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Assessment of functional outcome of distal femur intra-articular fractures treated with locking compression plate

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ABSTRACT

Background: Intra-articular distal femoral fracture makes up to 6% of all femur fractures. Because they damage the cartilage surface of the bone, intra-articular fractures can be more difficult to treat. The locking compression plates have nowadays proven to be gold standard in treating both simple as well as complex intra-articular distal femur fractures. This study is to evaluate the complications, functional and anatomical outcome of distal femur fractures, treated by open reduction and internal fixation using distal femoral locking compression plate.
Methods: This is a retrospective study of 30 patients with intra articular distal femur fractures operated with distal femur locking compression plate during the period of 2015 to 2018 in a tertiary care hospital with age range from 17 to 71 years and follow up till 2 years. Fractures were classified according to AO classification and functional outcome assessed by using Neer criteria.
Results: 10 cases had excellent score (33%), 16 cases (52%) had satisfactory score, 3 cases (11%) had unsatisfactory score and only one case had poor score. 85.1% of patients were in between satisfactory to excellent results. Complications observed were excessive bleeding, difficulty in reduction, superficial infections, knee stiffness, malalignment and limb length discrepancy.
Conclusions: The distal femur locking compression plate is a good implant to be used for distal femur intra-articular fractures. Early surgery, anatomical reduction and early mobilisation are the prerequisites for good functional outcome. Comminution and bone defect on the medial side needs pillar reconstruction by fibular bone graft.

Keywords: Distal femur fractures, Locking plate, Funcional outcome, Complications

INTRODUCTION

Intra-articular distal femoral fracture occurs at approximately one tenth the rate of proximal femoral fracture and make up 6% of all femur fractures.[1] Most high energy distal femoral fractures occur in males because of road traffic accidents, between 15 and 50 years of age while most low energy fractures occur in osteoporotic women >50 years as a result of falls. High energy trauma mainly sustained in road traffic accidents in younger patient. Low energy trauma, in elderly patients with severe osteoporosis. No single method of management has overcome all of problems associated with these injuries, since last two decades incidence of this type of fractures has increased a lot due to a rise in road traffic accidents.[2] 55% of all the distal femoral fractures are intra articular.[3] There is a bimodal distribution of fracture based on age and gender. Because they damage the cartilage surface of the bone, intra-articular fractures can be more difficult to treat.[3]

The main therapeutic principle for management of intra-articular fracture is joint reconstruction which constitutes the first step along with anatomical reduction, minimal soft tissue dissection, stable internal fixation and early mobilisation. The knee must remain free and mobile at the surgical site. In case of a comminuted fracture, rotation and length should be carefully assessed. Operative procedures are useful in permitting early rehabilitation and mobilisation.[4] Principals surgical management includes dynamic compression plate, anterograde intra medullary nailing, retrograde nailing, simple screw fixation, external fixation, condylar blade plate, dynamic condylar screw and distal femur locking plate. Since non-locked plate fixation relies on the screw to bone fixation to compress the plate to the bone, failure of screw fixation leads to catastrophic failure of the construct.[5,6] Given its lower density, osteoporotic bone is at risk for this mode of failure since it cannot with stand significant insertion torque and the potential for stripping of the screws is increased.[7,8]

Nowadays the locking compression plates are extensively used in the management of intra-articular distal femur fracture. Since the locking compression plate can be used as a conventional plate using only dynamic compression, as a pure internal fixator using locking head screws, or as both combined. Locking plate fixation in the simple intra-articular fracture provides anatomical reduction along with stabilisation of the joint. Distal femoral locking compression plates are an atomically contoured and have multiple locking screw options distally to allow for secure fixation in patients with osteoporosis, fractures with metaphyseal comminution where the medial cortex cannot be restored, or a short articular segment. The implant offers multiple points of fixed-angle contact between the plate and screws in the distal part of femur, theoretically reducing the tendency for varus collapse that is seen with traditional lateral plates. Furthermore, when locking compression plate is used through a minimally invasive technique, it enables quick healing, decreased rates of infection, and reduced bone resorption as blood supply is conserved.[9]

The locking compression plates have nowadays proven to be gold standard in treating both simple as well as complex intra-articular distal femur fractures. This study is to evaluate the complications, functional and anatomical outcome of distal femur fractures, treated by open reduction and internal fixation using distal femoral locking compression plate.

METHODS

We have done retrospective study of 30 patients with intra articular distal femur fracture operated during the period of 2015 to 2018 at Grant Government Medical College and Sir JJ Group of Hospitals. All patients are included according to pre-defined inclusion and exclusion criteria.

Inclusion criteria

All patients of age of 18 years or above both male and female and closed grade fracture C1, C2, C3 according to AO classification are included.

Exclusion criteria

Patients with comorbidity, extra-articular, group A and B3 fracture (according to muller AO group A), pathological fracture, peri-prosthetic fracture, patients with vascular injury and with open wound fracture are excluded.

Protocol

On admission detailed examination of the patients was carried out after hemodynamic stabilisation include screening for head, abdominal, pelvic trauma and were subjected to routine pre-operative investigations: All our patients received initial management as per the protocol, includes primary immobilisation with a Thomas Splint or with high above knee slab. X-rays of the femur with knee in two orthogonal plans were obtained. Patients with severe comminution required CT scan/ 3D CT scan for better understanding of fracture anatomy.

Surgical techniques[10,11]

Position: Supine on a radiolucent table with knee placed in slight flexion over a small sand bag or a triangular frame.

Approach: Lateral approach

Reduction: We first anatomically reduce articular fragments and provisionally stabilise them with K wires. Then the proper sized plate is selected, and the fracture is fixed.

Post-operative

Post-operatively suction drain was removed after 3 days and first wound inspection was done on 3rd post-operative day. Intra-venous antibiotics were continued for 3 to 5 days. Post-operative physiotherapy advised according to the fracture pattern and fixation achieved. On post-operative day 3, active and assisted knee range of motion (ROM) exercises were initiated if the fixation was stable. At post-operative day 5 to 6, the patients were mobilised with crutches/walker until 6 weeks. Full weight-bearing ambulation without any aids was started at approximately 3 months in majority of the cases with radiographic evidence of fracture union.

Follow up

Patients were discharged on post-operative day 10 after suture removal. The first follow- up was at 6 weeks and subsequent follow-ups were done at 3 months, 6 months

and at 1 year and 2 years and the functional outcome were assessed by using Neers score straight leg rises. Static cycling without load, as well as firm passive range of motion exercises of the knee, allow the patient to regain optimal range of motion. Touch-down weight bearing (10-15 kg) may be performed immediately with crutches, or a walker. This will be continued for 6-10 weeks post-operatively. Touch-down weight bearing progresses to full weight bearing gradually over a period of 2 to 3 weeks (beginning at 6–10 weeks post-operatively). In general, patients are fully weight bearing without devices (e.g., cane) by 16-20 weeks.

The collected data was entered in MS excel and then was analysed and statistically evaluated in statistical package for the social science-17 chi-square/Fischer test for qualitative and student test was performed for quantitative data.

RESULTS

A total of 30 cases of intra-articular distal femur fractures were included in the present study and was approved by the institutional scientific and ethical committee. The total number of patients studied was 30 out of which 21 were males and 9 were females. The commonest age group was 46 to 60 years (45%) followed by 31 to 45 years (30%), right sided fracture was seen in 60% cases while 40% of patients had left sided fracture. Road traffic accident was the mechanism of injury in 70% of cases while 30% of patients reported fall. 10% patients had C1, 30% of patients had C2 type fracture and 25% presented with C3, remaining patients had 10% of B1 and B2 each. CT scan was performed in 5 patients (16.7%) and 3D CT scan was done in 3 patients (10%) to assess the fracture anatomy better . 85% of patients required operative time of less than 90 minutes while 15% required more than 90 minutes.

Intra operative complications observed were difficulty in reduction and excessive bleeding, On an average 550–650 ml of blood was lost in 14 patients while in the rest of the cases blood loss was <450 ml. Infection as immediate post-operative complication was seen in only one patient (3.34%). Late post-operative complications included knee stiffness and malalignment. There were no cases of non-union or infection in the post-operative phase. All the patients had discrepancy in the limb length after the treatment was given. Majority of the patients had a discrepancy of 1-1.5 cm in the length of the limb. An average of 1.3 cm of limb length discrepancy was observed in the patients. Quadricepsplasty was required in 47% of the patients mainly in C2 and C3 fractures. The mean flexion at 1.5 months follow up was 75.75±13.50 which increased to 85.75±12.28 and at six months follow up it was 106.6±15.80.

10 cases had excellent score (33%), 16 cases (52%) had satisfactory score, 3 cases (11%) had unsatisfactory score and only one case had poor score. In this study of the 24 patients with excellent outcome, all the patients aged 45 to 60 years and more than 60 years had excellent outcome while 50% of patients each aged less than 30 years and 31 to 45 years had excellent outcome but this difference was statistically not significant (p=0.094). It was observed that, all types of fractures had excellent outcome except type C2 and C3 where 66.67% and 66% of patients had excellent outcome respectively.

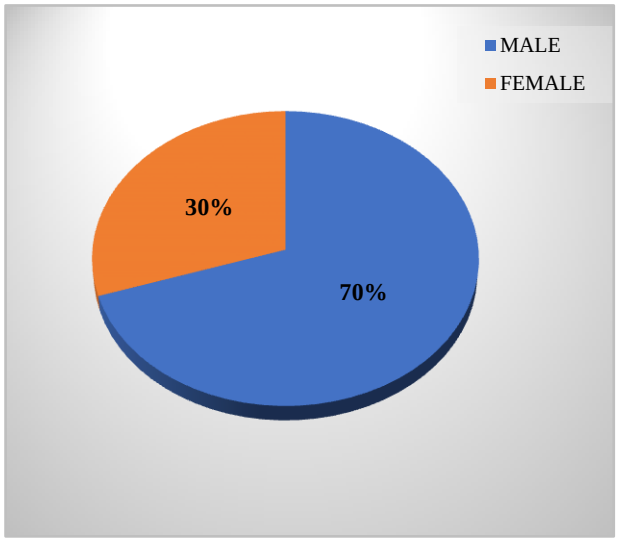

Figure 1: Sex distribution.

Table 1: Age distribution (n=30).

Age group (years)	Distribution	
	N	%
<30	3	10.00
31-45	9	30.00
46-60	14	45.00
>60	4	15.00
Total	30	**100.00**

Table 2: Range of motion (n=30).

Type	Intervals (months)	Distribution	
		Mean	SD
Flexion	3	75.75	13.50
	6	85.75	12.28
	12	106.6	15.80

Table 3: Association between type of fractures (according to AO muller classification) and outcome.

Type of fracture	Excellent		Good		Fair	
	N	%	N	%	N	%
B1	4	100.00	0	0.00	0	0.00
B2	4	100.00	0	0.00	0	0.00
C1	5	100.00	0	0.00	0	0.00
C2	9	66.67	1	12.67	1	12.67
C3	8	66.00	1	16.00	1	16.00
Total	26	85.18	2	07.07	2	07.07

Figure 2: (A) Intraoperative image, (B) X-ray, 1 year follow-up, (C) functional outcome.

Figure 3: Locking compression plate with fibular graft.

DISCUSSION

Fracture of distal femur has posed considerable therapeutic challenges throughout the history of fracture treatment. Most of these surgical failures were due to inadequate fixation of fracture fragment. The prognostic factors for distal femur fracture include age, intra-articular involvement and time of joint movement.

Sex distribution

Majority of the patients were male comprising of 70% of the total population studied and the rest were females (30%). The male female ratio studied in the current study was 2.33 because more outdoor activities as compared to females which corresponds to Ru et al study.[12] Hence this is similar to Link and Babst who stated that fractures occur in bimodal distribution with one group comprising predominantly of males sustaining high energy trauma and other group of older osteoporotic females.[13]

Age distribution

The mean age being 45.78 years with the youngest being 17 years and the oldest being 71 years. The peak incidence was found to be in the age group of 46-60 years (45%) followed by 31-45 years (30%). These findings corresponded to Nirav et al whereby almost 30 of distal femoral fractures occur in age group of more than 50

years. The osteoporosis within this group may pose problems for fixation.[14]

Side of involvement

18 patients comprising of 60% of the total population studied were found to have right sided fracture whereas the rest of the 40% (12 patients) had left sided fracture. None of the patients in the current study presented with bilateral femur fracture. This was differing from the study of Ru et al and Daroch et al, in which left leg was more involved. This difference in the laterality could be due to differences in genetic susceptibility, prevalence of other risk factors such as mechanism of injury and osteoporosis.[12,15]

Mechanism of injury

In the present study the mechanism of injury in majority of cases was found to be road traffic accident in 70% (21 patients) of the cases while the rest of the 30% cases (9 patients) reported fall. This is comparable to most of the related studies of Daroch et al, Link et al and Ru et al.[12,13,15]

Type of fractures

AO system of classification was used in the present study. 15% patients had C1, 30% of patients had C2 type fracture and 25% presented with C3. In the remaining, 10% had B1, 10% had B2. It was observed that, all types of fractures had excellent outcome except type C2 and C3 where 66.67% and 66% of patients had excellent outcome respectively.

Operative time

85% of the patients required operative time of less than 90 minutes whereas the rest of 15% took more than 90 minutes. Hence lesser time reduces the incidence of infections and thereby reduces the time of healing.

Complications

Intra operative

24 patients were having intra operative complications in the form of excessive bleeding in 45% (14 cases) along with difficulty in reduction in 10 cases. On an average 550–650ml of blood was lost in 14 patients while in the rest of the cases blood loss was <450ml. These are included in the most common complications occurring intra operatively as studied by Ru et al.[12]

Post operative (immediate)

Only one patient in the present study had immediate post-operative complications in the form of superficial infection which ultimately healed with appropriate antibiotics and antiseptics.

Post operative (late)

Knee stiffness in 2 cases (6.7%) and mal-alignment in 2 cases (6.7%). However, many studies reported implant failure as the major post-operative complication.

Limb length discrepancy

All the patients were observed to have limb length discrepancy within a range of 0-2 cm with majority of patients in the range of 1-1.5 cm. 1.3 cm was found to be an average length discrepancy of the limb and no treatment was needed. This was similar to Kumar et al where the average limb length discrepancy of less than 2 cm.[16]

Quadricepsplasty

In the present study quadricepsplasty was required in 14 cases (47%) which mainly included C2 and C3 fractures.

Union

Clinical

In present study 55% of the patients were recorded to achieve union at 3 months and the rest achieved it by 6 months. The results corresponded to the study done by Daroch MS.[15]

Radiological

Radiological union was achieved in all the cases. Union was seen between 5 months in majority of the cases (55%). Mean time for radiological union was 15 weeks. When the callous formation started, patient was advised to start partial weight bearing. Kanabar et al study shows union ranges between 12-19 weeks which resembles our study.[17]

Range of motion

Five patients (18.5%) were achieved full flexion >130 degrees and 17 patients (55.5%) achieved flexion between 100-129 degrees with the rest of the 8 patients achieved flexion below 100 degrees. In the present study the mean of range of motion at the knee joint was 106.6 degrees with maximum flexion of 140 degrees. The mean range of motion achieved in the study was similar Rademaker et al based on Neers criteria.[18]

Outcome

Knee score was calculated based on Neer criteria, out of 30 cases 10 cases (33%) were having Neer score more than 85 and graded to be excellent, 16 cases (52%) were having score 75-85 and graded as satisfactory, 3 cases (11%) were having score 55-74 and graded as unsatisfactory and only one case (4%) was having score of 55 and graded as poor. Rademaker et al obtained in

study of 67 patients found 84% satisfactory to excellent results.[18] Daroch et al in a study of 30 patients found 83.34% satisfactory to excellent result and various other researchers who had the similar results.[15]

In present study it was found that 85.1% of patients were in between satisfactory to excellent results

CONCLUSION

The distal femur locking compression plate is a good implant to be used for distal femur intra-articular fractures. Early surgery, anatomical reduction and early mobilisation are the prerequisites for good functional outcome. Distal femur locking compression plate being angle stable device offers relative stability which helps in achieving secondary union by periosteal callus formation. Distal design of locking plate which has provision for inter fragmentary compression and it is mandatory for achieving anatomical intra-articular reduction. Comminution and bone defect on the medial side needs pillar reconstruction by fibular bone graft, we recommend medial bone grafting if shortening is not tolerable. Limb length discrepancy (average less 2 cm) was commonest complication was well tolerated by patient.

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Ethical approval: The study was approved by the institutional ethics committee

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