



Functional outcome of distal femoral fractures managed surgically using locking compression plate laterally and augmented with titanium elastic nail system medially

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ABSTRACT

Background: Distal femur fractures are generally due to high velocity trauma particularly from road traffic accidents and fall from height. The treatment of distal femur fractures has evolved from conservative to operative to fixation of both lateral and medial columns of femur.

Aims and Objective: The aim of the study was to evaluate the functional outcome of operated cases of comminuted fracture of lower end of femur fixed with locking compression plate laterally and augmented with titanium elastic nail system medially. **Materials and Methods:** The present study was a prospective study carried out in Bharati Vidyapeeth Medical College and Hospital, Sangli after approval from institutional ethical committee. In this study, 20 patients with comminuted fracture of lower end of femur were included on the basis of a predefined inclusion and exclusion criteria. Detailed history was taken and clinical examination was done in all cases. After preanesthetic evaluation and relevant investigations patients were treated by reduction (close or open) and fixation was done by locking compression plate laterally and augmented with titanium elastic nail system medially. Patients were followed up at 6, 10 and 14 weeks for functional outcome by Neer's scoring system and degree of flexion at knee joint.

Results: Out of 20 studied cases there were 16 (80%) males and 4 (20%) were females with a M:F ratio of 4:1. The mean age of male patients was found to be 42.81 +/- 14.79 whereas mean age of female patients was 40.5 +/- 14.36. The mean age of male and female patients was found to be comparable with no statistically significant difference (P=0.78). Most of the patient were diagnosed with the fracture of AO TYPE C3 (7 cases), followed by AO TYPE C1 (4 cases). Full weight bearing was achieved in 8 (40%) patients within 18 weeks whereas remaining 12 (60%) patients required more than 20 weeks for full weight bearing. 14 (70%) patients had excellent outcome whereas, Good, Fair and poor outcomes were seen in 4 (20%), 1 (5%) and 1 (5%) patient. On one-way ANOVA analysis, showed that the flexion was significantly higher in 12 weeks as that of the 6 weeks (P = <0.0001). Further the flexion was significantly higher in 24 weeks as that of the 6 and 12 weeks (P = <0.0001). **Conclusion:** Our study found that locking compression plating laterally augmented with titanium elastic nail system medially for comminuted distal femoral fractures is a good fixation system and provides good angular stability.

Key words: Distal femoral fracture; Locking compression plate; Titanium elastic nail; Functional outcome

INTRODUCTION

The distal femur fractures are generally due to high velocity trauma particularly from road traffic accidents and fall

from height.¹ The management of distal femur fracture imposes a high challenge to surgeons. The incidence of these fractures is 0.5% of all fracture and 3% of all femoral fractures. The distribution of fractures is higher

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in woman of age more than 75 years and in adults ranging between 15-25 years.² Restoration of complete knee range of motion and function is highly challenging since these fractures are very close to the knee joint.³

The management of distal femur fractures has both conservative as well surgical method for the treatment. The treatment of distal femur fractures has evolved from conservative to operative to fixation of both lateral and medial columns of femur.⁴ The main aim of these methods techniques is to restore the normal anatomical functions of joints, accurate and stable fixation and to avoid varus or valgus angulation. In patients who have been treated by double plating there is an increased risk of need of bone grafting whereas single plating may be associated with less risk of need for subsequent bone grafting.⁵

We conducted this study to evaluate the functional outcome of operated cases of comminuted fracture of lower end of femur fixed with locking compression plate laterally and augmented with titanium elastic nail system medially.

MATERIALS AND METHODS

The present study was a prospective study carried out in Bharati Vidyapeeth Medical College and Hospital, Sangli after approval from institutional ethical committee. In this study, 20 patients above age of 18 years with comminuted fracture of lower end of femur with less than 3 weeks duration were included. Patients having pathological fractures were excluded from the study. The purpose of the study was to evaluate the results of locking compression plate in the treatment of fractures lower end of femur and to study the complications of locking compression plate. On admission detailed examination of the patients was carried out after hemodynamic stabilization. Then standard Antero – Posterior and Lateral view X – Rays were taken and the fracture configuration was noted. Patients were initially managed with either upper or lower tibial pin traction to immobilize and maintain the length. Computerized Tomography was done in selective cases to assess the exact alignment of the fragments. The fractures were classified using the Muller classification.

All basic investigations include complete hemogram; Blood Grouping and Viral markers were carried out. Informed written consent for surgery and for bone grafting was obtained from all patients. Preoperative blood transfusion was given taking into account patients' preoperative

hemoglobin levels. All patients were electively posted after getting the Anesthetic fitness for surgery.

Position of the patient

Both for locking compression plating and titanium elastic nail system were positioned in supine positions with both lower limbs extended and a small sand bag placed below the thigh of the operative limb to make the hip in neutral rotation and also flex the knee to aid in the posterior vessels falling away from operative area.

Incision and surgical approaches

Extensile lateral approach widely was used for all patients unless there were any special circumstances where visualization through Swashbuckler anterolateral approach was required.

Under spinal Anesthesia, the patient was positioned supine on the radiolucent table allowing both AP and lateral views. A sterile bolster was placed under knee to facilitate exposure and reduction. The uninjured limb was extended. The injured limb was draped so as to allow 30-60 degree of flexion to relax the Gastrocnemius muscle. In complex fractures, preparations of both the limb were done to achieve correct adjustment and comparison of length and rotation. An extensile lateral approach was used and a 10-15cm long skin incision was made, Sub cutaneous tissue, tensor fascia lata were incised and vastus lateralis was reflected taking care of the perforators, till the lateral condyle is reached, reduction of the condyles was done using a point reduction clamp and image intensifier. Reduction was held temporarily using two K wires by avoiding disturbance to plate positioning. The plate was then slid along the shaft using the bevel. The condylar fragment was aligned with metaphyseal fragment by appropriate manipulation (traction and rotation) under image control.

The reduction was held temporarily with a k wire, after aligning the plate along the shaft. After confirming the reduction and plate position parallel to the condyles the second K wire was passed into the plate and condyle. The condyles were then fixed to the plate using 6.5mm cannulated locking head cancellous screws without disturbing the reduction. The locking head screws were inserted using jig sleeve assembly with image intensifier in accordance with pre op planning. The choice of surgical approach was determined by the fracture location and pattern, any associated comminution, the primary reduction techniques, and the implant. An extensile lateral approach was used in majority of the cases. In all surgical approaches, the posterior and medial soft-tissue attachments to any metaphyseal bone segments were left intact.

Titanium elastic nail system

By using C- arm guidance, a 2 cm incision was made over the medial aspect of the distal femur. The Entry portal was made with the help of curved awl. An appropriate size Titanium elastic nail was then fixed from medial side into the medullary canal of the femur. The final position was then checked under C-arm guidance and the remaining screws were inserted to fix the lateral plate. The wound was then closed in layers and antiseptic dressing was applied. Patients were followed up at 6, 10 and 14 weeks for functional outcome by Neer's scoring system and degree of flexion at knee joint.⁶

The statistical analysis was done using SPSS 21.0 software and p value less than 0.05 was taken as statistically significant. 2-tailed fisher Extract was used to calculate p value.

Inclusion criteria

1. Patients with comminuted fracture of lower end of femur with less than 3 weeks duration
2. Age above 18 years.
3. Those who consented to be part of study.

Exclusion criteria

1. Compound Fractures.
2. Pregnancy.
3. Patients having pathological fractures, osteogenesis imperfecta and neuromuscular disorder.

RESULTS

The majority of patients included in this study were males. Out of 20 studied cases there were 16 (80%) males and 4 (20%) were females with a M:F ratio of 1:0.25. In this study maximum number of patients (6 cases) was in the age group between 41-50 years. The mean age of male patients was found to be 42.81 +/- 14.79 whereas mean age of female patients was 40.5 +/- 14.36. The mean age of male and female patients was found to be comparable with no statistically significant difference (P=0.78) (Table 1).

In this study the most frequent cause of fracture was road accident (12 cases) followed by fall from height (8 cases). Most of the patients were affected in the right side (12 cases) of the femur, Most of the patient were diagnosed with the fracture of AO TYPE C3 (7 cases), followed by AO TYPE C1 (4 cases). In 10 (50%) cases duration of surgery was less than 90 minutes whereas in remaining 10 (50%) cases duration of surgery was found to be above 90 minutes (Table 2).

In 5 (25%) patients partial weight bearing was achieved within 10 weeks. At 14 weeks partial weight bearing was

Table 1: Age distribution of the studied cases

Age in years	Gender distribution			
	Males		Females	
	No	%	No	%
<20	1	5	0	0
21-30	2	10	1	5
31-40	3	15	1	5
41-50	5	25	1	5
51-60	2	10	0	0
61-70	2	10	1	5
>70	1	5	0	0
Total	16	80	4	20
Mean age	42.81 +/- 14.79		40.5 +/- 14.36	
P Value (for mean age of males and females.)	P=0.78 (Not Significant)			

Table 2: Mechanism of injury, affected side, type of fracture, duration of surgery and type of reduction

Characteristics	Type	No of cases	Percentage
Mechanism of injury	Road traffic accident	12	60
	Fall from height	8	40
	Total	20	100
Affected side	Right	12	60
	Left	8	40
	Total	20	100
Type of fracture	AO TYPE A1	2	10
	AO TYPE A2	1	5
	AO TYPE A3	0	0
	AO TYPE B1	2	10
	AO TYPE B2	0	0
	AO TYPE B3	1	5
	AO TYPE C1	4	20
	AO TYPE C2	3	15
	AO TYPE C3	7	35
	Total	20	100
Duration of surgery	<90 MINUTES	10	50
	91-120 MINUTES	10	50
	TOTAL	20	100
Type of reduction done	CLOSED	8	40
	OPEN	12	60
	TOTAL	20	100

achieved in 15 (75%) cases. Partial weight bearing was achieved in all 20 cases within 20 weeks. Full weight bearing was achieved in 8 (40%) patients within 18 weeks whereas remaining 12 (60%) patients required more than 20 weeks for full weight bearing. Radiological union was seen in 19 (95%) patients within 20 weeks and only in 1 (5%) patient radiological union required more than 20 weeks (Table 3).

The analysis of functional outcome in patients on the basis of NEER'S score showed that out of 20 studied cases 14 (70%) patients had excellent outcome whereas, Good, Fair and poor outcomes were seen in 4 (20%), 1 (5%) and 1 (5%) patient (Figure 1).

Patients were followed up at 6, 12 and 24 weeks for determination of flexion achieved (Figure 2). During Follow up of cases, X-Rays were done to assess the successful radiological union (Figure 3).

On one-way ANOVA analysis, showed that the flexion was significantly higher in 12 weeks as that of the 6 weeks ($P = <0.0001$). Further the flexion was significantly higher in 24 weeks as that of the 6 and 12 weeks ($P = <0.0001$) (Table 4).

DISCUSSION

The present study delineates management of distal femur fractures by locking compression plate laterally and augmented with titanium elastic nail system medially in 20 patients. The outcome of the surgical management in restoration of lost knee function was evaluated by NEER'S score.⁶

The clinical complications distal femur fracture encompasses malunion, nonunion, angulation of varus, limb length discrepancy, risk of infection and secondary osteoarthritis of patellofemoral and tibiofemoral joints. The principle of treatment in these fractures include restoration of bony continuity, maintenance of good reduction, articular congruity, and good range of movements.⁷ The articular surface incongruity of maximum 2mm is accepted widely. These fractures earlier treated nonsurgical were associated with angular

deformity, joint incongruity, knee stiffness and delayed patient mobilization. The rectus femoris and the ligaments around the knee being in close proximity to the fracture site are prone to get injured and hence lead to extensor lag post-operatively.

The different fixation devices used include angle blade plate (schatzker 1979), rush rods (Shelbourne1981), enders nail (Kolmert 1986) and Zickel device. But these devices require expert handling and no report of rigid fixation articular surface.^{8,9} Though with improvements in implants and operative techniques fracture non-union, delayed union and inconsistent callus formation are uncommon. There is a concern of increased incidence of need for bone grafting in patients who have been treated by double plating. In a study of 23 patients with comminuted osteoporotic distal femoral fractures managed through the double-plating approach Metwaley RG found that 4 (17.4%) cases needed autologous bone graft after 6 months. On the basis of these findings the authors concluded that delayed union and the need for bone graft are the major drawbacks for this double plating.¹⁰

The TENS is a type of non-locked intramedullary nail which provides relative stability over the fracture site. Excellent results in adolescent and pediatric fractures have led to its use in augmentation of comminuted distal femur fractures so as to prevent the medial collapse and hence prevent varus deformity at the knee otherwise which is frequently seen in these kinds of fractures. The CRIF with a non-locked intramedullary nailing technique as an augmentation method for distal femoral fractures causes less damage to the soft tissues and hence reduces the devitalization of the medial column and less neurovascular injuries than ORIF with plating on medial side, as well as sparing the risk of re-fracture after plate removal. In addition to the above, the medial elastic nail provides an elastic fixation on the medial side and hence promotes early union especially in medial column comminuted fractures.¹¹

The mean age of the study population was found to be between 45 ± 5.67 years. Previous study done by Manish Singh et al found mean age of study population to be 36.2 years.¹² In this study, the major cause of the fracture was road traffic accident. A Similar study by Siliski et al found that road traffic accidents were cause of fracture in 76% of cases and out of 30 cases 26 patients had multiple fractures.¹³ Since road traffic accidents are most common cause of distal femoral fractures it is understandable that most of patients were young.

In this study most of the patients were affected with AO TYPE C3 fractures. A study performed by Smit Shah et al.

Table 3: Duration for weight bearing and radiological union achieved

Factors	Achieved time (Weeks)	Number of cases	Percentage
Partial weight bearing achieved	10	5	25
	12	7	35
	14	3	15
	14-20	5	25
	Total	20	100
Full weight bearing achieved	12	1	5
	14	2	10
	16-18	5	25
	>20	12	60
	Total	20	100
RADIOLOGICAL UNION (Weeks)	<16	10	50
	16-18	6	30
	19-20	3	15
	>20	1	5
	Total	20	100

Table 4: Comparison of Flexion achieved at 6, 12 and 24 weeks

S. No.	6 Weeks	12 Weeks	24 Weeks
1	21.5±4.45	64.5±6.25	99.6±11.54
P-value	NS	P=<0.0001	P=<0.0001

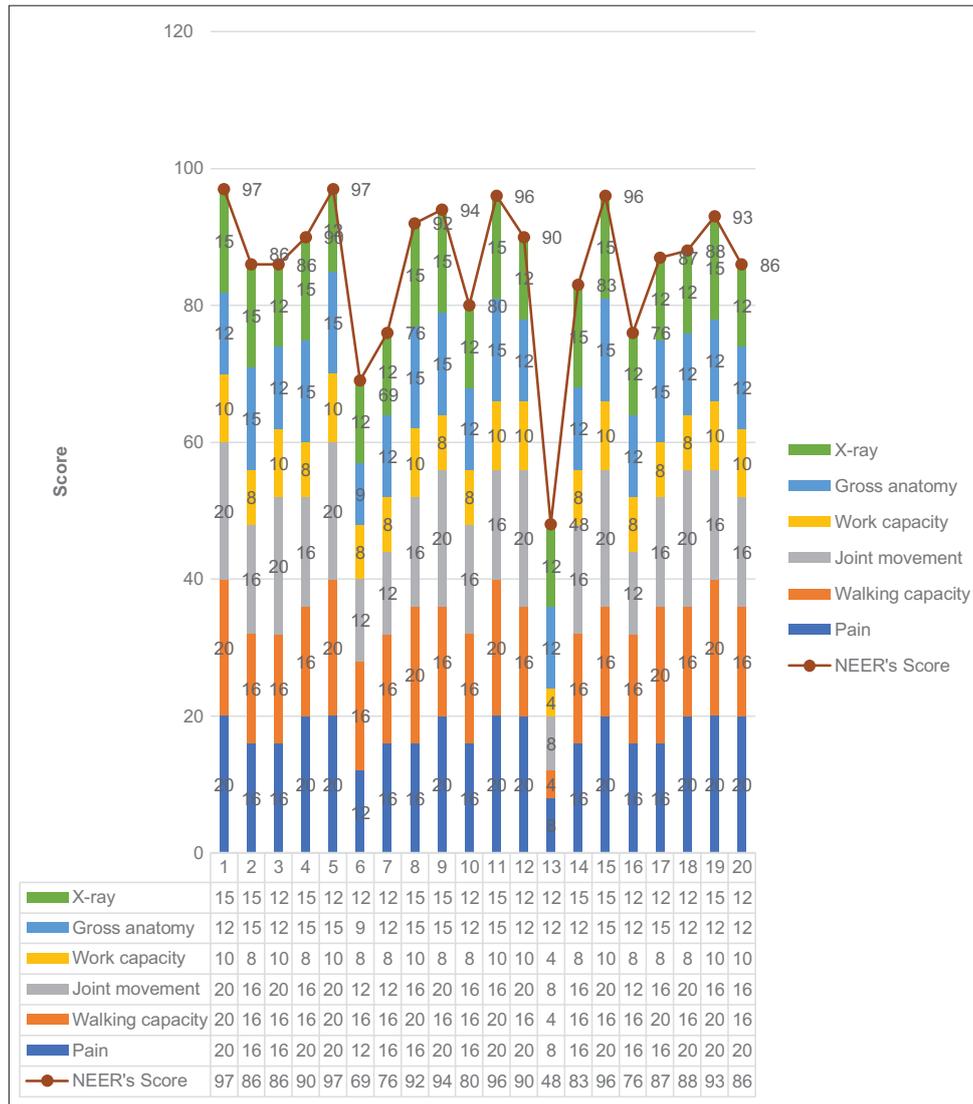


Figure 1: Functional outcome according to NEER's Criteria

majority of the patients was affected with C3 fractures.¹⁴ In the current study, 50% of the patients required less than 90mins as operative time and remaining 50% of the patients requires more than 90 mins as the operative time. In a study conducted by Manish Singh et al the average operative time was found to be 92 mins.¹²

In this study majority of the patients were treated by open reduction as compared to the closed reduction. Seven cases achieved partial and complete weight bearing in 12 and more than 20 weeks respectively. Most of the cases (10 patients; 50%) achieved complete reunion with less than 16 weeks. In a study conducted by Manish Singh et al.¹² 68% of the patients achieved complete reunion within 11-14 weeks.

In this study, the functional outcome was evaluated by ability of restoration of lost knee function by NEERs

score. Out of twenty cases, 14 patients (70%) showed excellent outcome and 4 patients (20%) showed good outcome 1patient (5%) showed fair outcome and 1 patient (5%) showed poor outcome. In a study conducted by Manish Singh et al 43% showed good outcome and 29% showed excellent outcome.¹²

Normal knee flexion is measured to be 140 degrees. Laubenthal et al has showed that the average motion needed for squatting, normal sitting posture and climbing stairs was 117°, 95° and 100° respectively thereby making at least 110° of flexion to be necessary for daily activity. In the current study the average flexion was found to be 105 degree and greater than 70% cases patients achieved greater than 100 degree of knee range of motion.¹⁵ In the current study, the average knee extensor lag was 5.25°. Out of 20 patients, 5 cases had 5 mm shortening. 7 cases had 5° valgus derangement.

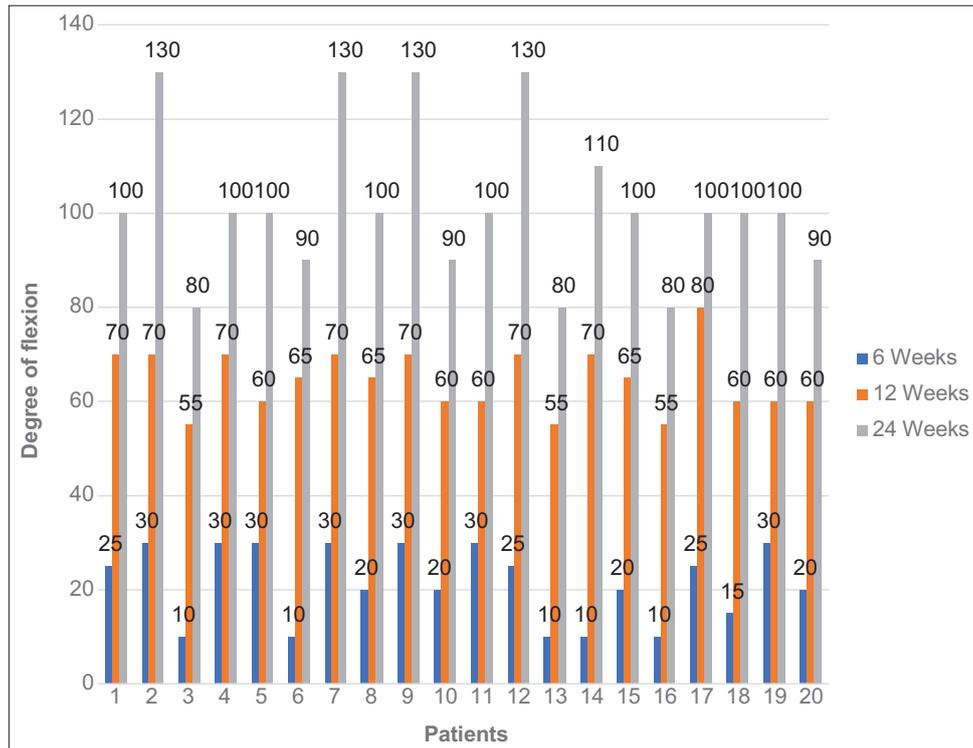


Figure 2: Degree of Flexion achieved at 6, 12 and 24 weeks



Figure 3: Distal Femoral Fracture X-rays preoperative (left upper), immediate post operative (right upper), at 3 months follow up (left lower) and at 6 months (right lower)

CONCLUSION

Locking compression plating laterally augmented with titanium elastic nail system medially for comminuted distal

femoral fractures is a good fixation system having excellent functional outcome.

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Author's Contributions

SM - Concept and design of the study; interpreted the results, prepared first draft of manuscript and critical revision of the manuscript; **SM, MG** - Statistically analyzed and interpreted; reviewed the literature and manuscript preparation; **AI** - Design of the study, statistically analyzed and interpreted, preparation of manuscript and revision of the manuscript; **SD** - Concept and coordination of the overall study.

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