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Correlation between functional and radiological outcome of distal femur fractures treated with minimally invasive percutaneous plate osteosynthesis locking compression plate

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Abstract

Aims: To prospectively study the functional outcome of extra articular and intra articular distal femur fractures treated with minimally invasive percutaneous plate osteosynthesis using modified Rasmussen criteria and correlation with radiological outcome described by Handolin *et al.*

Materials and Methods: Total 25 patients with distal femur fractures [A1 A2 A3 B1 B2 B3] were treated in our institution. They were operated with minimally invasive percutaneous plate osteosynthesis [mippo] lcp between december 2019 to june 2021 and examined according to protocol clinically and radiologically. Followed up regularly by clinical examination, rasmussens clinical scoring and xrays taken immediately after operation, at 6weeks, 12 weeks, and 24 weeks after surgery and ct scan in 3rd to 5th postoperative day or at immediate follow up.

Results: Total 25 patients were evaluated postoperatively thoroughly for functional and radiological outcome using modified Rasmussen's criteria and criteria described by Handolin *et al.* which showed excellent and good results of functional outcome in 65% (16) and 35% (9) patients respectively and no poor results. Coronal and sagittal alignments were satisfactory in 92% and 96% of subjects. Rotational alignment was satisfactory in 56% of patients. According to Handolin *et al.* classification excellent results in 16% (4) of patients good in 40% (10) fair in 32% (8) poor in 12%(3) of subjects. Leg length discrepancy was satisfactory in 92% (23) of patients.

Conclusion: Minimally invasive percutaneous plate osteosynthesis (MIPPO) showed an excellent option in treating the distal femoral fractures due to minimal soft tissue disruption. But regardless of the fracture pattern, rotational malalignment may occur at an extremely high rate after mippo for distal femoral fractures whereas satisfactory alignment is obtained for coronal and sagittal alignments and limb length.

Keywords: Distal femur fractures, minimally invasive, indirect reduction techniques, MIPO, Rasmussens clinical score, locking compression plate

Introduction

Distal femur fractures are one of the complex injuries that are encountered in our day to day practice with the incidence of about 0.37% of all fractures and 4 to 7% of all femoral fractures [1]. Distal femur fractures were facing considerable challenge in the management due to high energy trauma with extensive soft tissue injury with articular and metaphyseal involvement [2]. Many studies advised open reduction and internal fixation with various fixation devices ie, Interfragmentary screw, 95 degree angled blade plate, Dynamic condylar screw, Antegrade intramedullary nail, Retrograde intramedullary nail, Condylar buttress plate and the Locking compression plate [2].

The principle of locking compression plate is to have rigid fixation close to the bone and under the soft-tissue envelope and can be applied without stripping periosteum which is very much essential for fracture healing [3].

Studies have proved that distal femur fractures treated with minimally invasive percutaneous plate osteosynthesis (mippo) locking compression plate showed good functional outcome and less complications like postoperative infections, knee joint stiffness and is a stable method of

fracture fixation [4, 5]. However indirect reduction lead to greater rotational malalignment compared to open reduction in distal femur fracture fixation [6]. Recent studies shown that minimally invasive plate osteosynthesis is an excellent option in treating distal femur fractures both articular and extraarticular types [7]. But there are limited studies in assessing the functional outcome and complications following the procedure. Hence the need for study is to assess the functional outcome and incidence of malalignment of distal femur fractures treated with minimally invasive percutaneous plate osteosynthesis (mippo) and correlation of functional and radiological outcome.

Materials and methods

Prospectively followed up 25 cases of Distal Femur fractures treated with minimally invasive percutaneous plate osteosynthesis (MIPPO) LCP during 18 month period in our hospital.

Study was conducted on patients of all age groups with distal femur fracture treated by minimally invasive percutaneous plate osteosynthesis with locking compression plate within 1 week of injury. Extra articular (A1, A2, A3) and Intraarticular fractures (B1, B2, B3, C1, C2) were included in the study. Patients with distal femur fracture are admitted and examined according to protocol both clinically and radiologically.

Open fractures type 2 and 3 of Gustillo-Anderson classification were excluded from the study. Pathological, periprosthetic fractures and patients with associated tibial plateau fractures and bilateral lowerlimb injuries were also not included in the study.

Surgical technique

Under anaesthesia patients were placed in the supine position on a radiolucent table. Before sterile draping, correct anteroposterior fluoroscopic images of the contralateral hip and knee were obtained, which were used as a reference for appropriate intraoperative rotational alignment.

The standard lateral parapatellar approach was used with the knee in 30 to 60 degrees of flexion, supported by a rolled sheet. If a distal femoral articular fracture was present, it was reduced anatomically under direct visualization and fixed with two or three fully threaded 3.5-mm screws while avoiding the area of the lateral plate. Indirect reduction of the metaphyseal fracture was done and fixed with temporary K-wires. Thereafter, an anatomically pre-contoured locking plate for distal femur was inserted submuscularly and preliminarily fixed with temporary K-wires.

Before definitive screw fixation of the plate, the coronal alignment was checked by the cable method, the sagittal alignment was verified by lateral fluoroscopic images, and the rotational alignment was assessed by comparing the lesser trochanter profile to that of the contralateral leg using the fluoroscopic images obtained for the opposite side. When alignments were thought to be satisfactory, definitive plate

fixation with screws was performed. After plate fixation, coronal, sagittal, and rotational alignments were reconfirmed.

Rehabilitation started on the second postoperative day with quadriceps setting and continuous passive motion of the hip and knee joints. After discharge, patients were encouraged to perform straight leg-raising exercises. Non-weight bearing was recommended until callus bridging was visualized on plain radiographs. Coronal and sagittal plane angulations were assessed on anteroposterior and lateral full-length femur films obtained immediately after surgery and at the latest follow-up visits.

Postoperative anteversion CT of both legs for femoral version was performed to assess rotational alignment 3–7 days after surgery or on the next out-patient clinic visit after discharge for regular follow-up. During each visit patients were assessed clinically and radiologically.

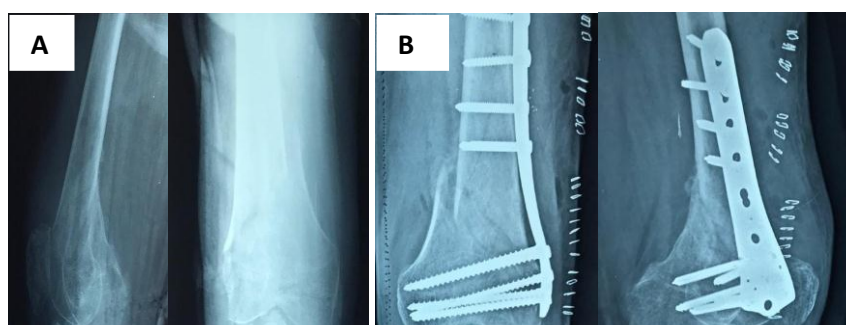
Clinical assessment at 1month, 3 months, 6 months follow up visits were done using Modified Rasmussens clinical score [8] which considered subjective symptoms like pain, walking capacity and clinical signs like extension, total range of motion, and stability. Results were graded into 4 groups (28-30, excellent; 24-27, good; 20-23, fair; <20, poor).

Coronal, sagittal, and rotational alignments and limb shortening were classified into four groups, as described by Handolin *et al.* [9] (side-to-side difference of alignment: <3°, excellent; 4°-7°, good; 8°-12°, fair; >12°, poor; Side-to-side shortening difference: <9mm, excellent; 10-19mm, good; 20-29mm, fair; >30mm, poor). Excellent and good categories were considered satisfactory, whereas fair and poor were regarded as unsatisfactory. Functional outcome and postoperative malalignment were analyzed using Pearson's χ^2 test. Statistical significance was accepted for p values < 0.05.

Results

In our study of 25 patients most young was of age 24 years and elderly was of 68 years. Mean age was 46.4 years. Males predominated females in the ratio of 76:24. Right femur was affected in 64% of patients (16) and left femur was affected in 36% (9) of patients.

Road traffic accidents were the main mode of injury, Was found in 56% of patients (14) and remaining 11 people (44%) had history of self fall. 84% of patients presented with distal femur fracture had closed type of injury and the remaining 16% patients had grade 1 open type injury. Mullers type A3 was the most common fracture pattern, in 48% of the patients followed by A2 (24%) and A1(16%). The time interval between the date of injury to that of surgery ranges between a minimum of 2 days to the maximum 7 days (Mean = 4.5days). The operating time varies between 70 minutes to 150 minutes. The mean operating time was 98 minutes. The time taken to achieve union ranges between minimum of 12 weeks to maximum of 20 weeks. (Mean = 15 weeks).



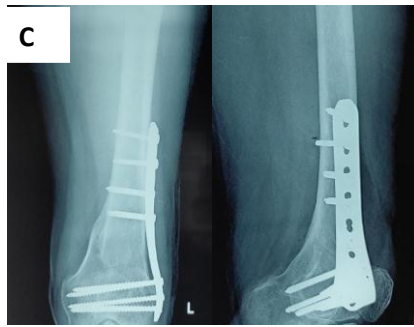


Fig 1: A) Preoperative radiograph of a 42 year old male with A3 type distal femur fracture, B) post operative radiograph after MIPPO-DFLCP, C) at 6 months follow up showing good union



Fig 2: Coronal Alignment Assessed In Lowerlimb Scannogram and Assessment of Sagittal Alignment

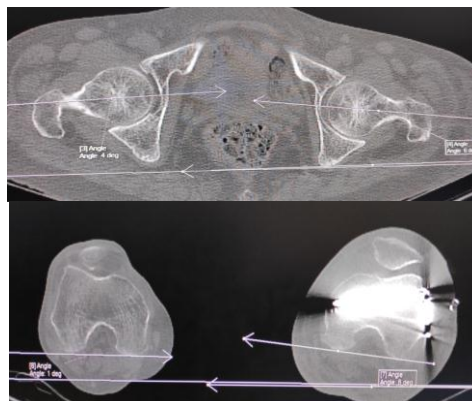


Fig 3: Axial ct sections at hip and distal femur level to assess the rotational alignment



Fig 4: Functional outcome at the follow up of 6 months after surgery

The coronal sagittal alignment measured from the radiographs a d difference is noted. Coronal alignment varied from 2⁰ to 10⁰ (mean: 4.8⁰). Sagittal alignment varied between 2⁰ to 8⁰ (mean: 3.9⁰). Rotational alignment varied between 2⁰ to 13⁰ (mean: 6.6⁰).

Limb length was measured and compared with opposite limb for shortening or lengthening. Shortening was observed ranges from 3mm to 24mm (mean: 10mm).

Table 1: Radiological outcome by Handolin *et al.* criteria

S. No	Outcome	Coronal Alignment	Sagittal Alignment	Rotational Alignment	Limb Length Discrepancy
1	Excellent	8	11	4	16
2	Good	15	13	10	7
3	Fair	2	1	8	2
4	Poor	0	0	3	0

Mean Rasmussens score was found to be 28. In this study 65% of the patients (16) showed excellent outcome and 35% of the patients showed good outcome (7). No fair or poor functional results were observed.

Table 2: Rasmussen's clinical score

Follow up	Minimum score	Maximum score	Mean score
1 month	16	21	18
3 month	20	27	24
6 month	23	29	26
Final	24	30	28

Knee stiffness was observed in 2 patients. 2 cases of postoperative infections were reported. Post operative reduction loss was noticed in one case in which revision open surgery and fixation was needed. 1 case of DVT was reported which was treated conservatively

Discussion

Due to the changing concepts towards relative stability and biological fixation from absolute stability and rigid fixation, minimally invasive percutaneous plate osteosynthesis (MIPPO) technique evolved. Many studies proved better outcome with lesser morbidity than the conventional technique.

In our study of 25 patients with distal femur fracture 19 were males (76%) and 6 patients were females (24%). Majority of the patient was in the age group of 30 to 50 years which comprised 40% of the total study group.

16 patients had injury to the right lower limb (64%) and 9 had left limb injury (36%). Road traffic accident was the major mode of injury (14 patients) and the remaining 11 people had history of self fall. Type A3 was the common type of fracture pattern

(12 patients- 48%) followed by A2 and A1 (6 and 4 patients respectively). 4 patients had grade 1 open injuries, remaining all cases were closed fractures.

All admitted cases were operated between 2 to 7 days post admission. The mean operating time was found to be 98 mins compared to 119 minutes by Yeap and Deepak *et al.* [10]. The time needed for the fracture to unite was 12 weeks minimum to a maximum time of 20 weeks. Average time to unite was found to be 15 weeks) which was comparable to 11 weeks by Kregor *et al.* [11], 14.3 weeks by Schandelmaier *et al.* [12], 12 weeks by Fankhauser *et al.* [13] and 18 weeks by Yeap and Deepak *et al.* [10]

Rasmussen's scoring system was used to assess the functional outcome. Minimum score was 24 and maximum score to 30. Mean score was found to be 28. In this study 65% of the patients (16) showed excellent outcome and 35% of the patients showed good outcome (7) comparable to 72.7 % by Yeap and Deepak *et al.* [10] No fair or poor functional results were observed.

Correlation between functional and radiological outcome

The functional and radiological results were correlated by means of statistical analysis. The Rasmussens clinical score recorded in the final follow up period was considered. It was correlated with radiological results obtained. From the analysis it has been concluded that there is no statistical relationship between sagittal malalignment and functional outcome (p value =0.584). Coronal malalignment and rotational malalignment were proved to be inversely related to functional outcome, where rotational alignment was related with high significance (p value =0.049). So high degrees of rotational malalignment was produced following the procedure despite good functional outcome

Table 3: Correlation between Rasmussens score and Rotational malalignment

Variable 1	Variable 2	Pearson correlation	Significance
Sagittal malalignment	Rasmussens final functional score	0.115	0.584
Coronal malalignment	Rasmussens final functional score	-0.595	0.002
Rotational malalignment	Rasmussens final functional score	-0.397	0.049

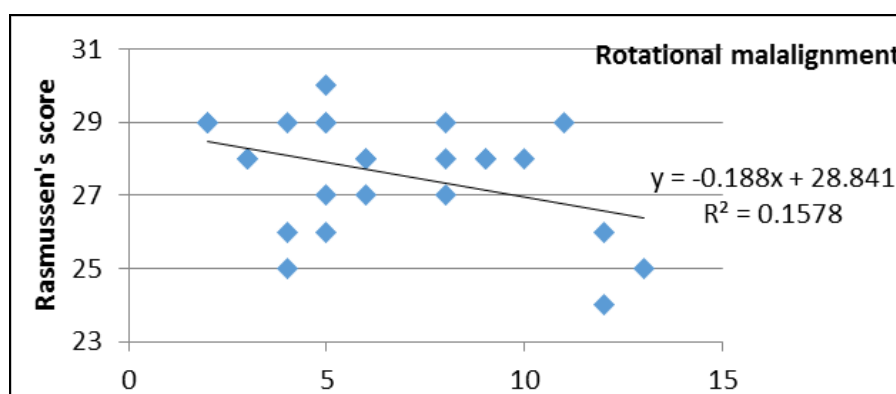


Fig 5: Correlation between Rasmussens score and Rotational malalignment

Conclusion

In our study, Minimally Invasive percutaneous Plate Osteosynthesis (MIPPO) technique using Locking Compression Plate (LCP) showed good to excellent results in terms of union and functional outcome. When operated within two weeks of injury, it was easier to achieve closed reduction. This decreases the operating time, blood loss and intra-operative morbidity.

Indirect reduction lead to coronal sagittal and rotational malalignment. Functional outcome was inversely related to radiological malalignment. Strong negative correlation was observed with rotational malalignment.

We conclude that the Minimally Invasive percutaneous Plate Osteosynthesis (MIPPO) technique using Locking Compression Plate (LCP) will results in early post- operative rehabilitation, satisfactory union and good functional outcome. The chances of infection and implant failure are less. However incidence of rotational malalignment is more. Proper patient selection and meticulous surgical techniques will give the best results.

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References

1. Martinet O, Cordey J, Harder Y, *et al.* The epidemiology of fractures of distal femur, *Injury.* 2000;31(3).
2. Cory Collinge A, Donald Wiss A. "Distal femur fractures", chapter 51 in Rockwood and Green fractures in adults, USA: Lippincott Williams and Wilkins, 2010, 1719pp
3. Smith Wade R. "Locking Plates – TIPS and Tricks." *The Journal of Bone and Joint Surgery.* 2007;89:2298-2307.
4. Mize RD, Bucholz RW, Grogan DP. Surgical treatment of displaced, comminuted fractures of the distal end of the femur. *J. Bone Jt Surg.* 1982;64-A, 871-879.
5. Olerud S. Operative treatment of supracondylar condylar fractures of the femur Technique and results in fifteen cases. *J.Bone Jt Surg.* 1972;54-A:1015-1032.
6. Lill M, Attal R, Rudisch A, Wick MC, Blauth M, Lutz M. Does MIPO of fractures of the distal femur result in more rotational malalignment than ORIF? A retrospective study. *Eur. J Trauma Emerg Surg,* 2015, doi:<http://dx.doi.org/10.1007/s00068-015-0595-8>.
7. Chandrasekaran M, Ravichandran Subbaraj, Nandakumar R, Krishna Bhargava Reddy. "Distal femur fractures treated with mipo locking compression plate technique: A prospective study on the functional outcome, *International Journal of Orthopaedics Traumatology & Surgical sciences.* 2016;2(2):263-268.
8. Rasmussen PS. Tibial condylar fractures. Impairment of knee joint stability as an indication for surgical treatment. *J Bone Joint Surg Am.* 1973;55:1331-1350.
9. 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;35:517-22.
10. Yeap EJ, aASD. "Distal femoral Locking Compression Plate fixation in distal femoral fractures: early results." *Malaysian Orthop J.* 2007;1(1):12-17.
11. Kregor PJ, ea. "Distal femoral fracture fixation utilizing the Less Invasive Stabilization System (LISS): the technique and early results". *Injury.* 2001;32:32-47.
12. Schandelmaier P, ea. "Distal femoral fractures and LISS stabilization." *Injury.* 2001;32:55-63.
13. Fankhauser F, ea. "Minimal-invasive treatment of distal

femoral fractures with the LISS (Less Invasive Stabilization System) A prospective study of 30 fractures with a follow up of 20 months." *Acta Orthopaedica.* 2004;75(1):56-60.