Original Article

Comparative Study between Open Vs Closed Intramedullary Interlocking Nail for Fracture Shaft of Femur

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ABSTRACT

Introduction: *A fracture shaft of the femur refers to a break or crack that occurs along the long, cylindrical portion of the femur bone in the thigh. Surgical intervention is often necessary for displaced or unstable fractures. Two reduction methods, open and closed nailing are used for the fixation of femoral shaft fractures.* ***Objective****: To compare the clinical and functional outcomes associated with open and closed nailing techniques for femoral shaft fractures.* ***Methods and materials:*** *This quasi-experimental study was conducted in the Department of Orthopaedics, Sher-e-Bangla Medical College Hospital, Barisal and Private Hospitals of Barisal from January 2020 to December 2021 over a period of two years. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS), version 12.* ***Results:*** *Mean age was almost similar in both groups. In closed group it was 38.17 ± 10.91 years whereas in open group it was 36.90 ± 11.93 years. In the closed reduction group, RTA accounted for 66.7% of the fractures, followed by falls at 23.3% and physical assault at 10.0%. Similarly, in the open reduction group, RTA was the leading cause at 76.7%, followed by falls at 16.7% and physical assault at 6.7. Union was confirmed maximum in*

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closed cases (93.3%) than open cases (86.7%) but the difference was not statistically significant. ***Conclusion:*** *It can be concluded that compared to open interlocking nailing techniques, closed interlocking nailing has a number of benefits, including faster union, higher union rates, and a lower infection rate.*

Keywords: *Femur shaft, interlocking nail, delayed union, union, non-union, infection*

INTRODUCTION

Fracture shaft of femur is one of the most common fractures seen in orthopaedic practice [1]. Femur is the longest bone of the body and one of the principal load bearing bones in the lower extremity [2]. Fracture of femoral shaft, often, results from high energy trauma like motor vehicle accidents, fall from height, automobile pedestrian accident, and gunshot injury and may be associated with multiple system injury [3]. It can be associated with life-threatening injuries and causes of permanent disability. Because of high morbidity and mortality in fracture shaft of femur, early evaluation and choosing specific management is highly recommended [4]. The treatment of femoral shaft fracture has evolved from the historical non-operative management to the most recent operative method. Several techniques are available for the treatment of fracture shaft of femur [5]. Closed reduction, spica cast immobilization, skeletal traction, femoral cast bracing, external fixation, internal fixation with plating, un-reamed/reamed intramedullary interlocking nail are some of the treatment modalities available to us [5]. Surgeon should be capable of using all these techniques and must weigh advantages and disadvantages of each one and adapt best positive treatment. The best treatment should be determined by a thoughtful analysis of morphology of the fracture, the mechanical characteristics of the bone, general condition of the patient and most importantly the status of tissues [5]. Due to the principal role of the femur of load-bearing, femur shaft fractures are often associated with prolonged morbidity and extensive disability if not treated or improperly treated [6]. As a result, tremendous advances have been achieved in treating femoral shaft fractures, with the gold standard for treatment remaining intramedullary nailing (IMN). Usually, the standard routine insertion of IMN is done after closed fracture reduction, but this is not always feasible due to fracture complexity, equipment's availability, surgeon's experience, and patient-related factors (obesity and polytrauma); then, an open-reduction technique might be needed to achieve proper reduction alignment in some challenging cases [2]. In addition, several studies have shown that the open reduction technique is associated with a higher risk of infection and lower union rates than closed reduction [7-9]. The purpose of this study was to compare the clinical and radiological outcomes of open- versus closed-reduction and IMN of such fractures.

METHODS & MATERIALS

This quasi-experimental study was conducted in the Department of Orthopaedics, Sher-e-Bangla Medical College Hospital, Barisal and Private Hospitals of Barisal from January 2020 to December 2021 over a period of two

years. Patients with fractures of the femoral shaft older than 17, who were subsequently managed with open or closed intramedullary nailing, were included in this study. Patients younger than 18 or those with open fractures, pathological fractures, atypical pathological fractures using bisphosphonate, patients who refused to participate in the study were excluded from the study. A total of 60 patients with fractures of the femoral shaft were selected of them 30 were scheduled for closed intramedullary nailing and 30 were scheduled for open intramedullary nailing. Patient demographic data as well as mechanism of injury and side of injury was collected. Patients underwent routine radiographic follow-up at six weeks, three months, and six months postoperatively. Radiographic evaluation was made. Patients were not allowed to use external bone stimulators to help them with fracture healing. Duration of surgery, infection, non-union, delayed union, time was taken for the radiographic union were also evaluated. A radiographic union score of the femur (RUSF) was calculated from each follow-up radiograph. RUSF was based on assessing healing at each cortex, including the medial and lateral cortices on the anteroposterior plain film, as well as the anterior and posterior cortices on the lateral film. Based on the 'radiographic union score of the tibia' described by Whelan et al. [10] (2013), the RUSF scoring system provides quantitative criteria for radiographic union. This scoring system indicates greater biomechanical strength in high-scoring cases than in low-scoring cases [11].

The investigators verified the data's accuracy and consistency after it had been collected. Data analysis was done using the Statistical Package for Social Science (SPSS-12). Results for quantitative variables were presented as mean with standard deviation (SD), while percentages and frequencies were used to represent categorical variables. The student t-test was used to compare continuous variables, and the Chi-Square test was used to compare categorical variables. A p-value less than 0.05 was considered statistically significant.

RESULTS

Mean age was almost similar in both groups. In closed group it was 38.17 ± 10.91 years whereas in open group it was 36.90 ± 11.93 years. There was no significant difference between the two groups. Males were predominance in both the groups but there was no significant difference between the groups**[Table-I]**.

Table I: Demographic profile of the study subjects (N=60)

	Closed	**Open**	**p-value**
Age (years)	38.17 ± 10.91	36.90 ± 11.93	0.669
Gender			
Male	22 (73.3)	25 (83.3)	0.347
Female	8 (26.7)	5 (16.7)	

Most of the fractures were due to road traffic accident followed by fall and physical assault. Regarding side of the fracture, most of the cases were on right side **[Table-II]**.

Table II: Mechanism and site of fracture of the study subjects (N=60)

	Closed (n=30)	Open (n=30)	p-value
Mechanism of fracture			
Road traffic accident	20 (66.7)	23 (76.7)	0.690
Fall	7 (23.3)	5 (16.7)	
Physical assault	3 (10.0)	2 (6.7)	
Side of fracture			
Right side	23 (76.7)	24 (80.0)	0.754
Left side	7 (23.3)	6 (20.0)	

Union was confirmed maximum in closed cases (93.3%) than open cases (86.7%) but the difference was not statistically significant. Delayed union was seen maximum in open cases (26.7%) than closed cases (10.0%) but the difference was not statistically significant. Infection was found more in open cases (20.0%) than closed cases (6.7%) but the difference was not statistically significant **[Table-III]**.

Table III: Comparison of outcome of the surgery between closed and open nailing (N=60)

	Closed (n=30)	Open (n=30)	p-value
Union			
Union	28 (93.3)	26 (86.7)	0.671
No-union	2 (6.7)	4 (13.3)	
Delayed union	3 (10.0)	8 (26.7)	0.181
Dynamization	2 (6.7)	3 (10.0)	1.000
Infection	2 (6.7)	6 (20.0)	0.254
Shortening	2 (6.7)	1 (3.3)	1.000
Malalignment	2 (6.7)	1 (3.3)	1.000
Screw breakage	2 (6.7)	1 (3.3)	1.000

Mean duration of radiological union and mean duration of surgery was significantly lower in closes group than control group. The mean RUSF at 6 weeks post-operatively was 7.33 and 8.47 in the closed

interlocking and open interlocking groups, respectively. There was a significant difference between the two groups (p=0.002). The significant difference persisted until 6 months post-operatively (RUSF in the closed interlocking vs. open interlocking groups: 8.90 vs. 9.70 respectively; p<0.001) **[Table-IV]**.

Table IV: Comparison of duration of radiological union and duration of surgery between closed and open nailing system (N=60)

	Closed (n=30)	Open (n=30)	p-value
Duration of radiological union (weeks)	19.73 ± 3.33	25.20 ± 3.38	<0.001
Duration of Surgery (min)	63.83 ± 7.27	91.17 ± 6.52	<0.001
RUSF			
Score at 6 weeks	7.33 ± 1.32	8.47 ± 1.28	0.001
Score at 3 months	8.47 ± 1.20	9.30 ± 0.75	0.002
Score at 6 months	8.90 ± 1.27	9.70 ± 0.70	<0.001

DISCUSSION

In this study, the mean age was nearly identical in both groups. It was 38.17±10.91 years in the closed group and 36.90±11.93 years in the open group (p>0.05). The closed reduction group had a mean age of 39 years, while the open reduction group had a mean age of 32.68 years [12]. In terms of gender distribution, both groups had a predominance of males, but there was no significant difference in gender distribution between the closed and open groups in this study. The study by Tahir et al. also reported a similar male predominance in both the closed nailing and open nailing groups [12]. In the closed nailing group, there were 186 males and 80 females, while in the open nailing group, there were 80 males and 44 females.

In this study, road traffic accidents (RTA) were the most common cause of fractures in both the closed reduction group and the open reduction group. In the closed reduction group, RTA accounted for 66.7% of the fractures, followed by falls at 23.3% and physical assault at 10.0%. Similarly, in the open reduction group, RTA was the leading cause at 76.7%, followed by falls at 16.7% and physical assault at 6.7%. Road traffic accident and fall were the most common cause of injury identified in the two treatment groups [12].

According to this study, the average radiological union time in the closed interlocking group was 19.73 ± 3.33 weeks, which was significantly lower than the average union time of 25.20 ± 3.38 weeks in the open interlocking group. This indicates that fractures treated with closed interlocking had a shorter healing time compared to those treated with open interlocking. The finding of prolonged healing time in the open interlocking group is consistent with other studies [13-16]. Seetharmaiah et al. compared closed interlocking nail femur with open nailing and reported an average radiological union time of 22.6 weeks in the closed group versus 24.21 weeks in the open group [17,18].

In this study, union was achieved in 93.3% (28) of closed nailing patients and 86.7% (26) of open nailing patients. Specifically, Naeem-Ul-Haq et al. reported a union rate of 95.1% in closed nailing versus 77.7% in open nailing; Meena et al. documented a union rate of 93% in closed nailing versus 87.9% in open nailing [13,16]. These findings suggest that closed interlocking nailing may result in faster healing and higher union rates compared to open nailing in the treatment of fractures. However, it's important to consider that these results are specific to the studies mentioned and may not be directly applicable to all cases or populations.

According to the data provided, the operative notes in the study indicated that closed nailing took an average of 63.8 minutes to complete, while open nailing took 91.1 minutes. Another study by Kisan and Samant found that closed nailing took 66 minutes and open nailing took 84 minutes [13]. According to Chaudhary's study, closed nailing took 71 minutes and open nailing took 97 minutes [19]. According to the studies, open nailing took longer to complete than closed nailing. The studies suggest that open nailing generally took longer to perform compared to closed nailing. However, the exact reasons for the increased duration of surgery in open nailing were not known in the study you mentioned. The increased duration in open nailing could be attributed to various factors such as the need for a larger incision, additional soft tissue dissection, increased complexity of the fracture, or other individual surgical considerations. Each case and surgeon's approach may vary, which can impact the duration of the surgical procedure.

The mean RUSF at 6 weeks post-operatively was significantly lower in the closed interlocking group (7.33) than in the open interlocking group (8.47). Similarly, up to 6 months mean RUSF was significantly lower in the closed interlocking group than open interlocking groups. Similar finding was observed in the study of Chen et al. (2022) [20].

Kimmatkar et al. suggested that poly trauma patients with femur shaft fracture should undergo closed nailing while open nailing was an alternative to closed nailing in patents in whom closed reduction was failed [2]. A comparison of complications of both groups of this study revealed that non-union was present in 2(6.7%) patients in closed nailing versus 8(13.3%) patients in open nailing and infection in 2(6.7%) versus 6(20.0%) patients. Perhaps the increased duration of surgery in open nailing group and opening and manipulation of the fracture site might be responsible for increased infection in this group. Naeem-Ul-Haq et al. revealed that non-union was present in 3(4.8%) patients in closed nailing versus 12(22.2%) patients in open nailing and superficial infection in 4(6.4%) versus 13(24%) patients [18]. Chaudhary et al. noted superficial infection in 4 patients in closed nailing versus 10 patients in open nailing and an equal number of patients (2 each) with non-union in closed versus open nailing [19]. Kumar and Kumar noted superficial infection in 1(4%) patient in closed group versus 2(8%) patients in open group, deep infection in 1(4%) patient in closed group and none in open group [21]. These authors concluded that post-operative complications in both groups were statistically insignificant.

CONCLUSION

Closed interlocking nailing for the fracture shaft of the femur has been shown to have

several advantages over open interlocking nailing procedures in terms of earlier union, better rates, and a lower infection rate.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

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