

Original Research Article

Functional and radiological outcome of distal femur fracture with intra-articular extension fixed with variable angle-locking compression plate: a prospective study

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ABSTRACT

Background: Distal femur fractures, often resulting from high-velocity injuries, pose significant challenges due to their complexity. This study aims to evaluate the efficacy of variable angle-locking compression plate (VA-LCP) in treating these fractures, focusing on both functional and radiological outcomes.

Methods: This prospective observational study included 40 patients aged 20-70 years with distal femur fractures treated at R. L. Jalappa Hospital and Research Centre. Data on demographics, comorbidities, fracture type and outcomes were collected. Patients underwent open reduction and internal fixation with VA-LCP and were followed up at 1 month, 3 months and 6 months postoperatively.

Results: The study revealed significant improvements in functional outcomes as measured by NEER's score, with most patients showing substantial increases by 6 months post-op. The majority of fractures were successfully united within an average of 20 weeks. Complications were minimal and included superficial infections and knee stiffness in a few cases.

Conclusions: VA-LCP provides effective stabilization for distal femur fractures, enabling early mobilization and resulting in positive functional and radiological outcomes. This technique is particularly beneficial for complex intra-articular fractures.

Keywords: Distal femur fracture, Functional outcome, Fracture fixation, Radiological outcome, VA-LCP, Variable angle locking compression plate

INTRODUCTION

Rapid industrialization and evolving lifestyles have led to an increase in road traffic accidents, often resulting in high-velocity injuries like distal femur fractures. These injuries are complex, especially in high-energy scenarios and carry significant implications for patient health and recovery, including an association with organ damage in motor vehicle collisions. The treatment of such fractures poses challenges for orthopaedic surgeons, given the vital role of the knee joint in function and mobility.¹ With severe injuries often involving complex bone fractures due to high kinetic energy impacts, advanced surgical

interventions and meticulous post-operative care are essential. Total knee arthroplasty is increasingly considered in complex cases, especially in the elderly.²

Effective treatment modalities are critical for managing these injuries, focusing not only on anatomical correction but also on restoring knee biomechanics. The evolution of implant designs, including variable angle-locking compression plates (VA-LCP), has broadened the options available to surgeons, promising improved outcomes for these challenging fractures.³ The purpose of this research is to assess the effectiveness of VA-LCPs in the treatment of distal femur fractures with intra-articular extension,

potentially improving clinical results and advancing the development of orthopaedic therapeutic approaches.

Aims and objectives

To evaluate the radiological outcome in a patient with distal femur fracture with intra-articular extension treated with ORIF+VA-LCP by follow up radiographs. To evaluate the functional outcome post-operatively using NEERS score.

METHODS

This prospective observational study included 40 patients aged 20-70 years with distal femur fractures treated at R.L. Jalappa Hospital and Research Centre. Data on demographics, comorbidities, fracture type and outcomes were collected. Patients underwent open reduction and internal fixation with VA-LCP and were followed up at 1 month, 3 months and 6 months postoperatively.

Patients with age between 18 to 70 years of age and with radiologically confirmed distal 1/3rd femoral fractures of AO types B1, B2, C1, C2 and C3 were included in the study. Patients with neurovascular injury with compound fractures, Pathological distal 1/3rd femoral fractures, Periprosthetic fractures and Patients with severe life-threatening medical co-morbidities were excluded.

Study period

The study period spanned from September 2022 to December 2023.

Sample size estimation

Kohli et al, reported that 82% of patients achieved radiological union before 18 weeks.⁴ Assuming an alpha error of 5% (95% Confidence Limit), the expected proportion (p) was set at 82% and the absolute precision (d) was set at 12%. Using these parameters, the minimum required sample size to determine the proportion of patients who would achieve radiological union before 18 weeks was calculated using the formula:

Sample Size: $(n) = Z \times pq / d^2$

Z is the value for Confidence Interval

d is the absolute precision

p is the expected proportion and $q = 1 - p$

$n = 40$

Ethical clearance was obtained from the Institutional Review Board. Informed consent was obtained from the study participants prior to the commencement of the study after explaining the procedure in local language.

Data entry and analysis

The statistical methods used for this study involved entering data into Microsoft Excel and analyzing it using the Statistical Package for the Social Sciences (SPSS), standard version 20. All continuous variables were summarized using the mean and standard deviation (SD).

The time required for radiological union, the time to achieve full weight bearing and knee flexion (in degrees) were summarized using the mean with a 95% confidence interval. The proportion of patients with radiological malunion and NEER's functional outcomes were reported using proportions with 95% confidence intervals.

RESULTS

In figure 1, gender distribution of the study participants is illustrated. The study includes a total of 40 participants, with a significant gender disparity. Out of the total participants, 15 are male, constituting 37.5% of the sample, while 25 are female, representing a larger proportion of 62.5%.

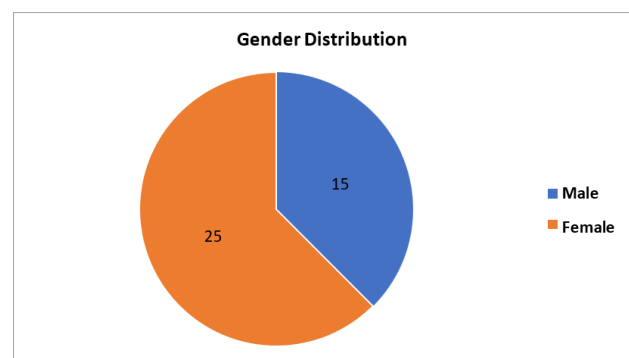


Figure 1: Gender distribution of study participants.

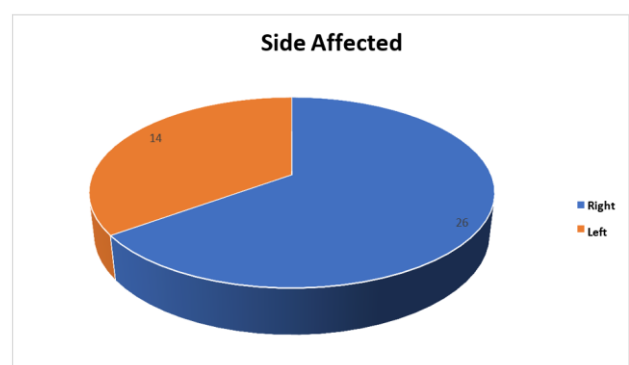


Figure 2: Distribution of the side affected.

Figure 2 illustrate the distribution of the side affected among the study participants. The study findings revealed that out of 40 participants, the right side is affected in 26 individuals, making up 65% of the total sample. In contrast, the left side is affected in 14 participants, accounting for 35% of the sample. This distribution

indicates a higher prevalence of right-side involvement among the participants.

Table 1 provide the age distribution of the study participants. The findings show that the majority of participants fall within the 40-60 age range, accounting for 40% of the total sample. This is followed by the 0-20 age range, which includes 30% of the participants. The 20-40 and 60-70 age ranges each comprise 15% of the participants.

Table 2 illustrate distribution of comorbidities among the study population. The findings reveal that 25% of individuals have diabetes, making it one of the more common conditions. Hypertension alone is present in 15% of the population, indicating its lower prevalence compared to other conditions. Notably, the combination of diabetes and hypertension is the most prevalent comorbidity, affecting 15% of the individuals, which highlights a significant overlap between these two conditions. Additionally, thyroid disorders are found in 10% of the population, underscoring their relative commonality. Out of all participants, 35% do not have any comorbid conditions.

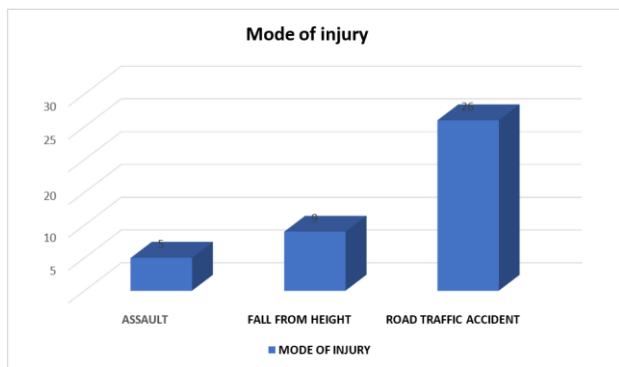


Figure 3: Distribution of the study participants according to the mode of injury.

Figure 3 illustrates out of the 40 participants, around 65 percent suffered injuries from road traffic accidents, 9 percent fell from a height and 12.5 suffered injuries from assault.

Figure 4 illustrates distribution of AO classification types provide a detailed analysis of the prevalence of various AO

classification types within the study population. The findings indicate that type B1 accounts for 30% of the cases, showing a moderate prevalence. Type B2 is less common, representing only 15% of the cases. Type C1 is more significant, comprising 20% of the population. Notably, type C2 is the most prevalent, making up 35% of the cases, highlighting its dominance. On the other hand, type C3 is not present in the population, as indicated by a 0% prevalence.

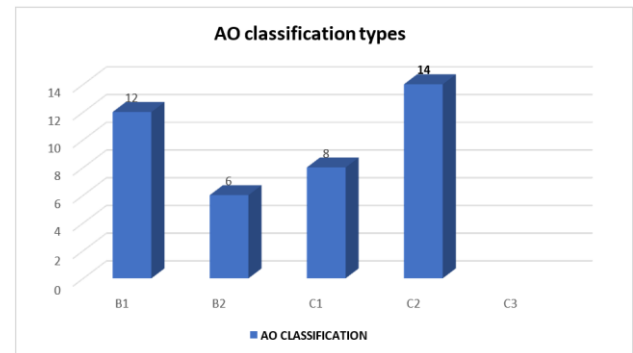


Figure 4: Distribution of AO classification types.

Table 3 shows NEER'S score for post-op 1st month and 3-month post-op and 6-month post-op provide insights into the progression of patients' functional improvement over time following surgery. The data reveals that in the 1st month post-op, all cases have a score of less than 28.

However, there is a significant improvement observed at 3-month post-op, with most cases showing substantial increases in their NEER's score. Specifically, cases 3, 5, 6 and 10 demonstrate the highest improvements, each reaching a score of 36 or more. This consistent pattern of high Neer's score in these cases indicates successful rehabilitation or surgical outcomes for these individuals. At 6-month post-op cases 3, 4, 7 and 9 also show marked improvements, achieving a score of 52 or more, indicating a positive recovery. Cases 2, 6 and 10, although improved, show the lowest Neer's score, which may suggest a slower recovery process or potential complications.

Out of 40 patients, 29 patients showed excellent outcome (score>50) and 11 patients showed good outcome (score 30-50) at the end of 6th month follow up and consolidation of fracture for all 40 participants has been achieved.

Table 1: Age distribution of the study participants.

Age range (in years)	Number of participants	%
0-20	12	30.0
20-40	6	15.0
40-60	16	40.0
60-70	6	15.0
>80	0	0.0

Table 2: Distribution of study participants with comorbidities.

Comorbidities	Count	%
Diabetes	10	25.0
Hypertension	6	15.0
Diabetes and hypertension	6	15.0
Thyroid disorder	4	10.0
No comorbidities	14	35.0

Table 3: NEER'S score for post-op 1st month and 3-month post-op and 6-month post-op.

Cases	Post op 1 month	Post op 3 month	Post op 6 month
Case 1	16	30	52
Case 2	18	34	50
Case 3	24	36	54
Case 4	18	32	54
Case 5	20	38	52
Case 6	20	36	48
Case 7	24	34	56
Case 8	28	30	52
Case 9	24	32	54
Case 10	20	36	50

DISCUSSION

The treatment of distal femur fractures, particularly those with intra-articular extension, poses significant challenges due to the complexity of these fractures and the need for precise alignment and stable fixation. The advent of VA-LCP has offered a promising solution by providing enhanced stability and allowing for early mobilization. This study aimed to evaluate the functional and radiological outcomes of distal femur fractures treated with VA-LCP in a prospective observational hospital-based study.

The study revealed a significant gender disparity among the participants, with females constituting 62.5% and males 37.5% of the sample. This aligns with existing literature suggesting a higher incidence of distal femur fractures among females, particularly in older age groups due to osteoporosis. Bhimani et al also reported a higher incidence of distal femur fractures in females, accounting for 60% of the sample.⁵ The researchers attributed this to the higher prevalence of osteoporosis in postmenopausal women, which makes them more susceptible to fractures from low-energy impacts.

Similarly, Pietu et al found that 65% of the fractures occurred in females, particularly in the age group above 60 years, reinforcing the role of osteoporosis in the increased fracture risk among women.⁶ Schandelmaier et al highlighted a similar gender distribution, with females making up 68% of the fracture cases.⁷ The researchers suggested that hormonal changes after menopause contribute significantly to bone density loss, thereby increasing fracture susceptibility. These comparisons underscore the consistency of findings across different

studies, emphasizing the need for targeted osteoporosis management to reduce the incidence of fractures among elderly women.^{8,9}

The present study findings indicated a higher prevalence of fractures on the right side (66.7%) compared to the left (33.3%). This could be attributed to various factors, including the dominance of the right leg in most individuals, leading to a higher impact during falls or accidents. Comparison with existing studies reveals similar trends. For instance, a study by Yeap et al and Deepak et al observed that 65% of distal femur fractures occurred on the right side.¹⁰ The researchers suggested that the right leg dominance in most individuals could lead to higher susceptibility to injuries during trauma.

This is consistent with our findings and reinforces the idea that the dominant leg is more frequently exposed to forces that cause fractures. Higgins et al also reported a higher incidence of right-side fractures in their cohort, where 60% of the fractures were on the right side. They attributed this to the natural tendency of individuals to use their dominant leg more frequently, increasing its exposure to high-impact activities and accidents.¹¹ A similar study by Pietu et al found that 62% of distal femur fractures were on the right side. They hypothesized that the right leg's greater use in activities such as driving and sports could be a contributing factor.⁶ Additionally, Schandelmaier et al noted a 64% prevalence of right-side fractures, again pointing to the dominance and more frequent use of the right leg as potential reasons.⁷

The researchers emphasized the need for further research to understand the biomechanical and behavioral factors that contribute to this trend. These comparisons illustrate a consistent pattern across multiple studies, where the right

leg is more frequently affected by distal femur fractures. The dominance of the right leg in most individuals,

Postoperative Neer's score improved significantly from the 1st month post-op period to 6-month post-op. Initially, all cases had a Neer's score less than 28, which increased substantially in most cases by the 6-month mark. This improvement reflects successful surgical intervention and effective postoperative rehabilitation protocols. Cases with the highest improvement (score>50) suggest optimal surgical and rehabilitation outcomes, while those with slower progress (score<50) may indicate complications or the need for prolonged rehabilitation. Comparison with existing studies highlights similar trends in postoperative outcomes. For instance, a study by Yeap and Deepak et al reported that the average range of motion improved from 10 degrees immediately post-op to 75 degrees at 1-month post-op.¹⁰ This is comparable to our findings, indicating that advanced fixation techniques and rehabilitation protocols can significantly enhance postoperative mobility.

CONCLUSION

VA-LCP in treating distal femur fractures with intra-articular extension demonstrated significant improvements in both functional and radiological outcomes. The study highlighted the efficacy of VA-LCP in providing stable fixation, allowing for early mobilization and effective postoperative rehabilitation. Despite the study's limitations, the findings contribute valuable insights into the management of complex distal femur fractures. The prevalence of comorbid conditions such as diabetes and hypertension among the study participants underscores the importance of comprehensive preoperative assessments and tailored management plans. The higher incidence of fractures on the right side and among females, particularly in older age groups, aligns with existing literature and emphasizes the need for targeted preventive measures.

The significant improvement in the Neer's score postoperatively reflects the success of VA-LCP in ensuring optimal surgical outcomes. Future research should focus on addressing the study's limitations, including larger sample sizes, longer follow-up periods and multi-center randomized controlled trials, to validate the findings and further enhance treatment strategies for distal femur fractures. Effective multidisciplinary care and the exploration of cost-effective treatment modalities will be crucial in advancing orthopedic practices and improving patient outcomes.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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