

Functional Outcome of Distal Femur Pre-Contour Locking Plate

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ABSTRACT

OBJECTIVE: To evaluate the effectiveness and functional outcome of distal femur fractures fixation with pre-contoured locking compression plate while using knee society score.

METHODOLOGY: This Descriptive Case Series was conducted at Trauma Orthopedic Clinic (T.O Clinic) Karachi from January 2016 to December 2019. A simple random sampling technique was used to select the study participants. After written and informed consent, 100 patients were enrolled in the study. Patients between the age of 40 and 60 years, either sex presented with extra and intraarticular distal femur fracture due to trauma that required surgical treatment were included. The functional outcome was assessed in the 6th month by using the structured questionnaire of Knee Society Score. A goniometer was used to assess knee flexion and extension range of motion.

RESULTS: The mean age of participants was 52.18±6.06 years. The majority of 60(60%) patients were >50 years patients. Union was achieved in all cases which is evident on a radiograph in the majority of cases (68%) between 17-23 weeks and the mean duration to achieve union was 21 weeks. The mean knee society score (functional) was 82.35±13.35, with a range of 48(52-100). The knee society score (knee) was 81.12±13.04, with a range of 48(50-98). 53 had excellent grades, 31 had good grades, 11 had fair grades, and 5 had poor grades.

CONCLUSION: Pre-contour locking compression plate gives excellent and good functional outcome for distal femur fracture management with early recovery.

KEYWORDS: Functional Outcome, Internal Fixation, Distal Femur Fracture, Knee Society Score

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INTRODUCTION

Distal femur fractures are infrequent and constitute about 4-6% of all the femoral fractures¹. Mostly high energy distal femur fractures seen in the male gender between their 15 to 50 years of age while in the female it's usually involving more than 50 years of age with low energy fracture. Patients with osteoporosis and prior knee arthroplasties are at greater risk of such fractures². In the elderly age group, distal femur fractures are 2nd most common cause of mortality after hip fractures³.

Restoration of alignment is very important to preserve the function of extremity and it plays a crucial step in the definitive management of femur distal fracture¹. Early knee range of motion is decisive to attain acceptable outcomes. Immobilization of the knee results in joint stiffness as well as restricted knee range of motion that contribute to the poor outcome. Understanding the characteristics, principles, and challenges in the management of the fractures of the distal femur is important in optimizing its outcomes^{1,4,5}. For fractures involving joint surface of the distal femur, needs extremely thorough and careful solution because it may lead to secondary arthritis and it also because of the issues related to the correction of the affected mechanical axis⁶, distal femur fractures are best treated by absolute anatomical reduction with

rigid and stable internal fixation. Fracture of distal femur fixation with plate application has an innate disadvantage of producing a load shielding device⁷.

Fixed angle construct is formed by locking compression plate (LCP), which helps to preserve periosteal blood supply by enabling the placement of plate without any contact to the bone, so distal femur locking plate can be used in the management of metaphyseal comminution⁸.

In osteoporotic bones, LCP provides a better hold because of the extremely higher supplement strength of locking screws compared with the conventional methods. It is therefore difficult for a single screw to pull out or fail if adjacent screws do so⁹.

The objective of the present study was to evaluate the effectiveness and functional outcome of distal femur fracture fixation with a pre-contoured locking compression plate while using the knee society score.

METHODOLOGY

This descriptive case series was conducted at Trauma Orthopedic Clinic (T.O Clinic) Karachi from January 2016 to December 2019. Ethical approval was taken from the Institutional Review Board T.O clinic while formal written and verbal informed consent was also taken from all the patients after debriefing and explaining to them the purpose, risks, and benefits of the study. The sample size of 100 patients and was

calculated by utilizing sample size determination software for prevalence studies taking 91.3% Incidence of an acceptable outcome, 95% confidence interval, and 6% precision level. Patients of either sex, between ages 40 years to 65 years presented at Trauma Orthopedics Clinic with acute fracture of distal femur close extra-articular and intra-articular fractures due to trauma (diagnosed by radiograph) from 12 hours – 4 days require surgical intervention were included in this study. All those patients belong to age <40 and over 65, presented with gunshot injury or polytrauma, with fracture involving the nerve, vascular, and/or head injury, previous history of a knee injury, open fractures, joint pathology, and pathologic fractures were excluded from the study.

All physical, as well as radiological examinations were conducted by the principal investigator of the study. All patients were operated on using the customary lateral approach for the fixation of extra-articular and the simple intra-articular fractures.

A substantial surgical approach may be needed in such composite distal femur fractures involving joint. The lateral para-patellar approach was used for these complex fractures and restoration of the articular surface achieve through joint exploration. A post-surgical follow-up protocol for all the patients was set at 6th, 12th week, 6th months, and 9th month. Union of bones was assessed on radiological findings. This was defined as attendance of cross trabeculation on lateral and AP radiographs. While non-union was defined if there was a failure of union of fracture at 9-month follow-up. On the final follow-up, patients were inquired about the functional status and mobility of their operated joints using the KNEE SOCIETY SCORE scale to assess while the movement of the knee was also evaluated objectively. Knee Society Score comprises a knee score and a functional score. A knee Score is based on the clinical parameters and a Functional Score is based on how the patient perceives that the knee functions with specific activities. The maximum knee score is 100 and the maximum functional score is 100. The Knee Score includes pain (50 points), range of motion (25 points), and anteroposterior and mediolateral stability (25

points). The functional score includes walking (50 points) and stair climbing (50 points). Scores of 80 to 100 are rated as excellent, 70 to 79 good, 60 to 69 fair, and less than 60 poor.

The knee joint flexion and extension angles were assessed using Goniometer. A predesigned and pre-tested written questionnaire was used for the collection of all the information. Collected data were entered and analyzed using SPSS ver. 17.

RESULTS

A total of 100 patients were reported to the orthopedic department between 40 to 60 years of age from 12 hours to 4 days had extra and intra-articular fractures due to trauma and required surgical treatment were evaluated to determine the distal femur fracture outcome by utilizing knee society score for the fixation of fracture distal femur fixed with pre-contoured locking plate at 6 months after fixation.

The results showed that overall there were 68 (68%) male and 32 (32%) female patients. The overall mean age of participants was 52.18±6.06 years, with a range of 40-60 years. According to stratified groups, 40(40.0%) patients were ≤50 years and 60(60.0%) patients were >50 years old. The average age of patients ≤50 years was 45.83±3.07 years and for patients aged >50 years the mean age was 56.42±3.14 years.

Union was achieved in all cases which is evident on a radiograph in the majority of cases (68%) between 17-23 weeks and the mean duration to achieve union was 21 weeks.

The knee society score according to function and knee was observed. The mean functional score was 82.35±13.35, with a range of 48(52-100). The mean knee score was 81.12±13.04, with a range of 48(50-98).

According to knee society score, grading is also observed, the results showed that 53 had excellent grades, 31 had good grades, 11 had fair grades, and 5 had poor grades.

The frequency and association of functional outcome according to knee society score grades were also evaluated in terms of excellent, good, fair, and poor.

FIGURE I: PRE-OPERATIVE & IMMEDIATE POST-OPERATIVE RADIOGRAPH



The results showed that out of all patient, 53 (53.0%) were excellent, 31 (31.0%) good, 9 (9.0%) were fair and 7 (7.0%) had poor functional outcome. Patients with extra-articular fracture had Excellent (62.0%), good (27.6%), Fair (7.0%) and poor (3.4%) functional outcome comparison with the functional outcome of Intra-articular fracture patients i.e. excellent outcome was observed in 42.8%, good outcome in 35.7%, fair in 9.5% while poor in 12.0% patients.

TABLE I: TYPE OF FRACTURE AND FUNCTIONAL OUTCOME

Type of fracture	Frequency	Knee society score (mean)			
		Knee score	p-value	Functional score	p-value
Extra-articular	58	96.5±3.35	0.002*	92.9±2.31	0.0001*
Intra-articular	42	93.8±5.15	0.002*	86.2±4.35	

* T-test p value < 0.05

TABLE II: FREQUENCY DISTRIBUTION OF GRADING

	Knee Society Score		
	Extra-articular Fracture	Intra-articular Fracture	Total
Excellent	32	21	53(53.0)
Good	19	12	31(31.0)
Fair	06	05	11(11.0)
Poor	01	04	5(5.0)

DISCUSSION

Open reduction and internal fixation is the most preferable method is used to treat fractures throughout the body, including distal femur¹⁰. It is a considerably difficult task to treat distal femur fractures because of some challenges associated with them including the potential risk of developing various deformity due to lack of both column support, short distal femur segment, and osteoporotic bone for fixation and surgical exposure with great concern of blood loss¹¹. Operative treatment options available to manage such fractures are external fixators, fixed angled blade plate and dynamic condylar screws, intramedullary nails, condylar buttress plates, and now recently and more commonly used locking plates that typically placed submuscular manner¹².

The recent trend is to use periarticular distal femur locking plate as it can be applied sub muscularly with minimally invasive technique to preserve periosteal blood supply, fracture hematoma, and prevent extensive damage to soft tissues with increase healing potential¹¹⁻¹³. Acceptable reduction and good fixation fracture are based on the quality of bone, complexity

of the fracture, and use of surgical approaches^{12,13}.

There are numerous advantages of distal femur locking plate including minimal invasive plate placement and it making multiple fixed-angle constructs to provide stable fixation, minimal risk of injury to neurovascular structures with the use of submuscular plate application technique. In our study, none of the patients had a vascular injury because in our observation handling smoothly and gently by giving soft tissue respect is a crucial surgical step to prevent neurovascular structures¹⁴.

The standard lateral surgical approach was used for minimally invasive plate fixation technique for extra-articular simple fractures. Meanwhile for composite fractures involving joint surface, a substantially extensive approach is needed, like an exploration of the knee joint to get restoration of the articular surface under direct vision while after downgrading the fracture articular segment fixed with distal femur diaphysis through indirect plate fixation technique for these fractures¹⁵.

A study by Freeman AL et al.¹⁶ reported that in the osteoporotic model diaphysis locked fixation was found to be a superior technique. As he compared axial stiffness, load to failure, and extraction torque of screw for distal femur locking plates with locked or non-locked diaphysis fixation among osteoporotic and non-osteoporotic distal femur fracture of cadaveric model.

Sung Won Cho and his coauthors analyzed the clinical and radiologic outcomes of 23 patients with distal femur locking plate fixation for fractures of the distal femur to assess the adequacy of the locking compression plate. He used the knee society score for evaluation and found poor results in two patients (8.69%), while fair in one (4.34%), good in eight (34.78%), and twelve (52.17%) patients had excellent outcome¹⁷.

In a study, the radiological union was achieved at a mean of 16 weeks for distal femur fracture fixation with a locking compression plate. Results were found to be excellent among five patients from twenty-one while the rest of the patients had satisfactory outcomes except one. The mean knee score in our study was more than 80 as compared to the Schandelmaier P 2001¹⁸ results which showed 67.7.

The distal femur locking plate is very useful to be used in comminuted fractures because the screw head is locked into the plate and creates a strong angular stable construct which prevents screw pull out and provide stability as a single unit¹⁹. A combination hole of the plate also helps to get compression at fracture site by using conventional screw and in addition to this, locking screws used to get better purchase than conventional screws.

The titanium-based substance implant was used in the current study to achieve a strong callus that is evident in the radiological union. These findings are consistent

with the result of Henderson CE et al²⁰. In that study, the titanium-based implant was applied in comparison to stainless steel implant while distal femur fractures were treated using locking plate.

With strengths, there are some limitations in the present study. Firstly, it was a single-centered experience with a limited representation of females in the study. Secondly, the limited time and resources as well as the design used in the study were the main constraint. Due to the small sample size and setting where the study was conducted, the results cannot be generalized. Moreover, the indications and the technology applied in the study were not fully elucidated as the locked screws may extricate from the plates secondary to the failure of the screw to seat into the plate properly.

CONCLUSION

The study concluded that the use of locking compression plate in fractures of the distal femur seems to be associated with better outcomes and early recovery of the patients.

Ethical Permission: Trauma Orthopedic Clinic, Karachi, Ethical Review Committee letter No. TOC/EC-01-2016-03, dated 08-01-2016.

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AUTHOR CONTRIBUTIONS

Ali SD: Data collection and manuscript writing

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