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DISTAL FEMUR FRACTURES TREATED WITH MIPO LOCKING COMPRESSION PLATE TECHNIQUE: A PROSPECTIVE STUDY ON THE FUNCTIONAL OUTCOME

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Abstract:

Fractures of distal femur are one of the complex injuries with the incidence of about 0.37%. These injuries have potential to generate significant long-term disability particularly when they are related with marked bone comminution, extensive articular cartilage damage and severe soft tissue injury. Aim of the present study is to assess the functional outcomes of Minimally Invasive Precutaneous Plate Osteosynthesis (MIPO) for distal femur fractures.In the present prospective study, 23 patients with distal femur fractures in adult were treated using locking compression plate and MIPO technique. The patients were selected from Mahatma Gandhi Medical College and Research Institute, Pondicherry. Rasmussen's scoring system was used for evaluating the functional assessment, focused on Clinical and radiological parameters. In this system, there are scoring points for subjective complaints, clinical signs, available range of motion and stability. The analysis was done in terms of gender, age group, Mode of injury, frequency and type of injury, surgical intervention and complication. Majority of the injured patients were male (56.5%). Among male patients 73.3 % of the injury was due to road traffic accidents, whereas among females majority of them were injured due to domestic fall. Common age group was found to be 41-60 years accounting 39%. All fractures in our patients went on to unite and the average union time was about 16 weeks with the range of 12 to 20 weeks. Of 23 patients only one patient had restricted ROM of about 70^0 and all the other patients had ROM of about 110^0 – 130^0. Two patients had limb shortening of 5-10 mm. Functional outcome was assessed using Rasmussen's scoring and we had excellent and good results in 15 (65%), 8 (35%) patients respectively. No poor results in our series. Minimally invasive percutaneous plate osteosynthesis is an excellent option in treating the distal femoral fractures of both the articular and extra articular types. Complications in this technique can be minimized by mastering the surgical procedure with sound knowledge about the complex anatomy of the distal femur.

Key-words: *MIPO, Distal femur fracture, Rasmussen's scoring system, locking compression plate.*

Introduction:

Fractures of distal femur 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 approximately 4% to 7% of all femoral fractures.[1] Generally in younger individual, distal femur fractures are due to high-energy injury mechanism where as in elderly especially in woman it occurs due to low-energy mechanism.[2] Ironically these injuries are prone to produce long term disability for the patient.[3] Fracture at the lower end of femur and upper end of tibia are often difficult to treat and tend to relate with several complications.[4] Distal femoral fractures have wide variety of fracture pattern and they are often associated with injuries like patellar fracture, open wounds and ligament disruption. These injuries have potential to generate significant long-term disability particularly when they are related with marked bone comminution, extensive articular cartilage damage and severe soft tissue injury.[5] Minimally Invasive Plate Osteosynthesis (MIPO) has been widely used in the treatment of long bone fractures and it was introduced by Wenda et al[6] and Farouk et al[7] Krettek et al.[8] The MIPO technique was introduced to prevent extensive exposure at the fracture site and there by reduces soft tissue damage.[9] It allows biological fracture healing by preserving the vascularity of majority of the bone fragments which will serve as a living bone graft during fracture healing. In Minimally Invasive Plate Osteosynthesis (MIPO), the plate inserted by a percutaneous approach minimizes soft tissue disruption, periosteal injury with preservation of fracture biology of the bony fragments.[10,11] MIPO is a method that combines both principles of the biomechanical properties of the fixation and an optimum bone to implant contact with preservation of biology of healing.[10,11] our aim was to assess the functional outcome of MIPO-Locking Compression Plate (LCP) technique for distal femur fractures.

Methods:

The proceedings were followed according to the ethical principles of the Institutional Human Ethics Committee and with the Helsinki Declaration. Institutional Ethics Committee had accepted the current study. Before starting the study, informed consent was acquired from each subject Patients with fractures around the knee presented to the emergency department at our institute and diagnosed to have supracondylar fractures of the femur in an adult were included in this study. It includes both types of distal femur fractures such as supracondylar (distal 15 cm of the femur) and intercondylar (articular surface) fractures. It was a prospective study and the period of study was from January 2012 to February 2014 with a minimum follow up of 18 months. A total of 23 patients of both sex was included in the study. Patients who attended our institute during the above mentioned period only were included in the study. All patients were operated within 5 days of the injury. MIPO technique was used for all patients. Patients with associated ipsilateral fractures, pathological fractures, delayed presentation of more than one week and age less than 18 years were excluded from the study. The functional outcome was assessed using the criteria given by Rasmussen for all the patients. Surgical procedure:

All patients were operated on fracture table with the fractured limb on traction and normal limb in lithotomy position under regional anaesthesia (Fig.1 A). A 4.5 mm distal femur locking compression plate (Indian implant anatomic LCP - DF) was used in all patients. Fractures involving articular surfaces were reduced anatomically by closed techniques and provisional fixation was done using 2.5 mm k wires from medial to lateral. If articular reduction was not satisfactory, through joystick technique condyles were manipulated and reduction was achieved. Then the metaphysical reduction was achieved to get anatomical alignment, rotation rather than anatomical reduction. Rotation was assessed intraoperatively using an imaginary line connecting anterior iliac spine and tibial tuberosity and the continuity of meta-diaphyseal cortical thickness under image intensifier. Then 5 – 6 cm oblique lateral incision was made through lateral approach for the distal femur (Fig 1 B). Extra periosteal dissection was carried out using a 10mm Cobbs elevator from distal to proximal direction in the subvastus plane. An appropriate sized plate to get 4 to 5 screws in distal and 5 screws in proximal segment of bone was chosen and was slid through the extraperiosteal plane across the fracture site and proximally plate was aligned through a separate 2-3 cm incision (Fig 1 C). Plate was provisionally fixed with k wires in the femoral condyles as well as in the diaphysis under image intensifier guidance after obtaining satisfactory reduction, rotation, and length. Any posterior angulation at the fracture site was corrected at this stage using bone levers through the plate entry wound, if required. Then fixation with cancellous and cortical locking screws were carried out checking in

both anteroposterior and lateral views in the image intensifier. Condylar fixation was carried out through plate entry wound and diaphyseal fixation was done using percutaneous incisions over the corresponding screw holes under image intensifier guidance. Any mediolateral displacement if present was corrected by inserting a non locking cortical screws first, followed by locking screws. After satisfactory fixation, stability was assessed under fluoroscopic imaging of the knee movement upto 90 degrees. For this purpose, the boot assembly of the fracture table was released while assessing the knee movement. All patients had satisfactory movement of upto 90 degrees during intraoperative checking. Wound closed without drain and compressive dressing applied with long knee brace support to the limb. Gentle ROM exercises, quadriceps exercises, ankle and toe pump exercises were initiated from the 2nd postoperative day onwards. Patients were allowed to have non weight bearing walking for the first 6 weeks following which progressive weight bearing was allowed depending on the radiological evidence of union. All patients were followed up at 6 weeks, 12 to 16 weeks,20 to 24 weeks, 9th month, 18thmonth. During each visit patients were assessed by Rasmussen's criteria apart from radiological assessment.

Results:

Out of 23 patients, 13 fractures were in men (56%). Common age group was 42-60 years accounting for 40% followed by 21-40 years age group accounting for 35%. Nearly 75% of the fractures were involving between the 20 – 60 years aged people. Road Traffic Accident (65%) was the common mode of injury and the frequency of injury was greater on the right lower limb (61%). Of the 23 patients, 20 patients (87%) were found to have closed type of injury followed by Grade 2 open fracture in one patients and Grade 1 in two. Among the Mullers type, fracture A2 was more common than other types accounting for 35% followed by C1 & C2 each accounting for 26%. On comparing articular and extra articular fractures, type C fractures were majority accounting for 52% of cases. Mean operative time was about 110 minutes with a range of 80 to 130 minutes. Average blood loss was about 80ml. All fractures in our series went on to unite and the average union time was about 16 weeks with the range of 12 to 24 weeks. Of 8 type A fractures, only one patient had metaphyseal angulation of about 10*. Of 12 Muller type C fractures, two patients had intraarticular step of about 5 mm as evidenced at the intercondylar notch level. Of 23 patients only one patient had restricted ROM of about 70* and all the other patients had ROM minimum of about 120* (Fig 4) at the final follow up at 18 months (Table 1). Four patients had extensor lag of about 5* at final follow up (Table 1). 15 patients were able to full weight bear at 16 weeks and the range was 12 to 24 weeks. One patient who had Muller's B1 type could resume full weight bearing at 12 weeks onwards. Here the patient required buttress plating by MIPO technique as the fracture was extending on to the metaphysis also. 4 patients who had type C2 fracture were able to full weight bear only at around 24 weeks with the evidence of radiological union (Table 1). There was one wound infection which was superficial involving skin and subcutaneous tissue encountered in grade II open fracture and settled with appropriate oral antibiotics for 2 weeks period. There was no non union or delayed union in our series. No patient required bone grafting. No patients received pharmacological prophylaxis for Deep vein thrombosis (DVT). All patients were put on DVT preventive limb exercises and stockings. One patient who had associated mild head injury had exuberant callus at the fracture site had resulted in restricted ROM to 70^0 to 80^0(Fig 5 A, B). Rasmussen's scoring system was used to assess the functional outcome at the end of 6 months, and at the final follow up at 18 months. Result was excellent in 16 (69%) patients followed by good result in 5 (21%) patients. Two patients had fair outcome in our series with no poor results as per Rasmussen's clinical criteria (Table 2).

Table:1
Fracture type and outcome

Type of fracture - Muller's	No. of patients	ROM at 18 months	Extensor lag	Fracture healing	Full weight bearing
A1	1	120* - 130*	Nil	14 weeks	14 weeks
A2	8	120*		16 – 20 weeks	6 patients at 16 weeks 2 patients at 20 weeks
A3	1	120*	5* One patient	24 weeks	24 weeks
B1	1	130*	Nil	12 weeks	12 weeks
C1	6	90*- 120*	5* one patient	16 weeks	16 weeks
C2	6	70* - 120*	5* two patient	20 – 24 weeks	2 patients at 20 weeks 4 patients at 24 weeks

0 Degrees

Table: 2
Rasmussen's clinical outcome

Rasmussen's clinical scoring	No. of patients	Outcome
28	16	Excellent
22	5	Good
17	2	Fair

Fig. 1
Showing operative technique in fracture table (Grade II open Fracture)

Fig 2
Pre op x-ray showing Muller- AO type A3 fracture of distal femur

Fig 3
Immediate post op x-ray (A) showing good reduction and fixation, B fully consolidated fracture

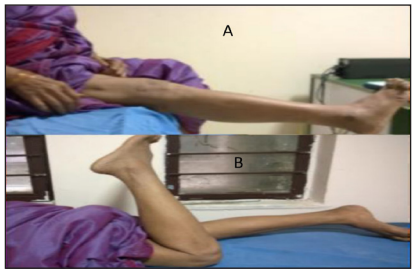

Fig 4
Showing functional outcome in one of our patient

Fig 5
Showing postop MIPO scar and healed fracture with exuberant callus and restricted ROM.

Discussion:

Fractures involving the distal femur have posed considerable therapeutic challenges in their management and are one of the commonest articular fractures, which is increasing day by day due to road traffic accident. After the 1980s, several studies have shown that operative treatment of the distal femur fractures resulted in better functional outcome than nonoperative

treatment.[11-13] Then later studies were done to compare the outcomes of open Vs closed reduction with internal fixation and found to have significant excellent or good results with lower incidence of malunion in the ORIF group.[13,14] Current study presents the clinical and radiological evaluation of 23 patients with distal femur fracture treated using MIPO technique with distal femur locking compression plate (LCP-DF). In this study common mode of injury was road traffic accidents in younger patients which is also the case in other studies.[1] when comparing Muller Types, A and C, overall type C fracture was more than type A or B, accounting for 52% of cases. Mean operative time was longer than the open technique as the reduction entirely relies on image assistance in both the planes. But the amount of blood loss was significantly lower than the open techniques as the soft tissue dissection was less than the open techniques. Only in 6 patients full weight bearing was prolonged to 24 months due to the presence of fracture comminution; otherwise full weight bearing was achieved from 12 weeks onwards with an average of 16 weeks in 15 patients accounting for 65%. Many studies have been done to assess the effectiveness of locking implants in the treatment of distal femoral fractures.[15-18] Locking compression plates which are biomechanically stronger than the conventional plates and can provide compression apart from adequate stability serves in dual mode known as Hybrid construct. Considering all these factors MIPO should yield superior results compared with all the conventional techniques when it is executed in an appropriate manner. Our study showed excellent and good results in our patients with no significant complications. All fractures went on to unite without any delayed, nonunion or malunion. No serious soft tissue related complications and significant blood loss. Early full weight bearing was achieved in 65% of cases with early union of fracture. Our results were comparable to that of Fankhauser et al,[18] Ravi et al.[19]

Conclusion:

Minimally invasive percutaneous plate osteosynthesis is an excellent option in treating the distal femoral fractures of both the articular and extra articular types. Complications in this technique can be minimized by mastering the surgical procedure with sound knowledge about the complex anatomy of the distal femur and the principles of MIPO and LCP.

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