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ORIGINAL ARTICLE

The functional outcome of surgical management of distal femur fractures using a distal femoral locking compression plate.

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ABSTRACT… Objective: To evaluate the functional outcomes following surgical intervention for distal femur fractures using femoral locking compression plates. **Study Design:** Descriptive study an Observational study. **Setting:** Department of Orthopedics, MTI Mardan Medical Complex in Mardan. **Period:** January 2023 to December 2023. **Methods:** Was conducted on 86 patients with distal femur fractures treated with femoral locking compression plates at the Orthopedic Ward. The sampling method employed was non-probability consecutive sampling. All surgeries were performed using a standardized technique by an experienced surgeon. Functional outcomes were assessed using the Oxford Society score six weeks post-procedure. Data analysis was conducted using SPSS 23, with significance set at $p \leq 0.05$. **Results:** Of total 86 patients, n=57(66.3%) were male while n=29(33.7%) were female. Mean age was 35.43±10.49. Overall, 39 patients (45.3%) had excellent functional outcomes, 22 patients (25.6%) had good functional outcomes, 13 patients (15.1%) had fair functional outcomes, and 12 patients (14.0%) had poor functional outcomes. After cross tabulation with functional outcomes, gender and BMI were found insignificant with p value of 0.584 and 0.399 respectively. While diabetes, hypertension and age was found to be significantly associated with functional outcomes with p value of <0.001,0.005 and <0.001 respectively. **Conclusion:** The use of locking compression plates for distal femur fractures resulted in predominantly favorable functional outcomes with minority of patients experiencing poor outcomes. Additionally, diabetes, hypertension, and age emerged as significant predictors of functional outcome.

Key words: Distal Femur Fracture, Functional Outcomes, Locking Compression Plate, Management.

INTRODUCTION

Fractures involving the supracondylar and intercondylar segments of the distal femur are frequently encountered injuries. The focus of the procedure is on realigning limb alignment, length, and rotation, along with achieving biomechanical reduction of the articular surface. Despite considerable advancements in orthopedic implants, managing distal femur fractures remains challenging due to their typically comminuted, intra-articular nature, often involving osteoporotic bone, which complicates fixation. Geriatric trauma patients often present with significant comorbidities, impacting treatment decisions.[1,2]

The distribution of adult distal femur fractures exhibits a multimodal pattern. Younger patients commonly suffer from high-energy trauma, such as motor vehicle accidents, while low-energy mechanisms like falls are prevalent among older individuals. The presence of severe comorbidities in geriatric patients adversely affects their functional outcomes, rehabilitation, and overall survival. In pediatric populations, inadequately managed intra-articular fractures and early joint damage can lead to long-term consequences.[3] As the population ages, rehabilitation of these complex fractures has been associated with suboptimal outcomes.[4]

Conservative treatment modalities, including traction, casting, or a combination thereof, often necessitate prolonged bed rest, which may result in angular deformities, pressure ulcers,

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and restricted knee range of motion. Surgical stabilization has consistently demonstrated superior outcomes compared to conservative management.[5,6]

The distal femoral locking compression plate is a relatively new pre-contoured plate designed to provide angular stability and rigid fixation. A study evaluating the functional outcomes of distal femoral locking compression plate in distal femur fractures reported excellent outcomes in 66.66%, good outcomes in 23.80%, and fair outcomes in 4.76% of cases.[7]

Distal femur fractures are frequently associated with soft tissue injuries, including ligamentous knee joint instabilities, which may be challenging to diagnose until the fracture has been stabilized. This study aimed to assess the functional outcomes of surgical management of distal femur fractures using the distal femoral locking compression plate.

METHODS

A case series study was conducted on 86 patients presenting with closed distal femur fractures, with or without intra-articular extension as diagnosed on radiographs at the Orthopedic Department of MTI Mardan Medical Complex in Mardan from January 2023 to December 2023 after approval from ethical committee (482/BKMC) (19-04-2024). Non-probability consecutive sampling was employed.

Before obtaining written consent, all patients received detailed information about the study's risks, benefits, and objectives. Basic demographic data such as name, gender, and address were recorded. A thorough physical examination and comprehensive medical history were documented for each patient.

Patients diagnosed with distal femur fractures based on O/OTA Fracture Classification" system, developed by the Arbeitsgemeinschaft für Osteosynthesefragen (AO Foundation) and the Orthopaedic Trauma Association (OTA).[5] They were diagnosed on radiographs (Xray or CT scans) in the emergency department and underwent surgical intervention using the distal femoral locking technique. Regional or spinal anesthesia was administered to all patients. Patients were positioned supine on a radiolucent examination table, with a sandbag placed beneath the ipsilateral hip and a towel under the knee to achieve a flexed position, while ensuring proper alignment of length and rotation. Tourniquets were applied when necessary based on femur length and fracture severity. The affected leg was prepped and draped, and a lateral incision was made along the lateral aspect of the thigh extending distally through the midline of the lateral condyle, while maintaining anterior to the proximal insertion of the lateral collateral ligament. The incision was then extended anteriorly along the lateral edge of the patella to the distal tip of the tibial tuberosity. The fascia lata was incised along with the skin, and incisions were made into the iliotibial tract and capsule/synovium of the lateral femoral condyle as needed for exposure. The superior lateral genicular artery was identified and ligated cautiously to avoid damaging the lateral meniscus. The incision was extended as necessary to expose the articular surface, particularly the medial femoral condyle. The lateral intermuscular septum of the Vastus lateralis muscle was reflected to expose the distal femoral shaft. Fracture reduction was achieved using manual traction, and temporary K-wires were used for condylar fractures. The pre-contoured distal femoral locking compression plate was secured with cancellous locking screws distally and cortical locking screws proximally. Hemostasis was maintained, and the incision was closed layer by layer after inserting a suction drain. In cases of intra-condylar fractures, a plaster of Paris (POP) slab was applied above the knee with the knee flexed at 15-20 degrees. Functional outcomes were evaluated using the Oxford Society Scoring system[5] six weeks post-procedure based on a 12-question questionnaire assessing the patient's functional status.

- A score > 41 is considered (Excellent)
- A score between 34 to 40 is considered (Good)
- A score between 27 to 33 is considered (Fair)
- A score < 27 is considered (Poor)

This procedure was undertaken under the supervision of an expert orthopedic surgeon having 5 years of post-fellowship experience.

Post operatively patients were assess by physiotherapist and all patients underwent rehabilitation program in physiotherapy department as per institutional guidelines.
Patients' information was recorded on an allotted proforma.

SAMPLE SELECTION

Inclusion Criteria

- Both (Male and Female)
- Age (18-70) Years
- Patients with closed distal femur fractures with/ without intra-articular extension diagnosed on radio-graphs.

Exclusion Criteria

- Patients with comminuted dia-metaphyseal fractures,
- Patients with open fractures and
- Patients with neurovascular injuries

DATA ANALYSIS

The data underwent analysis using SPSS 21 software. Mean and standard deviation were calculated for quantitative variables such as age, weight, height, and BMI. Frequencies and percentages were determined for qualitative variables including gender, functional outcome, diabetes, and hypertension. Functional outcomes were categorized based on age, BMI, gender, diabetes, and hypertension to assess potential effect modifiers. Post-stratification chi-square testing was conducted, with significance set at $p < 0.05$. Results were presented through tables and graphs.

RESULTS

A total of 86 patients were enrolled in the study, with a mean age of 35.43 ± 10.49 years, ranging from 20 to 68 years. The mean BMI was 24.78 ± 4.05, ranging from 17.00 to 33.

Table-I depicts the gender distribution among the participants, with 57 (66.3%) male and 29 (33.7%) female individuals. Among the patients, 20 (23.3%) had diabetes, while 66 (76.7%) did not. Additionally, 22 (25.6%) patients had hypertension, while 64 (74.4%) did not.

Figure-1 illustrates the distribution of functional outcomes among patients, with 39 (45.3%) achieving excellent outcomes, 22 (25.6%) good outcomes, 13 (15.1%) fair outcomes, and 12 (14.0%) poor outcomes.

Table-II presents a comparison of clinical demographic characteristics with functional outcomes. Among males, 28 had excellent outcomes, 12 had good outcomes, 9 had fair outcomes, and 8 had poor outcomes, while among females, 11 had excellent outcomes, 10 had good outcomes, 4 had fair outcomes, and 4 had poor outcomes. Significant associations were found between functional outcomes and diabetes status ($p < 0.001$), age categories ($p < 0.001$), and hypertension ($p = 0.005$), indicating their impact on functional outcomes. However, gender ($p = 0.585$) and BMI categories ($p = 0.399$) did not show statistically significant associations.

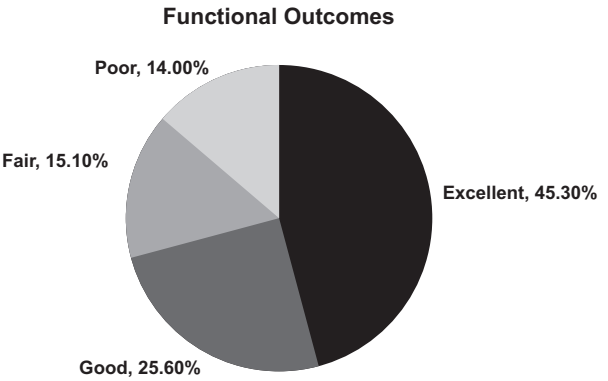

Figure-1. Functional outcomes of patients

DISCUSSION

Achieving optimal screw positioning during surgery poses a challenge. This study investigates the suitable placement of screws for relative fixation, advocating for the utilization of a locking compression plate as a bridging plate. Guidelines propose a plate length 8-10 times greater than the fracture length, with 0-3 vacant holes in the surrounding area, spacing of ≤ 2 mm, and insertion of ≥ 3 screws (bicortically) into proximal and distal bone fragments.[8]

Characteristics	Groups	Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	57	66.3	66.3	66.3
	Female	29	33.7	33.7	100
	Total	86	100	100	
Diabetes	Present	20	23.3	23.3	23.3
	Not Present	66	76.7	76.7	100
	Total	86	100	100	
Hypertension	Present	22	25.6	25.6	25.6
	Not Present	64	74.4	74.4	100
	Total	86	100	100	

Table-I. Descriptive statistics of patients

Characteristics	Groups	Functional Outcomes				Total	P-Value
		Excellent	Good	Fair	Poor		
Gender	Male	28	12	9	8	57	0.585
	Female	11	10	4	4	29	
	Total	39	22	13	12	86	
Diabetes	Present	1	4	7	8	20	<0.001
	Not Present	38	18	6	4	66	
	Total	39	22	13	12	86	
Age Categories	18-40yrs	37	17	3	3	60	<0.001
	41-70yrs	2	5	10	9	26	
	Total	39	22	13	12	86	
BMI Categories	Underweight	1	0	0	1	2	0.399
	Normal BMI	23	10	4	4	41	
	Overweight	12	7	5	4	28	
	Obese	3	5	4	3	15	
	Total	39	22	13	12	86	
Hypertension	Present	4	16	8	7	22	0.005
	Not Present	35	16	8	5	64	
	Total	39	22	13	12	86	

Table-II. Comparison of clinicodemographic characteristics and functional outcomes

According to our study the mean age of patients was 35.43 with SD±10.49. Same findings were reported by Bihamani M with mean age of 45.[9]

In our study 57 participants (66.3%) were male, while 29 participants (33.7%) were female. In the study by Pai Manjeswar M et al, 76% of the patients were male and 24% were female with 38 and 12 cases, respectively.[10] In the study by Bai et al., the female-male ratio was 1:1.[11] In the study by Rekha et al., 70% of the cases were male with 30% being female, which is a ratio comparable to our study.[12]

In this study 39 patients (45.3%) had excellent functional outcomes, 22 patients (25.6%) had good functional outcomes, 13 patients (15.1%) had fair functional outcomes, and 12 patients (14.0%) had poor functional outcomes. In the study Pai Manjeswar M et al, Twenty-four percent of cases had excellent outcomes as per Neer's and Kolmert's scoring systems, while 44% of cases had good outcomes. Only 16% of cases had fair and poor outcomes (82). In the study by Garg et al., 50% of cases had excellent outcomes as per Neer's criteria, 30% had good outcomes, while fair and poor outcomes were 10% each.[13] According to study by MA Ali et al., majority (n=85,81%) of the patients had excellent outcome after distal femoral locking technique as assessed with modified Mize outcome criteria while good outcome was achieved in 16(15.8%) patients. No non-union or implant failure was reported.[14]

Our findings indicate that gender does not seem to significantly influence the functional outcomes

observed in this study. This aligns with the conclusions drawn by van der Sjip MP in their systematic review.[15]

Our study highlight a clear relationship between age and functional outcomes, suggesting that older age may be associated with poorer functional outcomes in this study population (P value <0.0001) which is comparable to the findings of systemic review conducted by van der Sjip MP.[16]

These results suggest that BMI alone may not be a strong determinant of functional outcomes in this study population which is comparable to the findings of Soliman SS et al findings.[17]

LIMITATION

While the study's descriptive case series design and utilization of the Oxford Society scoring system may pose validity concerns, increasing the sample size could enhance the study's robustness. Another limitation is the short period of follow up for 6 weeks. Increasing the period of follow up will enhances the power of conclusion. Despite these limitations, the study sheds light on the beneficial effects of employing the distal femur compression locking plate procedure for treating distal femur fractures.

CONCLUSION

In general, the functional outcomes after employing the locking compression plate for distal femur fractures were favorable, with minority of patients experiencing poor functional results. Furthermore, diabetes, hypertension, and age emerged as notable factors influencing functional outcomes.

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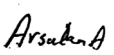
AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Shahad Ali	Research design and primary writing.	
2	Abu Saeed	Significant contribution to research and writing.	
3	Muhammad Arsalan Azmat Swati	Supervision, contribution to writing, critical review.	
4	Khalid Khan	Supervision and critical review.	
5	Adnan Ahmad	Assisted with data collection and literature review.	
6	Inam Ul Ghani	Contributed to drafting and provided insights.