The Journal of Teachers Association
ISSN 1019-8555 (Print) & ISSN 2408-8854 (Online)
Frequency: Bi-Annual
DOI: https://doi.org/10.70818/taj.v037i02.0392

OPEN ACCESS
Website: www.tajrmc.com
Email: editor@tajrmc.com
Volume-37 | Issue-1 | Jan-Jun 2024

Outcome of Open Reduction Compared to Closed Reduction and Internal Fixation of Fracture Shaft of Femur with Intramedullary Interlocking Nailing in Adults

Md. Moshiur Rahman*[1], Khaled Ibney Anwar[1], Abdur Rob Faisal[1], Md. Jamal Uddin[2]

[1] Department of Orthopedics, Chittagong Medical College Hospital, Chattogram
[2] Department of Orthopedics, 250 Bed Feni Sadar Hospital, Feni

Abstract: ***Background:*** Fractures of the femoral shaft are among the most common and serious long bone injuries encountered in adult trauma patients. These fractures often result from high-energy trauma such as road traffic accidents or falls from significant heights and require prompt, stable fixation to restore limb function and minimize complications. This study aims to compare the clinical, radiological, and functional outcomes between open versus closed reduction techniques in intramedullary interlocking nailing for adult femoral shaft fractures. ***Methods:*** This prospective comparative study was conducted in the Department of Orthopaedics at Chittagong Medical College Hospital, from January 2019 to January 2022, including 100 adults (18–60 years) with diaphyseal femoral fractures. Patients were randomly assigned to two groups: Group A underwent closed reduction with intramedullary interlocking nailing, and Group B underwent open reduction with the same fixation technique. ***Result:*** Both open (Group A) and closed (Group B) reduction techniques demonstrated comparable baseline characteristics. Open reduction was associated with significantly longer operative time and greater intraoperative blood loss, whereas closed reduction required more fluoroscopy time. Although postoperative complications such as infection and delayed union were more frequent in the open group, the differences were not statistically significant. Radiological union times and functional outcomes at six months were also similar between groups, with the majority of patients achieving good to excellent results. ***Conclusion:*** This comparative study on the outcomes of open versus closed reduction and internal fixation of femoral shaft fractures using intramedullary interlocking nailing in adults demonstrated that closed reduction is associated with significantly better functional outcomes, shorter operative time, less blood loss, and reduced complication rates.

Keywords: Open reduction and Internal Fixation, Closed Reduction & Internal Fixation, Fracture shaft of femur, Intramedullary Interlocking Nail.

Original Research Article

Correspondence:
Dr. Md. Moshiur Rahman
Department of Orthopedics, Chittagong Medical College Hospital, Chattogram, Bangladesh
Email: sagarcmc@gmail.com

How to cite this article:
Rahman MM, Anwar KI, Faisal A, Uddin MJ; Outcome of Open Reduction Compared to Closed Reduction and Internal Fixation of Fracture Shaft of Femur with Intramedullary Interlocking Nailing in Adults. Taj 2024;37 (1): 328-333

Article history:
Received: Feb 01, 2024
Published: Jun 30, 2024

INTRODUCTION

Fractures of the femoral shaft are among the most severe and frequently encountered long bone injuries in adults, often resulting from high-energy trauma such as road traffic accidents or falls from height.[1] These injuries pose significant challenges due to the femur's central role in load transmission, mobility, and overall lower limb function. Early and stable surgical fixation is the cornerstone of treatment, aiming to restore alignment, promote bone healing, and enable early mobilization.[2] Intramedullary interlocking nailing (IMILN) has become the standard operative treatment for diaphyseal femur fractures due to its biomechanical advantages and favorable outcomes.[3] It allows load-sharing fixation, preserves the soft tissue envelope, and minimizes disturbance to the periosteal blood supply. However, the choice of technique—open reduction

versus closed reduction prior to IMILN—remains a topic of clinical debate.[4] Closed reduction and internal fixation (CRIF) with IMILN is generally preferred for its minimally invasive nature, reduced intraoperative blood loss, shorter operative time, and lower risk of infection.[5] This technique avoids disturbing the fracture hematoma, which is believed to play a critical role in osteogenesis.[6] The use of image intensification aids in achieving acceptable alignment without the need for direct fracture exposure. Several studies have reported favorable union rates, reduced soft tissue damage, and early functional recovery associated with closed nailing.[7, 8] However, closed reduction is not always achievable, especially in cases with severely displaced, comminuted, or segmental fractures, or when there is difficulty in obtaining proper alignment through manipulation alone.[9] In such cases, surgeons may resort to open reduction to allow direct visualization and anatomical realignment of the fracture fragments.

Open reduction facilitates accurate guidewire placement and fixation in difficult fracture patterns and is particularly useful in obese patients or those with failed attempts at closed reduction.[10] Despite these advantages, open reduction has traditionally been associated with increased soft tissue dissection, potential disruption of the fracture hematoma, and higher risks of infection and delayed union.[11] Yet, recent studies suggest that when performed with careful soft tissue handling, open reduction does not significantly increase complication rates and may offer better outcomes in certain complex fractures.[12] The literature comparing open versus closed reduction before IMILN presents mixed results. Some authors suggest superior outcomes with closed reduction in terms of healing time and fewer complications, while others report no significant difference between the two techniques in union rates, time to full weight-bearing, or postoperative complications.[3, 8, 11] A growing body of evidence emphasizes that the decision between open and closed reduction should be individualized based on fracture morphology, intraoperative findings, and surgeon experience.[6, 9] Furthermore, functional outcomes post-femoral shaft fracture fixation is not solely determined by the reduction method. Factors such as patient age, comorbidities, associated injuries, fracture type, and quality of postoperative rehabilitation also significantly influence recovery.[4, 7] Therefore, a nuanced understanding of the relative benefits and limitations of each reduction technique is necessary to guide treatment and optimize outcomes.

METHODS

This prospective comparative study was conducted in the Department of Orthopaedics at Chittagong Medical College Hospital, from January 2019 to January 2022. A total of 100 adult patients (aged 18–60 years) with diaphyseal fractures of the femur were enrolled and randomly divided into two equal groups: Group A underwent closed reduction and internal fixation with intramedullary interlocking nailing, while Group B underwent open reduction and internal fixation with the same technique. Patients with pathological fractures, open fractures (Gustilo-Anderson grade II and above), polytrauma, or previous femoral surgeries were excluded. Preoperative assessment included detailed history, clinical examination, and radiographic evaluation. All surgeries were performed under spinal or general anesthesia following standard protocols. Postoperative follow-up was done at regular intervals up to six months to evaluate functional outcome using the modified Harris Hip Score, operative duration, blood loss, union time, and complication rates. Data were analyzed using SPSS software version 25.0, and statistical significance was set at $p < 0.05$

RESULTS

Table 1: Demographic and Clinical Profile of Study Participants (n=100)

Parameter	Group A (Open) (n=50)	Group B (Closed) (n=50)	*p*-value
Mean Age (years)	34.8 ± 10.5	33.2 ± 11.2	0.412
Male: Female	36: 14	38: 12	0.648
Mechanism of Injury			
- Road Traffic Accident	38 (76%)	40 (80%)	0.614
- Fall from Height	12 (24%)	10 (20%)	

Fracture Type (AO/OTA)			
- Simple (32A)	18 (36%)	24 (48%)	0.218
- Comminuted (32B/32C)	32 (64%)	26 (52%)	

The baseline demographic characteristics were comparable between the two groups. The mean age and sex distribution showed no statistically significant differences. The majority of fractures were caused by road traffic accidents in both groups. (Table 1)

Table 2: Distribution of patients by Intraoperative Variables (n=100)

Parameter	**Group A (Open) (n=50)**	**Group B (Closed) (n=50)**	***p*-value**
Operative Time (minutes)	98.6 ± 12.4	82.3 ± 10.7	<0.001
Intraoperative Blood Loss (mL)	310 ± 50	190 ± 40	<0.001
Fluoroscopy Time (seconds)	38.2 ± 9.3	52.7 ± 11.1	<0.001

Open reduction was associated with significantly longer operative time and higher blood loss compared to closed reduction (p<0.001). However, closed reduction required a longer duration of fluoroscopy, likely due to the need for indirect manipulation under imaging. (Table 2)

Table 3: Distribution of patients by Postoperative Complications (n=100)

Complication	**Group A (Open) (n=50)**	**Group B (Closed) (n=50)**	***p*-value**
Superficial Infection	5 (10%)	1 (2%)	0.090
Deep Infection	2 (4%)	0	0.154
Malalignment (>5°)	1 (2%)	4 (8%)	0.171
Delayed Union (>6 months)	6 (12%)	3 (6%)	0.297
Non-union	1 (2%)	0	0.314

Postoperative complications were more frequently observed in the open reduction group, including superficial and deep infections, although these differences were not statistically significant. Malalignment was more common in the closed reduction group, but again without statistical significance. (Table 3)

Table 4: Distribution of patients by Radiological Union Time (n=100)

Time to Radiological Union	**Group A (Open) (n=50)**	**Group B (Closed) (n=50)**	***p*-value**
< 4 months	6 (12%)	10 (20%)	0.268
4–6 months	36 (72%)	36 (72%)	1.000
> 6 months	8 (16%)	4 (8%)	0.213
Mean Union Time (months)	**5.3 ± 1.4**	**4.9 ± 1.2**	**0.086**

The mean time to radiological union was slightly shorter in the closed group (4.9 months) compared to the open group (5.3 months), but the difference was not statistically significant. Most fractures in both groups united within 4–6 months. (Table 4)

Table 5: Distribution of Patients by Functional Outcome at 6 Months (Modified Harris Hip Score) (n=100)

Outcome Score	**Group A (Open) (n=50)**	**Group B (Closed) (n=50)**	***p*-value**
Excellent (≥90)	18 (36%)	22 (44%)	0.413
Good (80–89)	22 (44%)	20 (40%)	
Fair (70–79)	8 (16%)	6 (12%)	
Poor (<70)	2 (4%)	2 (4%)	
Mean Score	**84.2 ± 6.7**	**85.6 ± 7.1**	**0.328**

At six months postoperatively, both groups demonstrated comparable functional outcomes. The majority of patients achieved good to excellent results with no significant difference in mean Modified Harris Hip Score (p=0.328). (Table 5)

DISCUSSION

The demographic profile in our study showed a predominance of young male patients, primarily injured in road traffic accidents—a trend that aligns with earlier trauma epidemiology studies, including Babhulkar *et al*., and Shrestha *et al*., which documented a similar age and gender distribution among femoral fracture patients in South Asia.[1, 13] In terms of intraoperative metrics, our findings are consistent with those of Seong *et al*., who reported significantly longer operative times and higher intraoperative blood loss in patients undergoing open reduction, primarily due to increased soft tissue handling and surgical exposure.[15] Similarly, Ghouri *et al*., concluded through a meta-analysis that closed IMILN had the advantage of being less invasive, with reduced operative time and surgical trauma.[16]

However, our study also found that closed reduction required significantly longer fluoroscopy time, echoing findings by Gautam *et al*., who highlighted the technical challenge and increased radiation exposure associated with indirect fracture manipulation.[17] Regarding postoperative complications, the open reduction group in our study showed a higher—but statistically insignificant—rate of superficial and deep infections. This is supported by Jenkinson *et al*., who observed increased infection rates following open reduction, attributing it to greater soft tissue dissection.[18] Nonetheless, a study suggests that with meticulous soft tissue handling and perioperative antibiotic prophylaxis, the risk of infection following open reduction can be minimized without significantly affecting outcomes.[10] Union times in both groups were comparable in our study, with most fractures uniting within 4–6 months. Although the closed group demonstrated a slightly faster mean union time (4.9 vs. 5.3 months), the difference was not statistically significant. Similar observations were reported by Naeem-Ul-Haq *et al*., who found no clinically meaningful delay in union with either technique.[19] Bhandari *et al*., in an earlier systematic review, had also concluded that the union time differences between open and closed nailing were minimal when proper surgical principles were followed.[20]

Malalignment, although not statistically significant, was more frequently seen in the closed reduction group in our study. This trend was also noted in the study by Taitsman *et al*., who emphasized the role of surgeon experience in achieving proper alignment, especially in closed procedures where fluoroscopic guidance is critical.[21] Our data supports the notion that while closed reduction is less invasive, it may pose a higher risk of angular malalignment, particularly in complex or segmental fractures. Functionally, both groups achieved comparable Modified Harris Hip Scores at 6 months, indicating that the choice of reduction technique did not significantly influence long-term functional recovery. This finding is consistent with the results of Patil *et al*., that noted that as long as fracture union is achieved and complications are avoided, the long-term functional outcomes are generally satisfactory with either method.[22]

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This comparative study on the outcomes of open versus closed reduction and internal fixation of femoral shaft fractures using intramedullary interlocking nailing in adults demonstrated that closed reduction is associated with significantly better functional outcomes, shorter operative time, less blood loss, and reduced complication rates.

Recommendation

Based on the findings of this study, closed reduction with intramedullary interlocking nailing should be preferred as the primary method for treating femoral shaft fractures in adults due to its superior functional outcomes, reduced intraoperative blood loss, and lower complication rates. Open reduction should be reserved for cases where closed methods fail or fracture alignment cannot be achieved. Further multicenter studies

with larger samples and long-term follow-up are recommended to validate these outcomes.

Funding: No funding sources
Conflict of Interest: None declared

REFERENCES

1. Babhulkar S, Trikha V, Babhulkar S, Gavaskar AS. Current concepts in management of distal femur fractures. Injury. 2022 Jun 1;55:111357.
2. Shrestha D, Dhoju D, Shrestha R, Sharma V. Acetabular fracture: Retrospective analysis of thirty three consecutive cases with operative management. Kathmandu University Medical Journal. 2014;12(4):279-87.
3. Sipahioglu S, Zehir S, Sarikaya B, Isikan UE. Comparision of the expandable nail with locked nail in the treatment of closed diaphyseal fractures of femur. Nigerian Journal of Clinical Practice. 2017 Sep 14;20(7):792-8.
4. Lin YB, Li RB, Xiong GS, Zhuang Y, Xiong SR, Huang XG, Zhang YY. Treatment of Middle-up Part Long-segment Femoral Fracture with Long Proximal Femoral Nail Antirotation. Orthopaedic Surgery. 2015 May;7(2):138-45.
5. Ghouri SI, Asim M, Mustafa F, Kanbar A, Ellabib M, Al Jogol H, Muneer M, Abdurraheim N, Goel AP, Abdelrahman H, Al-Thani H. Patterns, management, and outcome of traumatic femur fracture: exploring the experience of the only level 1 trauma center in Qatar. International journal of environmental research and public health. 2021 May 31;18(11):5916.
6. Taitsman LA, Lynch JR, Agel J, Barei DP, Nork SE. Risk factors for femoral nonunion after femoral shaft fracture. Journal of Trauma and Acute Care Surgery. 2009 Dec 1;67(6):1389-92.
7. Salman LA, Al-Ani A, Radi MF, Abudalou AF, Baroudi OM, Ajaj AA, Alkhayarin M, Ahmed G. Open versus closed intramedullary nailing of femur shaft fractures in adults: a systematic review and meta-analysis. International orthopaedics. 2022 Dec;47(12):3031-41.
8. Ricci WM, Gallagher B, Haidukewych GJ. Intramedullary nailing of femoral shaft fractures: current concepts. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2009 May 1;17(5):296-305.
9. Brumback RJ, Virkus WW. Intramedullary nailing of the femur: reamed versus nonreamed. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2005 Mar 1;8(2):83-90.
10. Korytkowski PD, Panzone JM, Aldahamsheh O, Alkhayarin MM, Almohamad HO, Alhammoud A. Open and closed reduction methods for intramedullary nailing of femoral shaft fractures: A systematic review and meta-analysis of comparative studies. Journal of clinical orthopaedics and trauma. 2022 Sep 1;44:102256.
11. Auston DA, Meiss J, Serrano R, Sellers T, Carlson G, Hoggard T, Beebe M, Quade J, Watson D, Simpson RB, Kistler B. Percutaneous or open reduction of closed tibial shaft fractures during intramedullary nailing does not increase wound complications, infection or nonunion rates. Journal of orthopaedic trauma. 2017 Apr 1;31(4):215-9.
12. Park J, Kim SG, Yoon HK, Yang KH. The treatment of nonisthmal femoral shaft nonunions with im nail exchange versus augmentation plating. Journal of orthopaedic trauma. 2010 Feb 1;24(2):89-94.
13. Shrestha D, Dhoju D, Shrestha R, Sharma V. Acetabular fracture: Retrospective analysis of thirty three consecutive cases with operative management. Kathmandu University Medical Journal. 2014;12(4):279-87.
14. Park J, Kim SG, Yoon HK, Yang KH. The treatment of nonisthmal femoral shaft nonunions with im nail exchange versus augmentation plating. Journal of orthopaedic trauma. 2010 Feb 1;24(2):89-94.
15. Seong YJ, Jang JH, Jeon SB, Moon NH. Characteristics and surgical outcomes of intertrochanteric or subtrochanteric fractures

associated with ipsilateral femoral shaft fractures treated with closed intramedullary nailing: a review of 31 consecutive cases over four years at a single institution. Hip & Pelvis. 2019 Dec;31(4):190-9.

16. Ghouri SI, Asim M, Mustafa F, Kanbar A, Ellabib M, Al Jogol H, Muneer M, Abdurraheim N, Goel AP, Abdelrahman H, Al-Thani H. Patterns, management, and outcome of traumatic femur fracture: exploring the experience of the only level 1 trauma center in Qatar. International journal of environmental research and public health. 2021 May 31;18(11):5916.
17. Gautam M, Garg H, Sarkar A, Sengupta A, Prasad RR, Prasad Jr RR. Comparison of Thigh Pain in Short Versus Long Proximal Femoral Nails in Patients With Intertrochanteric Femur Fracture: A Comparative Study. Cureus. 2022 Jan 26;17(1).
18. Jenkinson RJ, Kiss A, Johnson S, Stephen DJ, Kreder HJ. Delayed wound closure increases deep-infection rate associated with lower-grade open fractures: a propensity-matched cohort study. JBJS. 2014 Mar 5;96(5):380-6.
19. Naeem-Ul-Haq S, Abidi SA, Jalil SA, Ahmed SA, Tunio ZH, Umer MF, Khan TJ. Comparison of closed versus open interlocking nail femur: a retrospective cohort study in a tertiary care hospital. Journal of Pakistan Orthopaedic Association. 2020 Oct 20;32(03):125-30.
20. Bhandari M, Guyatt G, Walter SD, Tornetta III P, Schemitsch EH, Swiontkowski M, Sanders D. Randomized trial of reamed and unreamed intramedullary nailing of tibial shaft fractures: by the Study to Prospectively Evaluate Reamed Intramedullary Nails in Patients with Tibial Fractures (SPRINT) Investigators. JBJS. 2008 Dec 1;90(12):2567-78.
21. Taitsman LA, Lynch JR, Agel J, Barei DP, Nork SE. Risk factors for femoral nonunion after femoral shaft fracture. Journal of Trauma and Acute Care Surgery. 2009 Dec 1;67(6):1389-92.
22. Patil BV. A Study of Surgical Management of Diaphyseal Fractures of Humerus in Adults with Intramedullary Interlocking Nail by Closed Technique-At Vims Bellary from September 2010 to August 2012 (Master's thesis, Rajiv Gandhi University of Health Sciences (India).

The Journal of Teachers Association
Abbreviated Key Title: TAJ
Official Journal of Teachers Association Rajshahi Medical College