fractures: indications and technique. Tech Orthop. 1994;9:210-6.
11. Kregor PJ, Stannard JA, Zlowodzki M, Cole PA. Treatment of distal femur fractures using the less invasive stabilization system: surgical experience and early clinical results in 103 fractures. J Orthop Trauma. 2004;18(8):509-20.
12. Merritt K. Factors increasing the risk of infection in patients with open fractures. J Trauma. 1988;28:823-7.
13. Worlock P, Slack R, Harvey L, Mawhinney R. The prevention of infection in open fractures: An experimental study of the effect of fracture stability. Injury. 1994;25:31-8.
14. Merritt K, Dowd JD. Role of internal fixation in infection of open fractures: Studies with Staphylococcus aureus and Proteus mirabilis. J Orthop Res. 1987;5:23-8.
15. Arazi M, Memik R, Ogu¨n TC, Yel M. Ilizarov external fixation for severely comminuted

supracondylar and intercondylar fractures of the distal femur. J Bone Joint Surg Br. 2001;83(5):663-7.
16. Marsh JL, Jansen H, Yoong HK, Found EM. Supracondylar fractures of the femur treated by external fixation. J Orthop Trauma. 1997;11(6):405-11.
17. Ali F, Saleh M. Treatment of isolated complex distal femoral fractures by external fixation. Injury. 2000;31(3):139-46.
18. Beltran MJ, Gary JL, Collinge CA. Management of distal femur fractures with modern plates and nails: state of the art. J Orthop Trauma. 2015;29(4):165-72.
19. Janzing HM, Stockman B, Van Damme G, Rommens P, Broos PL. The retrograde intramedullary supracondylar nail: an alternative in the treatment of distal femoral fractures in the elderly? Arch Orthop Trauma Surg. 1998;118(1-2):92-5.
20. Ingman AM. Retrograde intramedullary nailing of supracondylar femoral fractures: design and development of a new implant. Injury. 2002;33(8):707-12.
21. Handolin L, Pajarinen J, Lindahl J, Hirvensalo E. Retrograde intramedullary nailing in distal femoral fractures-results in a series of 46 consecutive operations. Injury. 2004;35(5):517-22.
22. Watanabe Y, Takai S, Yamashita F, Kusakabe T, Kim W, Hirasawa Y. Second-generation intramedullary supracondylar nail for distal femoral fractures. Int Orthop. 2002;26(2):85-8.
23. Rodriguez EK, Boulton C, Weaver MJ. Predictive factors of distal femoral fracture nonunion after lateral locked plating: a retrospective multicenter case-control study of 283 fractures. Injury. 2014;45(3):549-54.
24. Kregor PJ, Stannard J, Zlowodzki M, Cole PA, Alonso J. Distal femoral fracture fixation utilizing the Less Invasive Stabilization System (L.I.S.S.): the technique and early results. Injury. 2001;32(3):SC32-47.
25. Ricci WM, Streubel PN, Morshed S, Collinge CA, Nork SE, Gardner MJ. Risk factors for failure of locked plate fixation of distal femur fractures: an analysis of 335 cases. J Orthop Trauma. 2014;28(2):83-9.
26. Large TM, Kellam JF, Bosse MJ, Sims SH, Althausen P, Masonis JL. Locked plating of supracondylar periprosthetic femur fractures. J Arthroplasty. 2008; 23(6):115-20.
27. Schu¨tz M, Mu¨ller 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(3):SC48-54.
28. Kim JW, Oh CW, Oh JK. Malalignment after minimally invasive plate osteosynthesis in distal femoral fractures. Injury. 2017;48(3):751-7
29. Briffa N, Karthickeyan R, Jacob J, Khaleel A. Comminuted supracondylar femoral fractures: a biomechanical analysis comparing the stability of medial versus lateral plating in axial loading. Strat Trauma Limb Reconst. 2016;11(3):187-91.
30. Prayson MJ, Datta DK, Marshall MP. Mechanical comparison of endosteal substitution and lateral plate fixation in supracondylar fractures of the femur. J Orthop Trauma. 2001;15(2):96-100.

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