



## Functional Outcome of Unstable Intertrochanteric fracture Treated with Proximal Femoral Nail Anti-Rotation

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Received: 17 December 2022

Revised: 21 January 2023

Accepted: 02 February 2023

Published: 28 February 2023

### Abstract

**Background:** Intertrochanteric fractures are one of the most disabling injuries, most commonly observed among the elderly, and shows a challenging problem for orthopedic surgeons. Nowadays, intertrochanteric fractures are being treated with different extramedullary and intramedullary devices. Among them, intramedullary fixations show the best outcome, and are widely used for different treatment of unstable intertrochanteric fractures (type 31A2, 31A3). A new device designed by AO/ASIF, the Proximal Femoral Nail Anti-Rotation (PFNA) represents a unique intramedullary nail system for improved management, with decrease in the number of complications. **Material & Methods:** This prospective hospital based clinical trial was conducted at the Department of Orthopaedic Surgery, Chittagong Medical College Hospital, Chattogram, Bangladesh. The study duration was 2 years, from January 2018 to December 2019. During this period, a total of 48 patients who were admitted in the study place with unstable intertrochanteric fracture of femur were included in the study. Patients were followed up for 24 weeks, and overall outcome was measured using Kyle's Criteria. **Results:** 48 patients were treated for unstable intertrochanteric fractures. The majority were between 50-80 years old (62.5%), with a mean age of 58.38. Gender distribution was even, with 50% male and 50% female. 75% of fractures were caused by a fall from height and 25% by a road traffic accident. 68.75% of fractures were type 31A3 and 31.25% were type 31A2. 68.75% of patients did not have comorbidities. The mean time interval for fixation was 12.6 days, and the majority of operations lasted between 45-90 minutes. 87.5% had a closed reduction and 12.5% had an open reduction. 64.58% of patients had radiation time between 2.5-3.3 minutes. At 2 weeks follow-up, 21.28% had poor functional outcome, 78.72% had fair functional outcome, and none had good or excellent outcomes. At 6 months follow-up, 2.17% had poor outcomes, 8.70% had fair outcomes, 34.78% had good outcomes, and 54.35% had excellent outcomes. 16.67% of patients experienced complications such as infection, varus, delayed union, and lateral migration. **Conclusion:** Most patients achieved good to excellent functional outcomes after treatment, with minimal complications.

**Keywords:-** Fracture, Unstable, Intertrochanteric, Outcome.



## INTRODUCTION

Proximal femoral fractures, including intertrochanteric fractures, have seen a significant increase in incidence in recent years due to an aging population and increased life expectancy.<sup>[1]</sup> Intertrochanteric fractures, which occur around the greater trochanter of the femur, are common in the elderly, particularly women, and can be caused by low-energy falls or high-energy trauma.<sup>[2]</sup> These fractures are often caused by osteoporosis and other age-related factors. The increase in the elderly population has led to a doubling of the number of these fractures over the past three decades, and this trend is expected to continue.<sup>[3]</sup> Conservative treatment can result in complications such as malunion, coxavara, medialization of shaft, and external rotation deformity resulting in shortening of limb and limp.<sup>[4]</sup> Due to inconsistent bone quality among the elderly, it is difficult to achieve and maintain stable fixation in elderly patients.<sup>[5,6]</sup> This highlights the importance of early surgical intervention for intertrochanteric fractures. Numerous operative procedures with different implants have been described for the treatment of intertrochanteric fractures. Treatment options include proximal femoral nail antirotation (PFNA) (intramedullary fixation), dynamic hip screw (extramedullary fixation) and gamma nail (intramedullary fixation).<sup>[7]</sup> Intramedullary fixation methods for fixation of unstable intertrochanteric fractures are now widely used technique. In the 1990s, intramedullary devices started gaining popularity despite any conclusive evidence of superior performance. The proposed advantages were insertion through a so-called minimally invasive incision and improved

fracture fixation biomechanics.<sup>[8]</sup> The PFNA was designed in 1996 which gave an advantage of minimally invasive surgery.<sup>[9]</sup> Intramedullary implants have biomechanical advantages over extramedullary implants as they have short lever arm which decreases the tensile strain on implant and bending moment on the implant. Intramedullary implants also have biological advantage of closed reduction, lesser blood loss and soft tissue dissection, short duration of surgery and early mobilization of the patients.<sup>[10]</sup> The PFNA has been shown to be a safe and effective treatment option for unstable intertrochanteric fractures, with a high rate of union and good functional outcome.<sup>[8,9]</sup> Studies have also shown that the use of a PFNA can reduce the risk of complications such as malunion and nonunion.<sup>[10]</sup> It's important to note that the functional outcome after treatment of an unstable intertrochanteric fracture with a PFNA can vary depending on the patient's age, overall health, and the severity of the fracture. Rehabilitation is an important aspect of recovery from this type of injury and is crucial for the best functional outcome. Rehabilitation after surgery should be started as soon as possible and should be individualized based on the patient's condition and goals. Physical therapy can help to restore range of motion, strength, and functional ability. Rehabilitation can also help to prevent complications such as muscle atrophy, joint stiffness, and incisional pain. In conclusion, the incidence of proximal femoral fractures, including intertrochanteric fractures, has increased in recent years due to an aging population. Intertrochanteric fractures are common in the elderly, particularly women, and can be caused by low-energy falls or high-energy trauma. Early surgical intervention with a proximal femoral nail antirotation (PFNA) has

become the optimal solution for treating these fractures. The PFNA has been shown to be a safe and effective treatment option with a high rate of union and good functional outcome. Rehabilitation is also crucial for the best functional outcome post-surgery. It is important to note that the functional outcome can vary depending on the patient's age, overall health, and the severity of the fracture. However, with proper treatment and rehabilitation, patients can expect to return to their pre-injury level of function, with a good range of motion and minimal pain. Proximal Femoral Nail Antirotation (PFNA) is a commonly used method for treating unstable intertrochanteric fractures, which are challenging for orthopaedic surgeons. The device was designed in 1996 by AO/ASIF and offers several advantages over other methods. It maintains the anatomical axis and reduces the risk of failure of fixation in osteoporotic bone. It also enables early mobilization of patients and reduces postoperative complications such as blood loss, infection, and soft tissue dissection.<sup>[11]</sup> In addition, intramedullary fixation decreases the national cost, bed occupancy rate, and disability by increasing its success rate. The purpose of this study was to evaluate the functional outcome of unstable intertrochanteric fractures of the femur (AO/OTA 31 A2.2 - 31 A 3.3) treated by Proximal femoral nail antirotation as minimally invasive procedure through Kyle's Criteria.<sup>[12]</sup>

### Objective

- To observe the functional outcome of unstable intertrochanteric fractures of the femur after treatment with femoral nail antirotation

- To observe the post-operative complications of unstable intertrochanteric fractures of the femur after treatment with femoral nail antirotation.

### MATERIAL AND METHODS

This prospective hospital based clinical trial was conducted at the Department of Orthopaedic Surgery, Chittagong Medical College Hospital, Chattogram, Bangladesh. The study duration was 2 years, from January 2018 to December 2019. During this period, a total of 48 patients who were admitted in the study place with unstable intertrochanteric fracture of femur were included in the study. Consecutive sampling method was used for the selection of the participants following the inclusion and exclusion criteria. After selection, the aim, objectives and procedure of the study was explained in details to the subjects. An informed written consent was taken from all study patients. Ethical Approval regarding the study was also obtained from the ethical review committee of the study hospital. A questionnaire was prepared considering the key variables for data collection. Post-operative follow-up was given at 2nd week, 6th week, 3rd month and 6th month. There was one drop out of patient at 2nd week and another one drop out at 6th week follow-up. The statistical analysis was carried out by using Statistical Package for Social Sciences (SPSS-25). Continuous variables were presented as mean  $\pm$  standard deviation (SD) and range. Categorical variables were presented as frequency and percentage. Continuous variables were compared by Student's t-test between two parameters, analysis of variance (ANOVA) test when parameters were more than two. Qualitative



variables were analyzed by Fisher's exact test. Statistical significance and confidence interval were set at  $p < 0.05$  and 95% level respectively.

### Inclusion Criteria

- Patients with AO type 31A2 and 31A3 intertrochanteric fractures of femur (diagnosed by X rays).
- Patients aged 18 and above
- Patients who had given consent to participate in the study.

### Exclusion Criteria

- Pathological fracture other than osteoporosis.
- Polytrauma patient.
- Patient unfit for anesthesia Unable to answer the criteria question.
- Exclude those affected with other chronic diseases etc.

## RESULTS

The table shows the demographic and injury characteristics of a group of patients who have

undergone treatment for unstable intertrochanteric fractures. The sample size is 48 patients. 15 patients (31.25%) were between 18-50 years old, 30 patients (62.50%) were between 50-80 years old, and 3 patients (6.25%) were over 80 years old. The mean age of the patients was 58.38 years. The gender distribution was even, with 24 male patients (50.00%) and 24 female patients (50.00%). The majority of the fractures were caused by a fall from height, with 36 patients (75.00%) being injured in this way. 12 patients (25.00%) were injured in a road traffic accident. The side of the injury was evenly distributed, with 21 patients (43.75%) being injured on the right side and 27 patients (56.25%) being injured on the left side. The majority of the fractures (33 patients or 68.75%) were classified as type 31A3, while 15 patients (31.25%) were classified as type 31A2. In terms of comorbidities, 33 patients (68.75%) did not have any comorbidities present at the time of treatment, while 15 patients (31.25%) did have comorbidities present.

**Table 1:** Distribution of participant by baseline characteristics (n=48).

Variables	Frequency	Percentage
Age		
18-50 years	15	31.25%
50-80 years	30	62.50%
>80 years	3	6.25%
Mean $\pm$ SD	58.38 $\pm$ 18.049	
Range	19-100 years	
Gender		
Male	24	50.00%
Female	24	50.00%
Ratio	1 to 1	
Mechanism of Injury		
Road Traffic Accident	12	25.00%
Fall From Height	36	75.00%



Side of Injury		
Right	21	43.75%
Left	27	56.25%
Type of Injury		
31A2	15	31.25%
31A3	33	68.75%
Comorbidities		
Absent	33	68.75%
Present	15	31.25%

**Table 2:** Distribution of participants by time interval from injury to fixation among the patients (n=48).

Time interval for fixation	Frequency	Percentage
6-10 days	15	31.25%
11-15 days	27	56.25%
16-20 days	6	12.50%
Mean ± SD	12.60 ± 2.980	
Range	7-20 days	

The table shows the time interval for fixation of a group of patients who have undergone treatment for unstable intertrochanteric fractures. The sample size is 48 patients. 15 patients (31.25%) had their fixation done within 6-10 days, 27 patients (56.25%) had their fixation done within 11-15 days, 6 patients (12.50%) had their fixation done within 16-20 days. The mean time interval for fixation was 12.60 days with a standard deviation of 2.980. The range of time interval for fixation is 7-20 days.

**Table 3:** Distribution of the patients according to duration of operation (n=48).

Duration of operation	Frequency	Percentage
45-90 minutes	43	89.58%
91-135 minutes	3	6.25%
135-180 minutes	2	4.17%
Mean ± SD	71.83 ± 24.457	
Range	45-180 minutes	

43 patients (89.58%) had an operation lasting between 45-90 minutes, 3 patients (6.25%) had an operation lasting between 91-135 minutes, and 2 patients (4.17%) had an operation lasting between 135-180 minutes. The mean duration of operation was 71.83 minutes, with a standard deviation of 24.457 minutes. The range of duration of operation was 45-180 minutes.

**Table 4:** Distribution of participants by per-operative events (n=48)

Events	Frequency	Percentage
Type of reduction		
Closed	42	87.50%



Open	6	12.50%
Blood loss during operation		
21-50 ml	32	66.67%
51-80 ml	15	31.25%
111-140 ml	1	2.08%
Mean ± SD	48.85 ± 18.687 ml	
Range	25-140 ml	
Radiation time		
2.5-3.3 minutes	31	64.58%
3.4-4.2 minutes	15	31.25%
4.3-5.0 minutes	2	4.17%
Mean ± SD	3.33 ± 0.528 minutes	
Range	2.5-5.0 minutes	

42 patients (87.50%) had a closed reduction and 6 patients (12.50%) had an open reduction. 32 patients (66.67%) had blood loss during operation between 21-50ml, 15 patients (31.25%) had blood loss between 51-80ml and 1 patient (2.08%) had blood loss between 111-140ml. The mean blood loss during operation was 48.85ml with a standard deviation of 18.687ml and range of 25-140ml. 31 patients (64.58%) had radiation time between 2.5-3.3 minutes, 15 patients (31.25%) had radiation time between 3.4-4.2 minutes, and 2 patients (4.17%) had radiation time between 4.3-5.0 minutes. The mean radiation time was 3.33 minutes with a standard deviation of 0.528 minutes and range of 2.5-5.0 minutes.

**Table 5:** Distribution of participants by functional outcome at different follow-ups (n=48).

Follow-Up	Functional Outcome			
	Poor	Fair	Good	Excellent
2 weeks [n=47]	10 (21.28%)	37 (78.72%)	0 (0.00%)	0 (0.00%)
6 weeks [n=46]	1 (2.17%)	15 (32.61%)	30 (65.22%)	0 (0.00%)
3 months [n=46]	1 (2.17%)	4 (8.70%)	32 (69.57%)	9 (19.57%)
6 months [n=46]	1 (2.17%)	4 (8.70%)	16 (34.78%)	25 (54.35%)

At 2 weeks follow-up, 10 patients (21.28%) had poor functional outcome, 37 patients (78.72%) had fair functional outcome, and none of the patients had good or excellent functional outcome. At 6 weeks follow-up, 1 patient (2.17%) had poor functional outcome, 15 patients (32.61%) had fair functional outcome, 30 patients (65.22%) had good functional outcome and none of the patients had excellent functional outcome. At 3 months follow-up, 1 patient (2.17%) had poor functional outcome, 4 patients (8.70%) had fair functional outcome, 32 patients (69.57%) had good functional outcome and 9 patients (19.57%) had excellent functional outcome. At 6 months follow-up, 1 patient (2.17%) had poor functional outcome, 4 patients (8.70%) had fair functional outcome, 16 patients (34.78%) had good functional outcome and 25 patients (54.35%) had excellent functional outcome.

**Table 6:** Distribution of participants by post-operative complications (n=48)

Complications	Frequency	Percentage
Wound infection	1	2.08%
Varus	2	4.17%
Delayed union	2	4.17%
Lateral migration	3	6.25%

Among the 48 participants, 1 patient (2.08%) developed a wound infection, 2 patients (4.17%) developed varus, 2 patients (4.17%) developed delayed union, and 3 patients (6.25%) developed lateral migration. The total number of patients who developed any complications is 8 (16.67%).

## DISCUSSION

In the present study, maximum patients, 30 (62.5%) were between 50-80 years of age group. The mean age of the patients was  $58.38 \pm 18.049$  years (range: 19-100 years). Multiple recent studies described similar age distribution among the participants.<sup>[7,13,14]</sup> This is mostly because these ages are one of the most productive phases of the life, and also the starting point for many people when bone deterioration starts. The male female ratio of the present study was equal. Although not exactly equal, other studies have also observed a similar level of male female distribution in various other studies.<sup>[7,13]</sup> However, contradictory findings with extremely high male or female prevalence were also observed in some studies.<sup>[14]</sup> This difference is mostly due to geographic and sociological factors. The left femur was affected in majority of the cases (52.2%). This higher prevalence of injury on the non-dominant side was similar to the findings of other studies.<sup>[15,16]</sup> The majority of the fractures (68.75%) were classified as type 31A3, while 15 patients (31.25%) were classified as

type 31A2. This distribution was similar to that of Endigeri et al.<sup>[7]</sup> In terms of comorbidities, 33 patients (68.75%) did not have any comorbidities present at the time of treatment, while 15 patients (31.25%) did have comorbidities present. The time interval for fixation of the fractures ranged from 7-20 days, with a mean of 12.6 days. The majority of the patients (56.25%) had their fixation done within 11-15 days, 31.25% had their fixation done within 6-10 days, and 12.5% had their fixation done within 16-20 days. These results were similar to the findings of other studies, but the study of Sharma et al., 2018 had a shorter mean interval of 4.5 days.<sup>[17,18]</sup> Regarding the duration of the operation, the study found that 43 (89.6%) patients required 45-90 minutes for the operation, 3 (6.3%) required 91-135 minutes for the operation, and the mean duration of operation was  $71.83 \pm 24.457$  minutes (range: 45-180 minutes). This was consistent with previous studies that have reported a similar range of operative time.<sup>[13,14,16]</sup> During the operation, 42 (87.5%) patients underwent closed reduction, and the mean  $\pm$  SD blood loss during the operation was  $48.85 \pm 18.687$  ml. The mean  $\pm$  SD radiation time was also recorded at  $3.33 \pm 0.528$  minutes. These results were similar to those reported in previous studies.<sup>[13,17]</sup> According to Kyle's criteria, patients were categorized into four subdivisions: excellent, good, fair, and poor.<sup>[12]</sup> At 2 weeks follow-up, 37 (78.7%) patients had fair and 10 (21.3%) patients had

poor outcome. At 6 weeks follow-up, 30 (65.2%) patients had good and 15 (32.6%) patients had fair outcome. At 3 months follow-up, 32 (69.6%) patients had good and 9 (19.6%) patients had excellent outcome. At 6 months follow-up, excellent outcome was in 25 (54.3%) patients and good outcome was in 16 (34.8%) patients. Similar results were reported by other studies, with Endigeri et al. (2019) finding excellent results in 64% of patients and Sahin et al. (2014) finding good results in 73.9% of patients.<sup>[7,16]</sup> The study also reported on the incidence of complications. Only 1 patient (2.1%) had wound infection and was treated with antibiotics and surgical intervention. No patients had non-union, cut-out, or implant failure. Two patients (4.3%) had varus deformity and two (4.3%) had delayed union, which were managed with bone marrow deposition and dynamization. Lateral migration was reported in 3 patients (6.5%). These results were consistent with those reported in previous studies.<sup>[7,16]</sup>

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## 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. The study also lacked a direct comparison with any other treatment options.

## CONCLUSIONS

The study found that the majority of the patients were between the ages of 50-80 and that the ratio of males to females was equal. The majority of the fractures occurred on the left femur and were classified as type 31A3. In terms of comorbidities, most patients did not have any at the time of treatment. The time interval for fixation of the fractures was similar to those found in other studies. The duration of the operation and the amount of blood loss were also consistent with previous studies. According to Kyle's criteria, patients were categorized into four subdivisions: excellent, good, fair, and poor. The results of the study showed that most patients having good or excellent outcomes and minimal complications.

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- Source of Support: Nil, Conflict of Interest: None declare