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ORIGINAL ARTICLE

Outcome of femoral shaft closed fracture treated by interlocking nail in patients presenting to a tertiary care hospital.

Wajid Ali[1], **Muhammad Arif Khan**[2]

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ABSTRACT… Objective: To evaluate the clinical and radiological outcomes of closed femoral shaft fractures managed with interlocking intramedullary nailing in patients. **Study Design:** Descriptive study. **Setting:** Department of Orthopedics, Hayatabad Medical Complex, Peshawar. **Period:** June 8 2023 to December 8, 2023. **Methods:** Using non-probability consecutive sampling, 70 patients with closed femoral shaft fractures, ages 18 to 70, were recruited. AP and lateral femoral X-rays as well as clinical assessment were used to diagnose fractures. Under spinal anesthetic, skilled orthopedic surgeons carried out the surgical fixing procedure. Callus bridging three cortices was considered radiological union, and the Thorensen criteria were used to evaluate functional outcomes. Six-month follow-up assessments were carried out. A p-value of less than 0.05 was deemed significant. SPSS version 20 was used to analyze the data, and chi-square tests were used for stratified comparisons. **Results:** Of the participants, 41.4% were female and 58.6% were male, with an mean age of 47.64 ± 14.03 years. 65.7% of patients had radiological union. Of the patients, 89.9% had an acceptable outcome, with functional outcomes being outstanding in 60.0%, good in 30.0%, fair in 7.1%, and bad in 2.9%. Results did not significantly correlate with smoking status, age, gender, diabetes, or hypertension. **Conclusion:** In closed femoral shaft fractures, interlocking intramedullary nailing is linked to a high percentage of radiographic union and satisfactory functional results. Comorbidities such smoking, diabetes, and high blood pressure had no discernible effect on the effectiveness of treatment.

Key words: Femoral Shaft Fracture, Functional Outcome, Interlocking Nail, Orthopedic Surgery, Radiological Union, Thorensen Criteria.

INTRODUCTION

As the longest and strongest bone in the body, the femur has always been of interest to orthopedic surgeons. In orthopedic practice, femoral shaft fractures are among the most common injuries treated. These fractures typically occur in healthy individuals as a result of high-speed collisions and are frequently observed in conjunction with other severe injuries that may be fatal.[1] Since the femur bears the majority of the body weight, any fracture can result in serious issues and permanent impairment if it is not promptly and appropriately treated.[2,3]

The optimum treatment for a femur fracture is determined by a number of factors. These include the age of the patient, the location and kind of the fracture, the severity of the bone break, and the patient's financial status.[2] While there are numerous tools available to treat these fractures, the interlocking intramedullary (IM) nail is thought to be the most effective option.[1,4] Due to its ability to speed up bone healing and enable patients to begin moving earlier, this technique is frequently employed.[5] Despite being successful and safe in general, IM nailing can still have some issues. Bone misalignment is a common problem that may need to be fixed surgically and might result in poor recovery.[6] Infections following surgery occur in approximately 1.2% to 5% of cases.[7,8]

With IM nailing, the healing rate is often high, ranging from 72% to 100%.[9,10] Non-surgical treatment, such as applying skeletal traction (ST) for a few weeks, is nevertheless frequently utilized in places with constrained resources.[11,12]

1. MBBS, Postgraduate Trainee Orthopedic, Hayatabad Medical Complex, Peshawar.
2. MBBS, FCPS, HOD Orthopedic, Hayatabad Medical Complex, Peshawar.

Correspondence Address:
Dr. Wajid Ali
Department of Orthopedic
Hayatabad Medical Complex, Peshawar.
dr.wajidalikhankmc@gmail.com

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However, there is a greater risk of issues with this method; difficulties have been observed in as many as 55% of cases.[12,13] The healing rate was 95.3% in one study. On X-rays, the bone healed in an average of 14 weeks, and patients were able to walk pain-free almost immediately after. Thoresen's grading scheme showed that 4.7% of patients had bad outcomes and 93% had great outcomes.[8] According to another study, 38.3% of patients who received IM nail treatment saw great results, 8.3% experienced good results, and 3.3% experienced poor results.[14]

Although there are several studies regarding the results of IM nailing for closed femoral shaft fractures. However, the results were evaluated using a variety of criteria. Therefore, in order to validate the results of numerous earlier investigations, the current study is meant to evaluate the results using particular and verified criteria.

OBJECTIVE

To determine the outcome of femoral shaft closed fracture treated by interlocking nail in patients presenting to a tertiary care hospital.

METHODS

Following ethical approval from the Institutional Review Board (No. 954-15/9/22) and the Department of Research and Evaluation of the College of Physicians and Surgeons Pakistan, this descriptive study was carried out in the Department of Orthopedics at Hayatabad Medical Complex, Peshawar, from 08-06-2023 to 08-12-2023. The study aimed to evaluate the results of patients who had closed femoral shaft fractures, which are defined as fractures that are radiologically confirmed on AP and lateral femur X-rays and indicate a fracture line that passes through three cortices. Clinical evidence for these fractures includes pain with a VAS score of four or higher, swelling that appears to bulge on the affected thigh, and tenderness with a VAS score of seven or higher. On X-rays, radiological union was identified by the presence of callus bridging three cortices, and the Thorensen criteria were used to assess functional result. Good to exceptional results were categorized as acceptable.

A total of 70 patients were enrolled using non-probability sampling technique with a 95% confidence level, an 8.3% good outcome proportion, and a 6.5% absolute precision, as determined by the WHO sample size calculator. Patients with a closed femoral shaft fracture who were between the ages of 18 and 70, male or female, and who presented within two weeks of the injury were eligible to participate. Individuals with neurovascular injuries, open fractures, polytrauma, or ASA status 3 or above were not included. After giving their informed consent, eligible patients who arrived at the emergency room or outpatient clinic were included. Age, gender, time since fracture, and comorbidities such diabetes mellitus, hypertension, and smoking status were among the demographic and clinical information that was documented.

Under spinal anesthesia, orthopedic doctors with at least two years of expertise carried out the surgery. In order to track clinical and radiographic fracture union and measure hip and knee range of motion, patients were evaluated every two weeks for the first two months and then every month for the next four months. In stable fractures, partial weight-bearing was started as soon as the acute pain eased, postponed until six weeks, when radiological signs of callus formation was seen, and then permitted in full by four months.

Clinical definitions of fracture union included radiological evidence of trabecular continuity, no pain, motion, or warmth at the fracture site, and no discomfort when bearing full weight. At six months, the final results were assessed using predetermined standards and documented in a structured proforma.

Data were analyzed using SPSS version 20. The Shapiro-Wilk test was used to determine whether continuous variables were normal. For continuous variables like age and fracture duration, the mean, standard deviation, median, and interquartile range were computed. Frequencies and percentages were used to represent categorical data, such as gender, comorbidities, and outcome measures. Age, gender, diabetes, hypertension, smoking, and fracture duration were all stratified. Following

stratification, relationships were evaluated using the chi-square test, with a significance level of $p < 0.05$.

RESULTS

The mean age of the 70 participants in the study was 47.64 ± 14.03 years. Of them, 16 (22.9%) were between the ages of 18 and 35, 21 (30.0%) were between the ages of 36 and 50, and 33 (47.1%) were between the ages of 51 and 70. The gender distribution included 41 (58.6%) males and 29 (41.4%) females. In terms of comorbidities, 14 people (20.0%) smoked, 23 people (32.9%) had hypertension, and 12 people (17.1%) had diabetes. Prior to intervention, the average fracture duration was 3.20 ± 1.65 hours.

Variable	n (%) / Mean ± SD
Age (years)	47.64 ± 14.03
18–35	16 (22.9%)
36–50	21 (30.0%)
51–70	33 (47.1%)
Gender	
Male	41 (58.6%)
Female	29 (41.4%)
Comorbidities	
Diabetes	12 (17.1%)
Hypertension	23 (32.9%)
Smoking	14 (20.0%)
Fracture duration (hours)	3.20 ± 1.65

Table-I. Baseline characteristics of study participants (n = 70)

Table-II shows that 46 (65.7%) of the subjects had radiological union, whereas 24 (34.3%) did not. Functional outcomes were classified as excellent in 42 (60.0%) patients, good in 21 (30.0%), fair in 5 (7.1%), and poor in 2 (2.9%). Based on these categories, an acceptable functional outcome was observed in 62 (89.9%) participants.

According to the age-stratified analysis in table 3, among patients aged 18–35 years, union was achieved in 11 (23.9%) patients, while non-union was observed in 5 (20.8%). In terms of functional outcomes, 8 (19.0%) had excellent function, 4 (19.0%) had good outcomes, 3 (60.0%) had fair results, and 1 (50.0%) had poor function. In the 36–50-year group, 13 (28.3%) achieved union and 8 (33.3%) did not. Functional outcomes in this age group showed that 15 (35.7%) had excellent function, 5 (23.4%) had good results, 1 (20.0%) had fair results, and none had poor outcomes. Among patients aged 51–70 years, 22 (47.8%) achieved union and 11 (45.8%) did not. Functionally, 19 (45.2%) demonstrated excellent outcomes, 12 (57.1%) had good results, 1 (20.0%) had fair function, and 1 (50.0%) had poor outcomes.

Outcome Measure	n (%)
Radiological Union	
Union	46 (65.7%)
No union	24 (34.3%)
Functional Outcome	
Excellent	42 (60.0%)
Good	21 (30.0%)
Fair	5 (7.1%)
Poor	2 (2.9%)
Acceptable Outcome	62 (89.9%)

Table-II. Primary outcomes (n = 70)

When stratified by gender, 25 (54.3%) males and 21 (45.7%) females achieved union, whereas 16 (55.7%) males and 8 (33.3%) females did not. Regarding functional outcomes, 25 (59.5%) males and 17 (40.5%) females had excellent function. Good results were observed in 11 (52.4%) males and 10 (47.6%) females, fair results in 4 (80.0%) males and 1 (20.0%) female, while poor outcomes were recorded in 1 (50.0%) male and 1 (50.0%) female.

No statistically significant association was found between age group and union ($p = 0.89$) or functional outcomes ($p = 0.33$), nor between gender and union ($p = 0.32$) or functional outcomes ($p = 0.71$).

According to the comorbidity-stratified analysis, among patients with diabetes, 9 (19.6%) achieved union, while 3 (12.5%) did not. Functional outcomes in diabetic patients showed that 8 (19.0%) had excellent function, 3 (14.3%) had good outcomes, none had fair results, and 1 (50.0%) had poor function. Among non-diabetic

patients, 37 (80.4%) achieved union and 21 (87.5%) did not; 34 (81.0%) had excellent function, 18 (85.7%) had good function, 5 (100.0%) had fair function, and 1 (50.0%) had poor outcomes.

In patients with hypertension, 15 (32.6%) achieved union and 8 (33.3%) did not. Functional outcomes among hypertensive patients were 13 (31.0%) excellent, 9 (42.9%) good, 1 (20.0%) fair, and none poor. Among non-hypertensive patients, 31 (67.4%) achieved union and 16 (66.7%) did not, with 29 (69.0%) excellent, 12 (57.1%) good, 4 (80.0%) fair, and 2 (100.0%) poor outcomes.
For smoking status, 10 (21.7%) smokers achieved union and 4 (16.7%) did not. Functional outcomes included 8 (19.0%) excellent, 5 (23.8%) good, none fair, and 1 (50.0%) poor. Among non-smokers, 36 (78.3%) achieved union and 20 (83.3%) did not, with functional outcomes of 34 (81.0%) excellent, 16 (76.2%) good, 5 (100.0%) fair, and 1 (50.0%) poor. No statistically significant differences in union or functional outcomes were observed based on diabetes, hypertension, or smoking status (p = 0.42, 0.49, and 0.45, respectively).

DISCUSSION

In orthopaedic practice, one of the most frequent fractures observed is a femur fracture shaft. One of the main bones in the lower extremities that bears weight is the femur. The femur is the body's longest bone. High energy trauma, such as car crashes, falls from a height, pedestrian accidents, and gunshot wounds, frequently results in femoral shaft fractures, which can be linked to various system injuries.

Stratification Factor	Union n (%)		Excellent Function n (%)			
	Yes	No	Excellent	Good	Fair	Poor
Age Group						
- 18–35	11 (23.9%)	5(20.8%)	8 (19.0%)	4(19.0%)	3(60%)	1(50%)
- 36–50	13 (28.3%)	8(33.3%)	15 (35.7%)	5(23.4%)	1(20%)	0
- 51–70	22(47.8%)	11(45%)	19 (45.2%)	12(57.1%)	1(20%)	1(50%)
Total	46	24	42	21	4	2
P value	0.89		0.33			
Gender						
- Male	25 (54.3%)	16(55/7%)	25 (59.5%)	11(52.4%)	4(80%)	1(50%)
- Female	21 (45.7%)	8(33.3%)	17 (40.5%)	10(47.6%)	1(20%)	1(50%)
Total	46	24	42	21	5	2
P value	0.32		0.71			

Table-III: Stratified Analysis by Demographic Factors (n = 70)

Stratification Factor	Union		Functional Outcomes				
	Yes	No	Excellent n (%)	Good n (%)	Fair n (%)	Poor n (%)	P value
Diabetes							
Yes	9 (19.6%)	3(12.5%)	8 (19.0%)	3 (14.3%)	0 (0.0%)	1 (50.0%)	0.42
No	37 (80.4%)	21(87.5%)	34 (81.0%)	18 (85.7%)	5 (100.0%)	1 (50.0%)	
Hypertension							
Yes	15 (32.6%)	8(33.3%)	13 (31.0%)	9 (42.9%)	1 (20.0%)	0 (0.0%)	0.49
No	31 (67.4%)	16(66.7%)	29 (69.0%)	12 (57.1%)	4 (80.0%)	2 (100.0%)	
Smoking							
Yes	10 (21.7%)	4(16.7%)	8 (19.0%)	5 (23.8%)	0 (0.0%)	1 (50.0%)	0.45
No	36 (78.3%)	20(83.3%)	34 (81.0%)	16 (76.2%)	5 (100.0%)	1 (50.0%)	

Table-IV: Stratified Analysis by Comorbidities (n = 70)

Early evaluation and appropriate management are strongly advised due to the significant morbidity and mortality rate in femur fracture shafts. The most modern surgical technique has replaced the previous nonoperative management of femoral shaft fractures.[15]

There are numerous approaches of treating femur shaft fractures. Among the therapeutic options we have are closed reduction, skeletal traction, femoral cast bracing, spica cast immobilization, external fixation, internal fixation with plating, and un-reamed/reamed intramedullary interlocking nails. The surgeon should have the ability to use all of these techniques, evaluate the benefits and drawbacks of each, and adjust the best course of action. The morphology of the fracture, the mechanical properties of the bone, the patient's overall health, and—above all—the state of the tissues (the skin, muscle connected to the neurologic and vascular status of the leg) should all be carefully considered in order to establish the appropriate course of therapy.[16]

Intramedullary nailing (IMN) has emerged as the gold standard in orthopedic surgery for surgically treating patients who are physiologically stable. The goal of fixation is early healing and long-term functional recovery without problems or sequelae. With 90–100% union rates, FSF is said to have excellent results in contemporary treatment.[17] The approaches for IMN fixation, including as antegrade and retrograde entry points, reamed and unreamed nails, and static and dynamic locking nails, have evolved in tandem with the technological advancements of implants and surgical procedures. Due of the ever-expanding indication, the choice between static and dynamic nailing is a persistent conundrum and a topic of discussion in contemporary orthopedic surgery. For transverse shaft fractures, both static and dynamic interlocking nailing are now used; however, different studies have shown varying degrees of success. Static interlocking nails have been criticized for potentially reducing load across the fracture site and impeding fracture healing because of the effect of stress shielding.[18]

The amount required to break the femur bone is typically large because it is the strongest bone in the body. The gold standard of surgical treatment for femoral shaft fractures (FSF) is closed intramedullary nailing (IMN). Lower infection rates, reduced blood loss, fewer complications with stiff hip and knee joints, and early mobilization are some advantages of closed IMN. Weight bearing and early mobilization were advised to promote early callus formation because no infection or stiffness in the hip or knee joints was seen in any of our cases, and a satisfactory reduction with cortical bone contact was attained. Despite the nail taking the entire body weight, immediate weight bearing remains the goal of treatment. According to a study, treating a transverse FSF with early protected weight bearing following a closed IMN is a great choice. If cortical bony contact is made, the IMN can function as a load-sharing mechanism. The IMN construct instantly turns into a load-bearing device in the event of comminuted fractures with a significant space between fragments. However, it has been demonstrated that early weight bearing with IMN is safe even in comminuted fracture patterns.[19,20]

In this study, the radiological union rate was 65.7%, while 89.9% of patients achieved an acceptable functional outcome based on the AOFAS scoring system. The proportion of excellent outcomes (60%) suggests a generally favourable postoperative recovery. These findings are comparable to those reported by similar studies, where a majority of patients showed good to excellent functional outcomes following surgical management of distal tibial fractures.[21,22]

Stratified analysis revealed no statistically significant association between age, gender, or comorbidities (diabetes, hypertension, smoking) with either union or functional outcomes. While younger age groups and non-comorbid patients showed numerically better results, these differences were not significant, aligning with previous findings where demographic and baseline health factors did not consistently predict union or functional scores.[22]

This study was limited by its single-center design, reducing the generalizability of findings;

the use of non-probability consecutive sampling introduced potential selection bias; the small sample size may have limited the statistical power of subgroup analyses; the six-month follow-up period may not reflect long-term outcomes; and reliance on clinical and radiological assessment without advanced imaging may have limited the precision of outcome evaluation.

CONCLUSION

In closed femoral shaft fractures, interlocking intramedullary nailing is linked to a high percentage of radiographic union and satisfactory functional results. Comorbidities such smoking, diabetes, and high blood pressure had no discernible effect on the effectiveness of treatment.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Wajid Ali:** Manuscript writing, drafting, data collection, proof reading.
2	**Muhammad Arif Khan:** Manuscript writing, drafting, data collection, proof reading