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Surgical Management of Distal Femur Fracture Using Anatomical Locking Compression Plate

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ABSTRACT

Introduction: Distal femur fractures are common injuries and are mostly caused due to vehicular injuries in the middle-aged population. Operative treatment has been preferred in the current scenario with open reduction and internal fixation in these fractures.

Objective: To observe the surgical outcome of distal femur fractures operated with anatomical locking compression plate.

Methods: This is a prospective observational study in 24 patients (20 male and 4 female). We classified the fractures according to AO/OTA classification and the patients were treated accordingly with anatomical locking compression plating. Functional outcomes were assessed according to "Schatzker and Lambert Score" at final follow up.

Results: The mean age of presentation at the time of injury in the present study was 40.6 years. Open fractures were seen in 11 patients and associated ipsilateral limb injuries were seen in 8 and contralateral limb injuries were seen in 4 patients. The mean follow up in the present study was 9 months. There were 8 cases of infection with seven being superficial infection treated conservatively and one case had a deep infection which was treated with debridement and antibiotics. In our study, there were 79.2 % (n=19) excellent to good results and 20.8 % (n=5) fair outcome according to Schatzker and Lambert criteria).

Conclusion: Distal femur fracture treated with anatomical locking compression plate needs careful anatomical reduction, rigid fixation, early knee mobilization and weight-bearing on signs of healing with the early presentation to the hospital from the time of injury were the essential factors in achieving a better outcome for the patient.

Key Words: Distal femur fracture, Anatomical locking plate, Schatzker and Lambert scoring system, Soft tissue contractures, Rehabilitation, Vehicular accidents

INTRODUCTION

Fractures in the distal femur have posed considerable therapeutic challenges throughout the history of fracture treatment. These fractures are usually comminuted and readily deformed because of muscle forces acting on the distal fragment. This results in functional impairment of the knee joint and ankle because of injury to the quadriceps system. The distal femur fractures also often occur in elderly patients with osteoporosis.¹

Distal femur fractures occur at approximately one-tenth the rate of proximal femur fractures and make up 6-7% of all femur fractures.^{2,3} The most common high energy mechanism of injury is road traffic accident (53%) and the most common low energy mechanism is a simple fall (33%).^{4,5} These potentially serious injuries resulting in various degrees of permanent disability and continue to pose a therapeutic challenge to the orthopaedic surgeons, even today in achieving successful outcome. Various modes of treatment have been advocated by several authors. They vary from closed treat-

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ment with traction, application of cast brace following preliminary traction, open reduction and internal fixation with a variety of implants.

Elderly patients and osteoporosis add to the difficulty in intra-articular fractures. Loss of stable fixation is of great concern. The Locking compression plate has added advantages in these patients.⁶ Despite the advance in techniques and the improvement in surgical implants, treatment of distal femoral fractures remains a challenge in many situations.¹ Anatomic reduction of the articular surface, restoration of limb alignment, and early mobilization are effective ways of managing most distal femoral fractures.⁷

The locking compression plate has the advantage of the combination of compression plating, locked plating and bridge plating.⁸⁻¹⁰ This reduces soft tissue damage and periosteal vessels are preserved. Therefore, it acts as a closed external fixator.¹¹ In this study, we evaluated the results of distal femur fractures treated with distal femur anatomical locking compression plate, their clinical, radiological outcomes & complications.

MATERIALS AND METHODS

The prospective study was carried out in the selected group of patients treated in the Department of Orthopedics at the tertiary care district hospital. Study was conducted on consecutive 24 patients diagnosed with distal femur fractures presented to the casualty and orthopaedic department from November 2016 to October 2018, after taking written and informed consent. The study was approved by the Ethics Committee of the university (SVIEC/ Medi/BNPG15/D16208).

Patients were selected according to the inclusion criteria of the study and were briefed about the nature of the study, intervention to be done and post-operative rehabilitation. Inclusion Criteria included patient aged 18 years and above, the fractures of the distal femoral metaphyseal, metaphyseal-diaphyseal with or without intra-articular extension and distal third fractures of the femur, comminuted distal femur fracture, close fractures, fractures with Gustilo Anderson open grade I and II wounds were also included. The exclusion criteria included patients who didn't want to participate in this programme, patients under 18 years of age, patients medically unfit for surgery and patients who did not have minimum six months followup.

All the patients were treated according to a protocol which consisted of standard antero-posterior and lateral digital X-ray and pre-operative CT scan. Open wounds were taken to the operation theatre for wound debridement within 5 hours of admission. Polytrauma patients were fixed as soon as their general condition allowed for surgery. Passive quadriceps exercises were started after 3-5 days post-operative. The

patient was discharged with non-weight bearing walking for 12-16 weeks depending on the fracture pattern. Partial weight-bearing was started after early signs of the clinical and radiological union. Patients were followed up depending on the clinical examination as well as the radiological findings of the union. The statistical analysis was done using SPSS software (Illinois, Chicago) with a p-value less than 0.05 considered as statistically significant.

RESULTS

The prospective study was carried out in the selected group of patients treated in the Dept Orthopedics of a tertiary care district hospital from November 2016 to October 2018 on 24 consecutive patients. These included closed as well as open injuries and polytrauma patients. The average age of our present study was 40.6 years. The youngest patient in our study was 21 years and the oldest patient in our study was 68 years. There were 17 patients below 50 years of age and only 1 patient above the age of 61 years. We observed more of the young active population in our study. In our study, there was a male preponderance (n=20, 83.33%). It is generally observed that the number of males out ranks females in a trauma series in our country.

Manual labourer and farmer sustained a maximum injury to the distal end of the femur. Vehicular accident and fall from height were the main modes of injuries in our study for distal end of femur fractures. In our study, there were 13 cases of closed injuries (54.2%) and 11 cases of open injuries (45.8%) in which Gustilo Anderson Grade-I and Grade-II were (25%) & (20.8%) respectively. According to AO/OTA classification, Type-A accounted for 37.5%, Type B accounted for 0% and Type C accounted for 62.5% fracture in our study. Half of the patients (n=12, 50%) were operated within 2 days of admission.

In our study 19 patients (79.2%) were fixed with distal femur lock compression plate (DFLCP) as definitive treatment primarily and 5 patients (20.8%) were fixed with DFLCP in second procedure due to the presence of open grade II fractures fixed with external fixator primarily. In our study, 62.5% (15 patients) required only one surgical procedure followed by five patients who required two surgeries due to open injuries and three patients who required more than two surgical procedures due to post-operative complications (infection and non-union). The average time of hospitalization in our study was 18.8 days. In our study, the most common complication was an infection which occurred in eight patients (33.3%). Seven patients had developed a superficial infection and one patient had developed a deep infection. All patients except one resolved with intravenous antibiotics for two weeks and regular dressing. One patient had to get operated for debridement. The second most common

complication was fat embolism which occurred in 2 patients (8.3%) developed on second and third days after the operation and had recovered with treatment (oxygenation & heparinisation). Seven (29.2%) patients had knee joint stiffness at long term follow up. The rate of mal-union was 8.3% (n=2 patients) due to comminuted fracture type, delayed union was 8.3% (n=2 patients) and non-union was 4.2% (n=1 patient where additional bone grafting was done). The average time of union in our study was 18.2 wks. Majority of fractures (75%) united in between (15-20) weeks. The rate of fracture union in our study with anatomical locking compression plate was 95.8%. Out of 24 patients, only one patient had non-union and three patients developed union at >20 weeks follow up. In our study, 66.7% of patients (n=16) returned to their previous occupation while 12.5% of patients (n=3) had to change their occupation (clerical from manual).^{7,8,9}

In the present study 16 (66.7%) patients had no shortening, 5 (20.8%) had to shorten less than 1.5 cm, 2 (8.3%) had shortening in between 1.5-2.5cm. All seven patients were given shoe compensation as they denied further surgical intervention. In our study total, 5 (21%) patients developed fixed flexion deformity ($10\pm 2^\circ$, range 5-23°). All five patients had open fracture grade II. All patients opted for aggressive physiotherapy and continuous passive motion devices. In our study, there were 79.2% (n=19) excellent to good results and 20.8% (n=5) fair outcome according to SCHATZKER AND LAMBERT' criteria. The fair results were due to open type of injury, more than two surgical procedures, presence of deep infection, shortening and fixed flexion deformity of the knee due to soft tissue contractures.

DISCUSSION

An impacted linear or slightly displaced fracture results from a trivial trauma to the flexed knee from the anterior and slightly medial aspect of the knee. Usually, this kind of fracture pattern is seen in an osteoporotic bone. A violent force applied on the anterolateral side of the flexed knee produces an oblique fracture extending just proximal to the lateral epicondyle to well above the medial epicondyle. A transverse fracture is produced by severe force applied to the lateral side of the extended limb. This usually produces a condylar segment which is longer on the lateral side classically seen when a limb is struck by a motor vehicle at the knee.^{10,11}

The extensive force applied to the anterior aspect of the flexed knee, as in a fall from a height or a 'DASHBOARD' injury, produces a comminuted fracture of the distal femur extending on the shaft of the femur with comminution. Compression adduction forces on knee joint produce condylar fractures. Shearing force when applied right angle to the articular surface of the distal end of femur produces a fracture line parallel to the direction of the force. This is the mechanism

of injury in most cases of distal femur fracture with an inter-condylar extension. The quadriceps and the hamstrings produce longitudinal tension, which tends to produce overriding and angulation of the fragments, driving the proximal fragment into the supra-patellar pouch, and hence causing further displacement and haemorrhage. The posterior angulation and displacement of the distal fragment are caused by the strong pull of gastrocnemius.

There is much controversy regarding the best method of treatment for the distal femur fractures, as most of the time-poor results are obtained. In the past, closed treatment with traction, application of cast following preliminary traction was used for the treatment of open and close distal femur fractures. Outcomes after non-operative treatment were generally unsatisfactory, with a high incidence of fixed flexion deformity, varus mal-alignment, valgus mal-alignment, shortening and mal-rotation. As a result, since the late 1970s, open reduction and internal fixation through plate osteosynthesis has emerged as the gold standard of operative therapy.

In our study, most of the patients belong to the 4th decade (31-40 years) which included 7 (29.2%) patients. The mean age was 40.6 yrs which was almost equivalent to the study of Vishwanath C et al.,¹² of 44.0 yrs (range 22-74 yrs). All trauma series have high male preponderance. Similarly, we also had a maximum male preponderance with a ratio of male to female of 5:1. In Vishwanath C et al. study, out of 50 patients, there were 32 male & 18 females. Hence, the male to female ratio was 1.7:1 and in Sabarisree M et al.,¹³ male to female ratio was 2:1. Males are in majority as they comprise the majority of the earning population who drive for long distance daily. In our study, the most common mode of trauma was motorcycle accidents in 62.5% (15 patients), which is comparable to the study conducted by Vishwanath et al., (66%). In our country, motorcycles are the most common mode of transport in young males who are the bread earners of the family. With the rapid increase in population and number of vehicles plying on the roads in a developing country like ours, the relative expansion and maintenance of roads are not adequate and so the number of road traffic accidents are increasing along with the pattern of injuries.

In our study, the right side was most commonly injured in 66.6% (16 patients) who were comparable to the study done by Vishwanath et al., (66%). Most of the patients had right side involvement and it's due to left lane driving pattern in our country making right lower limb more vulnerable in the head-on collisions. 33.4% (8 patients) had a left-sided injury in our study. In our study, out of 24 patients, 13 (54.2%) patients had closed fractures and 11 (45.8%) patients had open fractures. This shows the gravity of injury and damage to the soft tissue envelope which is vital for healing. Open fractures are one of the most challenging injuries to a trauma surgeon. Compared to closed fractures,

they have a significantly higher risk of infection, delay in wound healing, high rate of non-union and often require multiple surgeries for definitive care. This in turn poses a mental trauma to the patient. In our study, the average hospital stay was 18.8 days which was comparable to 17.2 days in the study done by Yeap et al.¹⁴ The shortest stay was 5 days. The longest stay was 61 days in a patient who had open grade 2 distal femur fracture along with both bone forearm fracture, proximal tibia fracture and 2,3,4 metatarsal fracture on the same side. External fixator for the femur and proximal tibia, rush pin and K- the wire was done as additional procedures for associated fractures.

In our study, the average union time was 18.2 weeks who had a union at final follow up. This is comparable to study done by Vishwanath et al., which states average union as 13 weeks and Satish et al which states average union as 19.3 weeks. Rate of the union in our study was 95% which was similar to the studies of Vishwanath et al., (95%) Full knee range of motion (flexion & extension) was attained in 5 of our patients. Because of restricted knee movements, 58.3% of our patients had either difficulty or inability to squat. 54.2% of patients had either difficulty or inability to sit cross-legged. The possible causes for restriction of knee movement in our study were associated quadriceps injury, intra-articular comminution, open injuries leading to development of intra-articular adhesions and extra-articular adhesion of quadriceps.

CONCLUSION

The present study on surgical outcome of distal femur fracture treated with anatomical locking compression plate was done at our institute from November 2016 to October 2018. In our study there were 79.2% (n=19) excellent to good results and 20.8% (n=5) fair outcome according to SCHATZKER AND LAMBERT' criteria). The fair results were due to open type of injury, more than two surgical procedures, presence of deep infection, shortening and fixed flexion deformity of the knee due to soft tissue contractures. Open, comminuted and fractures with intra-articular extension had more number of unsatisfactory results. Incidence of infection was comparatively more in open cases due to late presentation as discussed earlier. Proper and adequate debridement is mandatory to minimize the incidence of infection in open cases. In accordance with knee range of motion, 5 (20.8%) patients had less than 90 degrees of range of motion. So we conclude that rigid fixation after anatomical reduction followed by early mobilization of the knee should be implemented in all cases. Injury to quadriceps mechanism or impingement to quadriceps mechanism should be recognized early and should be taken care of, to prevent extensor lag and fixed flexion deformity of the knee.

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Figure 1: A. 68 years old female with Type- A extra- articular distal femur fracture B. operated with distal femur anatomical plating C. Patient shows good results of knee extension at 12 weeks followup. D. Patient shows good results of knee extension at 12 weeks follow up.



Figure 2: A. 42 years old male with Open Type-C distal femur fracture B. Patient was operated primarily with external fixator. C & D. This was followed by distal femur anatomical plating E. Patient with knee extension showing fair result at 12 weeks follow up. F. Patient with knee extension showing fair result at 12 weeks follow up.

Table 1: Age distribution of patients operated for distal femur fractures.

Age in years	Patients	Percentage (%)
21-30	5	20.8
31-40	7	29.2
41-50	5	20.8
51-60	6	25
61-70	1	4.2
Total	24	100

Table 2: Distribution of various injury patterns among the patients.

Mode of injury	Patients	Percentage (%)
Vehicular injury	15	62.5
Fall	9	37.5
Assault	0	0
Others	0	0
Total	24	100

Table 3: Fracture pattern according to AO/OTA classification

Fracture Pattern	Patients	Percentage (%)
Extra Articular	9	37.5
A1	0	0
A2	5	20.8
A3	4	16.7
Intra Articular	15	62.5
B1	0	0
B2	0	0
B3	0	0
C1	6	25
C2	6	25
C3	3	12.5
Total	24	100

Table 4: Knee range of motion at final follow up

Knee Movements (Degree)	Patients	Percentage (%)
>120	4	16.7
110-120	1	4.1
100-110	6	25
90-100	8	33.4
80-90	1	4.1
<80	4	16.7
Total	24	100

Table 5: Fracture union in weeks at final follow up

Time (No. of weeks)	Patients	Percentage (%)
10-15	2	8.3
15-20	18	75
>20	3	12.5
No Union	1	4.2
Total	24	100