

Analysis of the Therapeutic Effect and Influencing Factors of PFNA Internal Fixation Using Improved Needle Insertion Method in Treating Intertrochanteric Fractures of the Femur

Lei Wang¹, Junxing Ye^{2*}, Zheng Feng^{1*}

¹Jiangyin Second People's Hospital, Jiangyin 214400, Jiangsu, China

²Jiangnan University Affiliated Hospital, Wuxi 214000, Jiangsu, China

**Authors to whom correspondence should be addressed.*

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* Exploring the therapeutic effect of implementing an improved needle insertion method in the treatment of proximal femoral nail anti-rotation (PFNA) internal fixation in patients with intertrochanteric fractures of the femur, and exploring the influencing factors of postoperative efficacy. *Method:* 100 patients with intertrochanteric fractures of the femur admitted to our hospital from January 2020 to December 2023 were randomly divided into two groups, both receiving PFNA internal fixation treatment. The control group received conventional method of inserting guide pins during surgery, while the study group received improved method of inserting guide pins. The efficacy, clinical indicators, and complications were compared between the two groups. Then, those with excellent and poor postoperative efficacy were included in the excellent group and the poor group, respectively. Univariate and multivariate logistic regression analyses were conducted on the factors that affect postoperative efficacy. *Results:* The proportion of age in the excellent group was generally younger than that in the poor group. The proportions of preoperative and postoperative complications and anemia in the excellent group were lower than those in the poor group. The proportion of early postoperative functional exercise in the excellent group was higher than that in the poor group. The proportion of improved needle insertion method in the excellent group was higher than that in the poor group ($P < 0.05$). After multiple logistic regression analysis, age, postoperative complications, preoperative complications, anemia, and intraoperative needle insertion method were risk factors affecting postoperative efficacy ($P < 0.05$). *Conclusion:* The implementation of improved needle insertion method in PFNA internal fixation treatment for patients with intertrochanteric fractures of the femur has a definite therapeutic effect and high safety. Age, preoperative complications and postoperative complications, anemia, and intraoperative needle insertion methods are risk factors that affect the therapeutic effect.

Keywords: PFNA internal fixation; Intertrochanteric fracture of femur; Improved needle insertion method; Therapeutic effect; Influencing factor

Online publication: July 11, 2025

1. Introduction

Intertrochanteric hip fractures are a common type of fracture, particularly prevalent among the elderly population ^[1]. These fractures are often caused by indirect external forces, such as external impacts, adduction and abduction during falls, or sudden twisting of the lower limbs, and most patients experience comminuted fractures ^[2,3]. Non-surgical treatment often requires long-term bed rest, which can lead to complications such as urinary tract infections and deep vein thrombosis, as well as hip varus, causing significant negative impacts on the patient's recovery. Internal fixation surgery is a commonly used surgical treatment for such fractures, and among them, proximal femoral nail anti-rotation (PFNA) internal fixation is widely used in clinical practice due to its low operational difficulty and minimal trauma to the patient ^[4,5]. However, there are certain technical difficulties in the needle insertion process during PFNA surgery, especially because the fractured end of the intertrochanteric region has no support, making it difficult to insert the guide pin ^[6]. To improve the efficacy of PFNA surgery and reduce the incidence of complications, this study implemented a modified method of inserting the guide pin for patients with intertrochanteric hip fractures treated in our hospital. By adjusting parameters such as the angle, position, or depth of the needle insertion, the goal is to better adapt to the anatomical characteristics of the fracture, improve the stability and fixation effect of the internal fixation device, and explore factors that may affect the efficacy. Through the analysis of these factors, clinical practice can be better guided, improving the success rate of surgical treatment, reducing complications, and providing a basis for clinical treatment.

2. Materials and methods

2.1. General information

100 patients with intertrochanteric hip fractures treated in our hospital from January 2020 to December 2023 were selected. The control group (50 patients) consisted of 34 males and 16 females, with ages distributed as follows: <65 years old (25 patients), 65–75 years old (18 patients), and >75 years old (7 patients). The causes of injury were car accidents (9 patients), falls (27 patients), heavy object injuries (10 patients), and other reasons (4 patients). The study group (50 patients) consisted of 33 males and 17 females, with age distributions of <65 years old (27 patients), 65–75 years old (15 patients), and >75 years old (8 patients). The causes of injury were car accidents (8 patients), falls (32 patients), heavy object injuries (7 patients), and other reasons (3 patients). Inclusion criteria were: age ≥ 60 years old; diagnosis of intertrochanteric hip fracture confirmed by X-ray and CT; receipt of PFNA internal fixation treatment; unilateral fracture; and informed consent. Exclusion criteria were: coagulation dysfunction; limited mobility of the affected limb before the fracture; pathological fracture; fracture of other parts; severe organ damage; and intolerance to surgery. There was no statistically significant difference in general information between the two groups ($P > 0.05$).

2.2. Methods

The control group underwent conventional guide pin insertion. The patients were positioned in a supine position, with the healthy lower limb in hip and knee flexion, fixed in an abducted position on the operating table, and the trunk adducted towards the healthy side. Under C-arm X-ray fluoroscopy, the affected limb was tractioned in an abducted position, adducted, and internally rotated until the fracture was satisfactorily reduced. A Kirschner wire guide pin was used to locate the insertion point, and after confirming the satisfactory position of the insertion point under fluoroscopy, an opener was used to open along the guide pin and insert the guide pin. Subsequently, reaming was performed, and the main pin was inserted. The study group underwent modified guide pin insertion. The surgeon used their fingers to touch the patient's greater trochanter from behind and find the apex of the

greater trochanter. The intersection of the intertrochanteric crest and the apex of the greater trochanter, extended approximately 1.5 cm forward from the apex, was used as the insertion point for the main pin. The remaining operation steps were the same as those in the control group.

2.3. Observation indicators

(1) Efficacy: Excellent: The fracture is completely healed, and normal walking is possible; Good: The fracture is basically healed, and walking is possible; Acceptable: There is slight hip varus, and hip joint movement is slightly restricted; Poor: The fracture site is healed with deformity, and hip joint movement is severely restricted. Excellent and good efficacy rates were calculated as the sum of excellent and good cases, while poor efficacy rates were calculated as the sum of acceptable and poor cases. (2) Various clinical indicators were recorded for the two groups. (3) The occurrence of complications was analyzed for the two groups.

2.4. Statistical analysis

SPSS 22.0 was used for statistical analysis. Clinical indicators such as guide pin insertion time and fracture healing time, which followed a normal distribution and had homogeneous variances, were expressed as mean \pm standard deviation (SD) and analyzed using the *t*-test. Count data such as efficacy and complications were expressed as [*n* (%)] and analyzed using the chi-square test. Multivariate analysis was performed using logistic regression analysis. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Efficacy

The overall excellent and good rate in the study group was 76.00% (38/50), which was higher than the 92.00% (46/50) in the control group ($\chi^2 = 4.762$, $P < 0.05$).

3.2. Typical case

Patient Zhou Xiaojun, female, 73 years old, was admitted to the hospital due to pain and limited mobility in the left hip caused by a fall one hour prior. The diagnosis at admission was a left intertrochanteric hip fracture. The patient underwent closed reduction and PFNA internal fixation of the left intertrochanteric hip fracture and recovered well after surgery. See **Figure 1**.

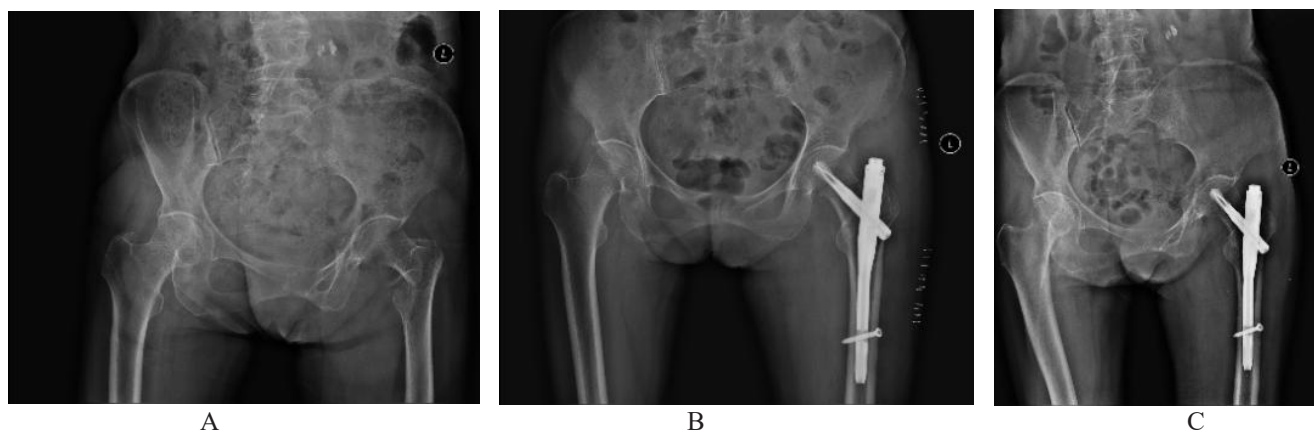


Figure 1. A shows the preoperative X-ray of the patient, B shows the postoperative X-ray, and C shows the follow-up X-ray 3 months after surgery

3.3. Clinical indicators

The clinical indicators of the study group were superior to those of the control group ($P < 0.05$). See **Table 1**.

Table 1. Comparison of clinical indicators between the two groups (mean \pm SD)

Group	Guide pin insertion time (min)	Bleeding volume during guide pin insertion (ml)	Fluoroscopy frequency (times)	Operation time (min)	Fracture healing time (weeks)	Hospital stay (days)	Time to weight-bearing (weeks)
Control group ($n = 50$)	35.27 \pm 8.94	189.78 \pm 30.16	17.13 \pm 1.48	74.38 \pm 6.27	13.52 \pm 1.74	10.84 \pm 1.35	4.77 \pm 0.96
Study group ($n = 50$)	25.17 \pm 7.58	133.29 \pm 26.47	5.14 \pm 1.06	55.63 \pm 5.19	11.08 \pm 1.48	9.01 \pm 1.29	3.57 \pm 0.92
<i>t</i>	6.093	9.954	46.572	16.289	7.553	6.930	6.382
<i>P</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.4. Complications

The overall incidence of complications in the study group was lower than that in the control group ($P < 0.05$). See **Table 2**.

Table 2. Comparison of complications between the two groups [n (%)]

Group	Hip varus	Delayed fracture union	Internal fixation loosening	Lower extremity deep vein thrombosis (DVT)	Total
Control group ($n = 50$)	2	5	3	1	11 (22.00)
Study group ($n = 50$)	0	1	2	0	3 (6.00)
χ^2	-	-	-	-	5.316
<i>P</i>	-	-	-	-	0.021*

3.5. Univariate analysis of factors affecting postoperative efficacy

84 patients with excellent postoperative efficacy were included in the excellent group, and 16 patients with poor postoperative efficacy were included in the poor group. Compared with the poor group, the excellent group had a younger overall age distribution, a lower proportion of preoperative comorbidities, postoperative complications, and anemia, and a higher proportion of early postoperative functional exercise and the modified needle insertion method during surgery ($P < 0.05$). See **Table 3**.

Table 3. Univariate analysis of factors affecting postoperative efficacy

Item	Excellent group ($n = 84$)	Poor group ($n = 16$)	χ^2	<i>P</i>
Gender	Male	56	0.026	0.871
	Female	28		
Age (years)	<65	49	26.026	0.000
	65–75	29		
	>75	6		

Table 3 (Continued)

Item		Excellent group (n = 84)	Poor group (n = 16)	χ^2	P
Cause of injury	Traffic accident	13	4	2.325	0.508
	Fall	52	7		
	Heavy object injury	14	3		
	Other	5	2		
Postoperative complications	Yes	5	9	24.217	0.000
	No	79	7		
Preoperative comorbidities	Yes	31	12	7.958	0.005
	No	53	4		
Anemia	Yes	38	13	6.975	0.008
	No	46	3		
Early postoperative functional exercise	Yes	70	5	16.766	0.000
	No	14	11		
Preoperative long-term bed rest	Yes	14	5	1.031	0.310
	No	70	11		
Intraoperative needle insertion method	Conventional method	36	14	10.714	0.001
	Modified method	48	2		

3.6. Multivariate logistic regression analysis of factors affecting postoperative efficacy

Age, preoperative comorbidities, postoperative complications, intraoperative needle insertion method, and anemia were identified as risk factors affecting postoperative efficacy ($P < 0.05$). See **Table 4**.

Table 4. Multivariate logistic regression analysis of factors affecting postoperative efficacy

Factor	B	S.E.	Wald χ^2	P	OR	95% CI
Age	3.052	0.716	16.113	0.001	0.902	0.081–0.763
Postoperative complications	-2.937	1.024	7.085	0.009	1.026	0.108–0.924
Preoperative comorbidities	-1.897	0.926	9.242	0.005	1.084	0.091–1.975
Anemia	-1.852	0.706	7.295	0.013	0.602	0.195–1.042
Early postoperative functional exercise	0.831	0.054	1.276	0.094	0.483	0.093–0.905
Intraoperative needle method (modified)	5.082	1.704	14.039	0.001	0.891	0.102–1.226

4. Discussion

Intertrochanteric hip fracture is one of the common types of fractures among the elderly, usually caused by osteoporosis, falls, or other traumatic factors ^[7,8]. Due to the deepening trend of population aging, the incidence of intertrochanteric hip fractures is also rising continuously ^[9]. In this context, it is crucial to find a safe and effective treatment method ^[10]. Internal fixation surgery, as one of the main methods to treat intertrochanteric hip fractures,

has been widely used in clinical practice. Among internal fixation surgeries, PFNA is favored because of its good stability at the fracture site and support for early patient mobilization^[11]. However, traditional PFNA surgery poses certain challenges in terms of surgeon experience and operational skills, especially during the needle insertion process^[12]. In traditional PFNA surgery, the surgeon needs to reasonably determine the needle insertion angle and position based on the patient's fracture situation, to ensure the correct placement and stability of the internal fixation device^[13,14]. However, in actual clinical practice, difficulties often arise in the smooth insertion of the guide pin, and in this study, better results were achieved by adopting a modified needle insertion method^[15].

The study observed that the study group had better efficacy than the control group, and the overall complication rate was lower than that of the control group ($P < 0.05$). This suggests that the modified needle insertion technique has a significant effect on improving efficacy and can reduce the incidence of complications. This may be due to the different fracture characteristics of patients with femoral intertrochanteric fractures, traditional needle insertion methods may not fully meet clinical needs, resulting in poor surgical outcomes or increased incidence of complications^[16,17]. To overcome such problems, the modified needle insertion method adjusts parameters such as needle insertion angle, position, or depth to better adapt to the patient's individual anatomical structure and fracture characteristics, improving the stability and treatment effect of the internal fixation device. This helps prevent post-surgical displacement and instability during early activity, thereby reducing complications such as fracture nonunion or loosening of internal fixation^[18,19]. Additionally, once surgeons become proficient in the modified needle insertion technique, it can effectively reduce surgery time, which not only helps reduce the risk of surgery-related complications but also benefits patients by lightening their post-surgical burden and improving surgical efficiency^[20,21]. The study observed that multivariable logistic regression analysis identified several risk factors that can affect treatment efficacy, including age, preoperative comorbidities, postoperative complications, intraoperative needle insertion method, and anemia. The reasons for these factors are analyzed as follows: (1) Age: Older patients have different bone density, physiological conditions, and fracture types compared to younger patients. Additionally, elderly patients may have more complex fractures due to osteoporosis and comorbidities, affecting the difficulty and complexity of surgical operations^[22,23]. (2) Preoperative comorbidities and postoperative complications: Patients with comorbidities before surgery may have involvement of other organs, significantly increasing the risk of postoperative complications and affecting surgical treatment efficacy. Moreover, preoperative comorbidities such as diabetes and cardiovascular diseases can affect the patient's overall condition and fracture healing ability, increasing surgical risk. Postoperative complications can directly impact fracture healing^[24]. (3) Anemia: Anemia can affect postoperative tissue oxygen supply, thus delaying the fracture healing process. (4) Intraoperative needle insertion method: The choice and skill level of the intraoperative needle insertion method directly relate to the position and stability of the internal fixation device^[25]. The modified needle insertion technique requires a higher level of skill and more precise operation from the surgeon; otherwise, it may lead to inaccurate or unstable needle insertion and affect surgical efficacy.

5. Conclusion

In summary, the application of the modified needle insertion technique in PFNA internal fixation treatment demonstrates better efficacy and higher safety. Meanwhile, age, preoperative comorbidities, postoperative complications, anemia, and intraoperative needle insertion method are risk factors that can affect treatment efficacy.

Funding

National Natural Science Foundation of China General Program (82372412); Wuxi Science and Technology Innovation Fund (Y20232018); Jiangnan University Affiliated Hospital Clinical Research Project (LCYJ202307)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wang Z, Li K, Gu Z, et al., 2021, The Risk Assessment Model of Fracture Nonunion After Intramedullary Nailing for Subtrochanteric Femur Fracture. *Medicine (Baltimore)*, 100(12): e25274.
- [2] Chen D, Liu Y, Wang Z, 2022, Analysis of Influencing Factors for Surgery Within 48 Hours of Admission for Elderly Patients with Intertrochanteric Hip Fractures. *Chinese Journal of Bone and Joint Injury*, 37(4): 400–402.
- [3] Nie K, Zhou Z, Hong P, 2023, Efficacy of Two Different Intramedullary Fixation Methods for the Treatment of Intertrochanteric Hip Fractures in the Elderly and Their Impact on Perioperative Indicators and Postoperative Complications. *Chinese Journal of Clinicians*, 51(2): 220–222.
- [4] Lu L, Li X, Liu X, et al., 2023, Analysis of Influencing Factors on the One-Year Prognosis of InterTan Intramedullary Nail Fixation for Intertrochanteric Hip Fractures in the Elderly (≥ 90 Years Old). *Chinese Journal of Bone and Joint Injury*, 38(6): 580–584.
- [5] Jiang Z, Zheng M, Zhao X, et al., 2021, Analysis of Influencing Factors on the Postoperative Effect of Unstable Intertrochanteric Hip Fractures Treated with PFNA-II. *Chinese Journal of General Practice*, 19(12): 2016–2019, 2101.
- [6] Ghasemi F, Esmailnejad-Ganji SM, Manafi Rasi A, et al., 2023, Evaluation of Quality of Life and Associated Factors in Patients with Intertrochanteric Femoral Fracture. *PLoS One*, 18(11): e0293686.
- [7] Zhao J, Chen W, Guo S, et al., 2023, Analysis of Influencing Factors on Functional Recovery After PFNA Treatment for Intertrochanteric Hip Fractures in the Elderly. *China Medical Herald*, 20(15): 82–85.
- [8] Gu J, He S, Wang L, 2022, Analysis of One-Year Postoperative Mortality and Risk Factors of Elderly Patients with Intertrochanteric Fractures After PFNA. *Niger J Clin Pract*, 25(9): 1557–1562.
- [9] Tang Y, Zeng Z, Zhu Z, et al., 2022, Analysis of Influencing Factors on Proximal Shortening After Surgery for Intertrochanteric Hip Fractures. *Journal of Clinical Surgery*, 30(12): 1179–1182.
- [10] Dudko S, Kosior P, Kusz D, et al., 2017, Factors Influencing the Treatment of Proximal Femoral Fractures. *Ortop Traumatol Rehabil*, 19(1): 45–54.
- [11] Ma Z, Fu H, Chen X, 2022, Clinical Efficacy and Risk Factors for Nonunion of Closed Reduction and Intramedullary Nail Fixation in the Treatment of Ipsilateral Femoral Shaft Fractures Combined with Intertrochanteric Hip Fractures. *Chinese Journal of Clinical Anatomy*, 40(2): 211–215.
- [12] Halvachizadeh S, Martin DP, Pfeifer R, et al., 2023, Which Non-Infection Related Risk Factors Are Associated with Impaired Proximal Femur Fracture Healing in Patients under the Age of 70 Years. *BMC Musculoskelet Disord*, 24(1): 405.
- [13] Zhou J, Li S, Pan Y, et al., 2021, Efficacy of Proximal Femoral Nail Antirotation Internal Fixation for the Treatment of Intertrochanteric Hip Fractures and Analysis of Influencing Factors for Postoperative Occult Blood Loss. *Progress*

in Modern Biomedicine, 21(6): 1165–1168, 1159.

- [14] Fan J, Xu X, Zhou F, et al., 2021, Risk Factors for Implant Failure of Intertrochanteric Fractures with Lateral Femoral Wall Fracture After Intramedullary Nail Fixation. *Injury*, 52(11): 3397–3403.
- [15] Velasco Villa D, Mateo Negreira J, Los Santos Aransay A, et al., 2018, Interimplant Femoral Fractures: Risk Factors, Treatment, and Evolution. *Rev Esp Cir Ortop Traumatol (Engl Ed)*, 62(6): 393–400.
- [16] Guo S, Guo Y, Hao H, et al., 2023, Investigation of Exercise Compliance and Analysis of Influencing Factors among Elderly Patients with Intertrochanteric Hip Fractures After Surgery. *Chinese Journal of Clinical Healthcare*, 26(5): 674–677.
- [17] Huang B, 2021, Analysis of Influencing Factors for the Failure of Internal Fixation in the Treatment of Intertrochanteric Hip Fractures in the Elderly. *Modern Diagnosis & Treatment*, 32(12): 1915–1916.
- [18] Lim SJ, Yeo I, Yoon PW, et al., 2018, Incidence, Risk Factors, and Fracture Healing of Atypical Femoral Fractures: A Multicenter Case-Control Study. *Osteoporos Int*, 29(11): 2427–2435.
- [19] Guo J, Yu S, 2021, Influencing Factors of Deep Venous Thrombosis After PFNA Surgery for Patients with Intertrochanteric Hip Fractures. *Modern Diagnosis & Treatment*, 32(14): 2271–2272.
- [20] Yan J, Li C, Feng K, et al., 2021, Exploration of Related Factors Influencing Postoperative Hip Function Scores in Elderly Patients with Intertrochanteric Hip Fractures. *Chinese Journal of Clinical Healthcare*, 24(5): 667–670.
- [21] Sheehan KJ, Guerrero EM, Tainter D, et al., 2019, Prognostic Factors of In-Hospital Complications After Hip Fracture Surgery: A Scoping Review. *Osteoporos Int*, 30(7): 1339–1351.
- [22] Sheehan KJ, Sobolev B, Guy P, 2017, Mortality by Timing of Hip Fracture Surgery: Factors and Relationships at Play. *J Bone Joint Surg Am*, 99(20): e106.
- [23] Qiu J, 2021, Occurrence and Influencing Factors of Postoperative Fracture Nonunion in Patients with Intertrochanteric Hip Fractures. *Aerospace Medicine and Human Performance*, 32(5): 534–535.
- [24] Liu J, Xie H, Zhao Y, et al., 2021, Effects of PFNA Insertion Site Design on the Efficacy and Safety of Patients with Intertrochanteric Hip Fractures. *Journal of Traumatic Surgery*, 23(1): 28–32.
- [25] Cho JW, Oh CW, Leung F, et al., 2017, Healing of Atypical Subtrochanteric Femur Fractures After Cephalomedullary Nailing: Which Factors Predict Union. *J Orthop Trauma*, 31(3): 138–145.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.