Original Article

Comparative Study Between Dynamic Condylar Screw and Locking Plate Fixation in Fixation of Distal Femoral Fracture in Adults

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ABSTRACT

Objective: In order to handle DFF in adults, this comparative study compares and contrasts DCS and locking plate fixation in terms of clinical and functional outcomes along with post-surgical complications.
Study Design: Cross-sectional retrospective study.
Place and Duration of Study: This study was conducted at the Mufti Mehmood Memorial Teaching Hospital in Dera Ismail Khan, Pakistan from January 2020 to January 2022.
Materials and Methods: There were 101 patients, whom were allocated into Group A (treated using DCS, n=51) and Group B (treated with locking plate fixation, n=50), through randomized stratification protocols. Regular follow up and monitoring on weekly and monthly basis was ensured for at least one year. The functional outcome of both techniques was compared based on range of motion, patients' satisfaction, pain and incidence of complications during follow-up visits.
Results: Mean age of patients in Group A and B was 46.91+12.30 and 48.18+10.09 years. Group A and B had 58.82 and 72% male patients. Demographic variables of Group A and Group B did not differ statistically significantly ($p>0.05$). In Group A, majority of patients (56.86%) experienced outstanding functional outcomes, 27.55% had good, 9.80% had satisfactory outcomes, and 5.88% had poor outcomes. Similarly, 60% of Group B patients had outstanding, 32.0% had favorable, 6.0% had satisfactory and 2.0% had an-unfavorable outcome. Harris Hip Score also revealed the comparable findings for both groups. Occurrence of various complications was higher in DCS treated patients.
Conclusion: In management of distal femoral fractures in adults, both DCS and locking plate fixation procedures showed satisfactory and comparable clinical and functional outcomes, however, locking plate fixation outperformed DCS in terms of patient performance and satisfaction, while also presenting fewer complications. LCP was discovered to be a less complicated and more user-friendly technique, according to the existing evidence.

Key Words: Fracture fixation; Geriatric patients; Harris Hip Score; Orthopedic Surgery; Range of motion.

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INTRODUCTION

Orthopedic trauma care is significantly challenged by distal femur fractures in adults. In order to restore the anatomy, provide stability, and encourage early mobilization, these injuries frequently necessitate surgical intervention.[1] A number of surgical procedures and implants have been created over time to successfully fixate DFF. DCS fixation and locking plate fixation are two frequently used techniques. This comparative study assessed effectiveness and contrast of these two treatment modalities for treating distal femoral fractures, accounting for 7% of femoral fractures in adults.[2,3]

Fractures of distal femur are frequently complex, intra-articular, and frequently involve osteoporotic bone.[5] Understanding the inherent characteristics of distal femoral fracture as they pertain to treatment as well as the principles and difficulties of management are essential for optimizing results.[1] The treatment objectives are to restore axial alignment, anatomic reduction of the joint surface, minimize joint rigidity by allowing early mobilization, and preserve extremity function with minimal soft-tissue disruption. Surgical

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fixation has demonstrated superior outcomes to nonsurgical management, including enhanced alignment, union, knee motion, and functional outcome.[4]

Use of a specially crafted screw that engages medial and lateral surfaces of femoral condyles being required for DCS fixation.[5] The screw maintains stability while allowing compression of the fracture fragments. On the other side, locking plate fixation makes use of plates with threaded screw holes that are anatomically shaped. By creating a fixed-angle design, these plates offer angular stability, preserving the blood flow and lowering the possibility of implant failure.[6]

Several variables, such as the type of fracture, quality of bone, age of the patient, and surgeon's preference, determine whether DCS or locking plate fixation is preferred. Both approaches have benefits and drawbacks. DCS technique has been used extensively for many years and provides excellent compression and stability, particularly in osteoporotic bone. An increased likelihood of implant cut-out and failure in comminuted fractures or fractures with a short distal fragment are among of its downsides.[7-9]

Locking plate fixation has grown in popularity recently as a result of its better biomechanical characteristics and capacity to offer stable fixation in intricate fracture patterns. Locking plates provide angular stability, which lowers the likelihood of build failure, particularly in osteoporotic bone. The biological preservation of the fracture hematoma is another benefit of locking plate fixation, which aids in fracture healing.[10-11]

Fractures in osteoporotic bone are especially problematic due to the insufficient bone stock for solid fixation and the tendency for intra-articular comminution.[12] Screw fixation, fixed-angle devices (95° DCS) plates, 95° angle blade plate), pre-contoured locking plate, intramedullary nail, external fixation, and total knee arthroplasty are among available options.[13-14]

Although locking plate fixation and DCS fixation are both frequently utilized procedures for treating distal femoral fractures in adults, there is currently a study void addressing a direct comparison of these two approaches on DFF.[15] There have been few studies comparing DCS with locking plate fixation in terms of clinical and radiological outcomes, complications, and patient satisfaction. A thorough comparative investigation is required to fill this knowledge gap and offer surgeons evidence-based recommendations for choosing the best fixing method for distal femoral fractures.[16-17]

The objective of comparison study is comparing clinical and radiological outcomes of DCS and locking plate fixation. The time it takes for a fracture to heal, postoperative problems, range of motion (ROM), pain ratings, functional results, and implant-related complications including implant failure or screw loosening are just a few examples of these outcomes. Additionally, the study assessed post-operative patient satisfaction and quality of life using standardized assessment methods. The results of this study would assist orthopedic surgeons in selecting the best fixing procedure for specific patients based on evidence, taking into account the fracture characteristics, patient considerations, and desired outcomes.

MATERIALS AND METHODS

This descriptive cross-sectional study was done from January 2020 to January 2022 at Mufti Mehmood Memorial Teaching Hospital in Dera Ismail Khan, Pakistan. Based on 7% prevalence and 95% confidence, WHO sample size calculator suggests 101. Group A (DCS, n=51) and Group B (locking plate fixation, n=50) were randomly assigned (Figure No. 1.).

After surgery, patients were released with painkillers, oral antibiotics, and calcium. For a year, weekly and monthly monitoring was done. Each consultation included X-rays and fracture assessment. Every patient 20 had infection, union, and failed fixation.Patients with AO/OTA 33-A, 33-B, or 33-C distal femoral fractures were recruited to provide a homogenous and representative research group and minimise risks and confounding factors. If they had adequate bone quality for fixation, appeared within 7 days after damage, and had finished skeletal development, males and females were included. Patients who were surgically and anesthetically fit, capable of informed consent, and willing to follow the research procedure were enrolled. The study included closed distal femur fractures up to 15 centimetres from the distal articular surface, Grade I and Grade II compound fractures with displaced A.O type A1, A2, A3, C1, and C2 fractures, and injuries with preoperative active mobility if patients consented.

To ensure research validity and participant safety, exclusion criteria were adopted. Open fractures (Gustilo-Anderson type IIIB or IIIC) and severe soft tissue injuries excluded children under 18. The research excluded patients with tumour- or metastasis-related pathological fractures. Polytrauma patients with severe associated injuries requiring immediate care, a history of surgery or fracture in the same limb, or preexisting conditions or comorbidities that could affect fracture healing or surgical outcomes (such as severe osteoporosis, uncontrolled diabetes, or immune-suppression) were excluded. The analysis also removed participants who rejected or were unable to follow the procedure. Displaced A.O. B1, B2, B3, and C3 fracture types, Grade III open fractures, pathological fractures, minors with skeletal immaturity, and undisplaced fracture patterns needing conservative care were also eliminated.

DCS fixates distal femoral fractures sequentially. The patient was prepped for operation under general or regional anaesthesia. To reach the fracture site, a lateral incision was performed on the distal femur. Reducing

and realigning fracture pieces using reduction clamps or other tools restored anatomical alignment. After fracture reduction, a guide-wire was placed percutaneously under fluoroscopic supervision. A cannulated drill created a lag screw route across the guide-wire. The guide-wire trajectory determined the lag screw size. Lag screw was moved across fracture site until it contacted opposite cortex, compressing and stabilising fracture. After lag screw insertion, a unique side plate was affixed to distal femur's lateral side. A bone-shaped plate covered the fracture. Screws through plate perforations secured it to the bone. The fasteners were oriented to stabilise the femoral shaft and condylar fragment. To eliminate debris and impurities, the surgical incision was carefully irrigated after setting and verifying the lag screw and side plate. Sutures closed the epidermis after the deep layers and subcutaneous tissues.

The patient was sedated and draped for locking plate treatment of distal femoral fractures. To reach fracture site, distal femur was surgically incised. Reduced and repositioned fracture fragments restored anatomical alignment. Fixation plate was shaped to fit distal femur's lateral side. Plates placed locking fasteners into the bone. They latched into plate, creating a fixed-angle structure that was very resistant to screw loosening and withdrawal. Multiple fastening screws engaged the femoral shaft and distal fragment along the plate. The incision was irrigated and closed after positioning the plate and fasteners.

SPSS 25 analysed the data. Mean, standard deviation, median, numbers, and percentages were reported. Chi-square test and one-way ANOVA with Tukey's HSD compared groups.

The institution's Ethical Review Committee allowed the research. Figure No. 1: Group allocation of study patients.

RESULTS

This comparative study provided insight into the efficacy and outcomes of DCS and LPF in treating adult distal femoral fractures. A sum of 101 patients were selected in this cross-sectional investigation and their demographic values did not show statistically significant differences between these two groups A and B, based on the chi-square test and p-values, for DCS fixation and locking plate fixation, respectively. Demographic variables of Group A (n=51) and Group B (n=50) in study did not differ statistically significantly. With a p-value of 0.549, mean age of patients in Group A was 46.91 years (SD=12.30) and in Group B it was 48.18 years (SD=10.09). 58.82% of Group A's patients were male, while 72.0% of Group B's patients were male (p=0.5997). 74.50% of Group A patients was from rural areas, compared to 78.00% of Group B patients, yielding a p-value of 0.1072. The analysis of afflicted side revealed that 54.90% of Group A patients had right-sided fractures, compared to 64.0% of Group B patients (p=0.1766). There were no statistically significant differences between the two groups in terms of age, gender, location, or affected side (p>0.05). These results indicated that the demographic characteristics of the patients in study were comparable and did not influence treatment allocation or outcomes significantly (Table No. 1.).

The table presented the classification of patients into Group A, and B based on AO/OTA criteria, as well as statistical measures to determine the significance of any differences. In Group A, A1 fractures were the most prevalent, occurring in 17 patients (33.33%), followed by A2 fractures in 7 patients (13.73%). In Group B, the distribution was marginally different, with 28.0% of patients having A1 fractures and 12.0% having A2 fractures. With p-values of 0.8274 and 0.9464, respectively, the chi-square test revealed that these differences were not statistically significant. Similar to A3 fractures, Group A had six patients (11.76%) while Group B had eleven patients (22.0%). With a p-value of 0.3691, the statistical analysis failed to reveal a significant difference between the two categories. For fracture types B and C, there were no significant differences between the two groups. The chi-square test results and p-values for each fracture type indicated that there were no significant differences between Group A and Group B in the distribution of fracture types. Comparison of fracture varieties based on AO/OTA criteria revealed no statistically significant differences between Group A and Group B. This suggested that distribution of fracture types was comparable between the two treatment groups, indicating a comparable AO/OTA-classified patient population (Table No. 2.).

Provided data revealed the causes of femur fractures based on the frequency (n) of each cause. Automobile collisions emerged as the leading cause, accounting for 36 cases in the dataset. With 23 reported cases, falling from a significant height was the second most prevalent cause. Assault accounted for seven instances, whereas osteoporosis and aging were responsible for nine and ten cases, respectively. Two cases were attributed to genetic defects, indicating a structural vulnerability in the femur. Eight cases involved overuse leading to stress fractures, while six cases involved other pathological conditions. It is essential to note that provided data are specific to the dataset and may not account for all potential causes of femur fractures in the general population. Nevertheless, these results provided valuable insights into the common causes of femur fractures in the context of the data analyzed (Figure 2.).

The functional outcomes were rated as excellent, good, satisfactory, or poor based on ROM and level of satisfaction. In Group A, which received DCS fixation, majority of patients (56.86%) experienced outstanding functional outcomes. In addition, 14 patients (27.55%) had positive functional outcomes, 5 patients (9.80%) had satisfactory outcomes, and 3 patients (5.88%) had

negative outcomes. Similarly, 60% of Group B patients who underwent LPF had outstanding functional outcomes, 16 patients (32.0%) had favorable outcomes, three patients (6.0%) had satisfactory outcomes, and only one patient (2.0%) had an unfavorable outcome. The 2 values for the exceptional, decent, satisfactory, and poor results were 0.00, 0.0257, 0.0821, and 0.2041, respectively. The respective p-values were 1, 0.8726, 0.7744, and 0.6514. The statistical analysis revealed no correlation between the treatment groups (DCS versus LPF) and the functional outcomes of ROM and level of satisfaction. P-values exceeded the conventional threshold of 0.05, indicating that any differences observed between the two treatments groups (Table No. 3.). Harris Hip Score evaluated functional outcome and ROM from excellent (>80), to good (70-80), to satisfactory (65-79), to poor (65). Mostly patients in Group A, attained excellent functional outcomes, with 33 cases (64.70%) scoring above 80 on the Harris Hip Score. Ten patients (19.60%) had positive functional outcomes, three patients (5.88%) had satisfactory outcomes, and five patients (9.80%) had negative functional outcomes. Similarly, 70.0% of patients in Group B, achieved outstanding functional outcomes with a Harris Hip Score above 80. Eleven patients (22.0%) had favorable outcomes, three patients (6.0%) had satisfactory outcomes, and one patient (2.0%) had a negative outcome. The 2 values for the exceptional, decent, satisfactory, and inadequate outcomes were 0.0088, 0.00, 0.1573, and 1.3088, respectively. The respective p values were 0.9253, 1, 0.6916, and 0.2526. The statistical analysis revealed no significant relationships between treatment groups and Harris Hip Score outcomes. All p-values were greater than 0.05, indicating that any differences between DCS and LPF in terms of functional outcomes were not statistically significant (Table No. 4.).

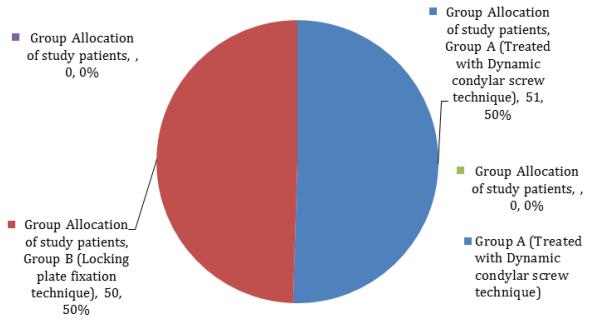

Figure No. 1: Group wise allocation of study patients

Occurrence of various complications between patients treated for femur fractures with DCS and LPF were also recorded and important insights revealed regarding the potential dangers and complications associated with these treatment modalities. In terms of infection, non-union, malunion, implant-related complications, and deep vein thrombosis, the two groups did not differ significantly.

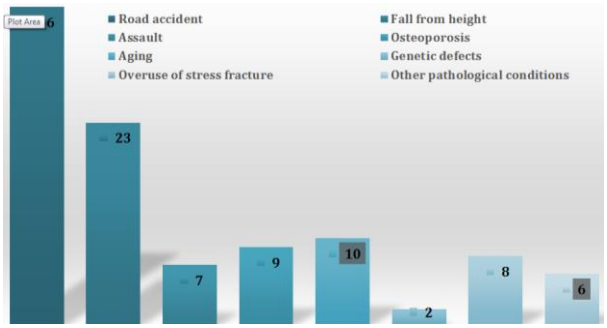

Figure No. 2: Causes of femur fractures in study groups (n=101)

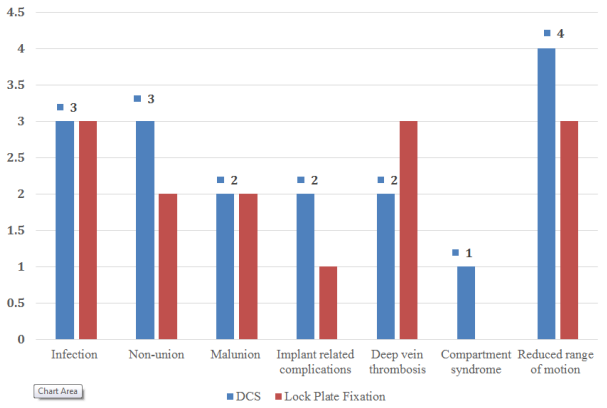

Figure No. 3: Complications resulting from surgical fracture fixation (n=No. of patients)

Table No. 1: Comparative demographic values of patients

S. #	Demo-graphic variable	Group A (n=51)	Group B (n=50)	$\chi 2$	p-value
1	Age (Mean+SD) years	46.91+12.30	48.18+10.09	0.601	0.549
2	Gender n(%) Male Female	30 (58.82) 21 (41.17)	36 (72.0) 14 (28.0)	0.2293 0.5997	0.6320 0.4387
3	Location n(%) Rural Urban	38 (74.50) 13 (25.49)	34 (78.0) 16 (32.0)	0.0201 0.1072	0.8872 0.7433
4	Affected side n(%) Right Left	28 (54.90) 23 (45.09)	32 (64.0) 18 (36.0)	0.0941 0.1766	0.7589 0.6742

Both DCS and LPF had comparable incidence rates for these complications. Nonetheless, some variations were observed. Compared to LPF group, DCS group had marginally higher rates of non-union, implant-related complications, compartment syndrome, and decreased range of motion. On other hand, incidence of deep vein thrombosis was marginally higher in LPF group. Although both DCS and LPF may be effective treatment options for femur fractures, clinicians should consider the potential risks and complications of each approach (Figure No. 3.).

Table No. 2: Stratification of patients based on AO/OTA criteria

S. No	Type of fracture	Group A		Group B		χ2	p-value
		No. of patients (n)	Frequency (%)	No. of patients (n)	Frequency (%)		
1	A1	17	33.33	14	28.0	0.0475	0.8275
2	A2	07	13.72	06	12.0	0.0040	0.9464
3	A3	06	11.76	11	22.0	0.8065	0.3691
4	B1	05	9.80	03	6.0	0.0821	0.7744
5	B2	04	7.84	04	8.0	0.1158	0.7335
6	B3	03	5.88	05	10.0	0.1158	0.7335
7	C1	05	9.80	05	10.0	0.091	0.7629
8	C2	02	3.92	01	2.0	0.0011	0.9730
9	C3	02	3.92	01	2.0	0.0011	0.9730

Table No. 3: Functional outcome of DCS and LPF in fixing femur fractures

Groups	Functional outcome in terms of range of motion and level of satisfaction			
	Excellent	Good	Satisfa-ctory	Poor
Group A n (%)	29 (56.86)	14 (27.45)	5 (9.80)	3 (5.88)
Group B n(%)	30 (60.0)	16 (32.0)	3 (6.0)	1 (2.0)
χ2	0.00	0.0257	0.0821	0.2041
p-value	1.00	0.8726	0.7744	0.6514

Table No. 4: Functional outcome of DCS and LPF in fixing femur fractures using Harris Hip Score

Groups	Harris Hip Score			
	Excellent >80	Good 70-80	Satisfa-ctory 65-79	Poor <65
Group A n(%)	33 (64.70)	10 (19.60)	3 (5.88)	5 (9.80)
Group B n(%)	35 (70.0)	11 (22.0)	3 (6.0)	1 (2.0)
χ2	0.0088	0.00	0.1573	1.3088
p-value	0.9253	1.00	0.6916	0.2526

DISCUSSION

This comparative study provides insight into the efficacy and outcomes of DCS and LPF in treatment of adult distal femoral fractures. Both techniques have advantages and disadvantages. On the basis of ROM and level of contentment, the functional outcomes of DCS and LPF-treated patients were evaluated. In Group A (DCS), majority of patients (56.86%) had outstanding functional outcomes, while Group B (LPF) had 60% of patients with excellent outcomes. Harris Hip Score was used to evaluate functional outcomes and ROM, with comparable results in both groups. Infection, non-union, malunion, implant-related complications, and deep vein thrombosis showed non-statistically significant differences between DCS and LPF groups. Nonetheless, some differences were observed, with slightly higher rates of certain complications in the DCS group and slightly higher incidence of deep vein thrombosis in the LPF group.

Similar study revealed that average operative time for DCS was approximately 121 minutes compared to 118 minutes for LCP. Mean number of days for full weight bearing and the average time of fracture union were marginally shorter in LCP than in DCS, yet the difference was not statistically significant. Both DCS and LPF had comparable efficacy and patient satisfaction, although LPF was found superior in management of comminuted distal fractures compared to DCS, as in our study we found[18]. Our findings were also supported by a study involving 30 patients in Patiala, India, with distal femoral fractures. In 8 (24%) cases, bone transplantation was performed at the time of primary fracture fixation. Bone grafting was performed in two cases in the DCS group and six cases in the LCP group. In the DCS group, two cases (6% of total) had only one inter fragmentary screw and one case had two inter fragmentary screws in addition to the DCS lag screw and plate for additional support. LCP was the implant of choice for comminuted distal femur fractures, and DCS was only recommended in distal femur fractures in geriatric patients when there is at least 4 cm of uncomminuted bone stock above the intercondylar notch[20]. In biomechanical testing of a simulated A3 distal femur fracture, DFLP fixation of distal femur fractures produced a stronger construct than DCS fixation in terms of both cyclic loading and ultimate strength.[15] A study found that distal femoral locking compression plate fixation and Dynamic condylar screw with plate are equally effective for achieving satisfactory union and functional outcome in AO type 33-B, 33-C fracture distal femur.[6] Surgical complications such as superficial incision infection, postoperative stiffness, varus deformity, and implant failure were similar in both groups.[21] In our study, DCS generated better functional outcomes than DLFP for fractures of type A. Infection, knee rigidity, and malalignment of fractures were the most frequent complications we observed in series of DLFP and DCS patients, which could be mitigated by surgical expertise, meticulous soft tissue handling, prudent antibiotic use, and vigorous early knee mobilization. distal locking femur plate (DLFP) produced superior

results and appeared viable treatment option for distal femur fractures.[22]

CONCLUSION

The DCS and LPF outcomes in treating distal femur fractures in adults were investigated. Both treatment methods resulted in comparable fracture healing, ROM and functional outcomes, indicating positive clinical and radiographic outcomes. The levels of patient satisfaction were comparable between two categories. Our study demonstrated, however, that locking plate fixation outperformed DCS in terms of patient performance and satisfaction, while also presenting fewer complications. LCP was discovered to be a less complicated and more user-friendly technique, which may explain why the majority of orthopedic surgeons prefer this method. The study emphasized the necessity of vigilant monitoring for implant-related complications and making individualized decisions based on patient-specific factors. These results provide orthopedic surgeons with evidence-based recommendations for selecting the most appropriate fixation method for distal femoral fractures in adults. To validate and rectify any limitations of the current study, it is suggested that future prospective studies with larger sample sizes be conducted.

Author's Contribution:

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