



Functional and Radiological Outcomes of Distal Femur Fractures treated with Less Invasive Stabilization System versus Dynamic Condylar Screw

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ABSTRACT

Introduction: Fractures in the distal femur are quite rare, comprising around 0.4% of all fractures and 3% of femoral fractures. Managing distal femur fractures has been a subject of debate, but recent developments favor indirect reduction and minimally invasive approaches. The objective is to find a harmonious equilibrium between the mechanical stability of the fractured segments and their biological viability. Given their elevated complication rate, achieving optimal restoration of functional anatomy and ensuring stable fixation is imperative for prompt recovery from distal femoral fractures. Comparison of less invasive stabilization system versus dynamic condylar screw fixation in treatment of distal femur fractures is subject of ongoing debate as to which one is better.

Aims and Objectives: To compare the functional and radiological outcomes of distal femur fractures treated with less invasive stabilization system versus dynamic condylar screw fixation.

Place and Duration of study: A randomized clinical trial was conducted in the Orthopedic Department of Sheikh Zayed Hospital, Lahore, from July 2, 2020, to January 1, 2021.

Material and Methods: A randomized clinical trial was conducted at Sheikh Zayed Hospital in Lahore over a six-month duration. In total 104 patients who fulfilled the inclusion criteria were admitted to the Orthopedic Department via Emergency and OPD. Demographic data and medical histories were taken. The sample size consisted of 52 patients in each group, with random allocation to either the LISS (A) or DCS (B) groups determined by a lottery method. Follow-up appointments were scheduled for all patients at one month, three months, and six months post-surgery. Radiological outcome was evaluated at each follow-up visit while functional outcome assessed at sixth monthly follow up. Data analysis was performed using the SPSS: version 22, considering $p \leq 0.05$ as significant.

Results: Frequency of functional outcome was i.e. excellent (32.7%), good (14.4%), fair (2.9%) in group A and excellent (27.9%), good (31.7%), fair (7.7%) in group B (p -value >0.05). Mean fusion time was 18.67 ± 3.04 in group A and 19.62 ± 4.36 in group B (p -value >0.05).

Conclusion: Our findings indicate no substantial distinction between the two groups. Using DCS or LISS, both methods yield favorable outcomes with negligible complications in the management of distal femoral fractures. Both systems effectively reduce soft tissue injury.

Key Words: Distal Femur Fractures, Dynamic condylar screw (DCS), Less invasive stabilization System (LISS)

INTRODUCTION

The femur, recognized as the longest and most robust bone in the human body¹, is susceptible to distal femoral fractures, which specifically impact the lower 9-15 cm of the femur extending up to the articular surface of the knee². In Europe, distal fractures are reported to occur approximately 10, times less frequently than proximal femoral fractures, with an incidence rate of around 6%³. In

younger individuals, high-energy trauma such as firearm incidents, road traffic accidents and sports injuries are common causes whereas distal femoral fractures in elderly patients often result from low-velocity injuries like falls during walking⁴. Treating distal femur fractures poses challenges, as they are frequently comminuted, unstable, involve intra-articular extension, and are associated with significant soft tissue damage to the quadriceps mechanism and ligamentous disruption of the knee joint⁵. The management of distal femoral fractures can be carried via operative versus non operative approaches. Prior to 1970, non-operative regimen was the preferred choice for treatment due to the limited availability of modern implants and minimal understanding of advanced surgical techniques. Challenges associated with non-operative management include knee stiffness, mal-union, non-

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union and patient confinement to bed. Conversely, operative management offers advantages such as the ability to address soft tissue concerns, enable early mobilization and facilitate relatively straightforward nursing care⁶.

Since the late 1990s, the introduction of diverse implant systems including the dynamic condylar screw, retrograde femoral nail and the Less Invasive Stabilization System for the Distal Femur has contributed to enhanced treatment outcomes⁷. In comparison to standard plates, the LISS plate enables significantly greater load-bearing capacity due to angular stability provided by locking screws. As LISS allows for more elastic deformities, making it a swift and uncomplicated procedure with minimal additional soft-tissue disruption than conventional plating systems. On the other hand, the drawbacks of the Dynamic Condylar Screw (DCS) include that that insertion of the condylar lag screw necessitates the removal of substantial amount of bone via reaming, complicating revision surgery if needed as DCS lacks a locking mechanism, so it leads to inadequate fixation of osteoporotic bone⁸.

A multicenter RCT by Canadian Orthopedic Trauma Society revealed that there was no statistically significant difference between the LISS and the DCS in terms of functional scores, union time and no fractures healed. Revisions and complications were more in the LISS group. There was one reoperation in the DCS group and seven in the DCS group⁹.

Nonetheless, the comparative analysis between DCS and LISS remains a subject of debate and no such study was conducted previously in Pakistan, so rationale behind our study was to compare and assess the functional and radiological outcomes of LISS versus DCS in distal femur fractures in local setting to put an end to this debate.

MATERIAL AND METHODS

A randomized clinical trial was conducted in the Orthopedic Department of Sheikh Zayed Hospital, Lahore, from July 2, 2020, to January 1, 2021 after approval from Institutional Review Board vide order No: F.1-6/ M. Education / 1372 /2019. The study comprised a total of 104 patients selected through non-probability consecutive sampling, with 52 patients each assigned to the LISS group (Group A) and the DCS group (Group B). Inclusion criteria were, patients aged 18-70 years with closed fractures and open fractures upto grade 2B. Whereas exclusion criteria were fractures older than three weeks, fractures associated with neurovascular injury, and patients with ASA Grade IV or higher.

Demographic data and injury history, including the time, mode, and side of injury, were collected. Patients were assessed for life-threatening conditions following the ATLS protocol, and initial resuscitation was performed. Initial radiographs, including antero posterior and lateral views were taken and skin traction was utilized on the affected limb. Informed written consent was obtained preoperatively after obtaining approval from the hospital's ethical committee. All patients underwent surgery on the next regular list.

During LISS plating, a 5 cm incision was made from Gerdy tubercle in line with the femur. The LISS plate was applied beneath the Vastus Lateralis muscle, and after fracture reduction, the precontoured plate was fixed to the distal femur using large bone clamps. The condylar part of the plate was temporarily fixed with a K wire, and a 4.5mm cortical screw was applied through the jig proximal to the fracture in bicortical fashion, followed by the application of condylar locking screws. A K wire was inserted perpendicular to the lateral femoral condyle for DCS surgery at intersection of anterior and middle third on lateral aspect and 2 cm proximal to distal end of femur. An appropriate length lag screw was passed over the guide wire after proper triple reaming and tapping. Once the lag screw was in place, a side barrel plate of appropriate length was affixed.

Follow-up appointments were scheduled for all patients at one month, three months, and six months post surgery. Radiological outcomes, including mean fusion time, were assessed at each visit, and functional outcomes were evaluated using the Wilde modification of the Neer knee scoring system after six months.

Data analysis was performed using the SPSS: version 22. Non probability consecutive sampling technique and same expert surgical team operating upon all cases were helpful to address bias. Qualitative variables such as gender, ASA grade, side of fracture, mode of injury, and functional outcome were presented as frequency and percentage. Quantitative variables like age, duration of fracture, and fusion time were expressed as mean \pm SD. The functional outcomes of both groups were compared using the chi-square test while student t-test was applied to statistically test the differences in mean fusion time between the two groups, considering $p \leq 0.05$ as significant.

RESULTS



Fig1: Less Invasive Stabilization System fixation of distal Femur



Fig2: Dynamic Condylar Screw Fixation of Distal Femur

Age distribution of the patients showed that out of 104 patients, 26.9 %(n=28) were in age group of 18-50 years and 23.1 %(n=24) were in age group of 51-70 years in group A and 16.3 %(n=17) were in age group of 18-50 years and 33.7 %(n=35) were in age group of 51-70 years in group B. Mean age was calculated as 47.94±16.44 years in group A and 51.37±15.25 years in group B .In gender distribution of the patients, 32.7 %(n=34) were male whereas 17.3 %(n=18) were females in group A and that 29.8 %(n=31) were male whereas 20.2 %(n=21) were females in group B . None of the patients

dropped out of the study. Frequency of functional outcome was noted as excellent (32.7%), good (14.4%), fair (2.9%) in group A and excellent (27.9%), good (31.7%), fair (7.7%) in group B .Mean fusion time was 18.67±3.04 weeks in group A and 19.62±4.36 weeks in group B.

Out come	Criteria	Count & % of Total	Group		Total
			Group A	Group B	
Functional outcome	Excellent	Count	34	29	63
		% of Total	32.7 %	27.9 %	60.6 %
	Good	Count	15	18	33
		% of Total	14.4 %	17.3 %	31.7 %
	Fair	Count	3	5	8
		% of Total	2.9 %	4.8 %	7.7 %
Total	Count	52	52	104	
	% of Total	50.0 %	50.0 %	100 %	

Table-1: Distribution of Functional Outcome

Fusion time	Group	N	Mean	Std. Deviation	Std. Error Mean	p-value
	Group A	52	18.67	3.047	0.423	
	Group B	52	19.62	4.362	0.605	

Table-2: Comparison of Mean Fusion Time using T-Test

DISCUSSION

Fractures involving the distal femur encompass both the supracondylar and intercondylar regions. Treatment objectives adhere to AO principles, underlining the significance of anatomic reduction of the articular surface and the restoration of limb length, alignment and rotation. Despite advancements in implant design, managing distal femur fractures remains challenging due to their often comminuted, intra-articular nature, compounded by the involvement of osteoporotic bone, making achieving stable fixation a formidable task. In the geriatric trauma population, prevalent co-morbidities may influence therapeutic options¹⁰. Distal femoral fractures account for 0.4% of all and 3% of femur fractures¹¹.The literature recognizes a typical bimodal age distribution, wherein younger, predominantly male patients experience high-energy trauma, while older individuals, more often females, suffer injuries from low-energy events like falls from standing. The prevalence of osteoporosis adds to the complexities faced by the older population. The steadily aging demographic is expected to

contribute to a rise in the fragility fractures around the knee¹². A study by Kao et al. reported that minimally invasive percutaneous plating of distal femur fractures with Dynamic Condylar Screw (DCS) or Less Invasive Stabilization System (LISS) yielded positive outcomes with minimal complications but LISS exhibited a reduced likelihood of early implant loosening compared to DCS. The study achieved complete union in 91.1% of patients, with comparable success rates in the DCS and LISS groups. Functional outcomes in the DCS group were excellent (30.7%), good (65.38%), and fair (3.8%), while the LISS group showed excellent (47.4%), good (47.4%), and fair (5.3%) outcomes. Radiologically, mean fusion times were comparable between the two groups¹³. In another study by Ru J, the use of LISS in the treatment of distal femoral fractures resulted in an overall good to excellent functional outcome of 92.3%, with an excellent rate of 50%, good rate of 42.3%, and a fair outcome of 7.69%, assessed by the Merchant score. The mean fusion time for fractures was 16.1 weeks¹⁴. Iftikhar Ali, in a separate study, assessed the functional outcome of DCS treated supracondylar and intercondylar fractures in adults. The overall good to excellent functional outcome was 74.2%, with an excellent rate of 57.14%, good rate of 17.14%, and fair outcome of 8.57%. Radiologically, the mean fusion time was 15 weeks¹⁵. Court-Brown et al. highlighted distal femur fractures as classic fragility fractures, predominantly occurring in women with a mean age of 67.3 years. Periprosthetic fractures of the distal femur, particularly following total knee replacement (TKR), have seen an increasing trend, with patients living longer and maintaining active lifestyles. The frequency of periprosthetic fractures varies but can be substantial, particularly after revision procedures¹⁶. Reddy et al. reported that Less-Invasive Stabilization System, inserted percutaneously, seeks to attain optimal fixation and stability for intricate fractures while minimizing soft-tissue dissection. The indirect reduction technique frequently utilized with LISS plates has demonstrated positive outcomes in the treatment of distal femoral fractures¹⁷. While our study found comparable functional and radiological outcomes in both groups, a comprehensive examination of complications is essential for a thorough comparison in future research endeavors.

CONCLUSION

In this recent research, our findings suggest that there is no notable disparity in outcomes between

the two groups. Both DCS and LISS exhibit favorable results and few complications when employed for distal femoral fracture treatment. Notably, both systems contributed in minimizing soft tissue trauma.

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