

Postoperative Outcomes of Type 2-3 Trochanteric Fractures Treated with Double-Screw Intramedullary Nails: A Multicenter Prospective Study

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How to cite this paper: Kawano, T., Kijima, H., Tani, T., Suzuki, N., Iwamoto, Y. and Miyakoshi, N. (2025) Postoperative Outcomes of Type 2-3 Trochanteric Fractures Treated with Double-Screw Intramedullary Nails: A Multicenter Prospective Study. *Surgical Science*, 16, 208-213.

<https://doi.org/10.4236/ss.2025.164022>

Received: September 14, 2024

Accepted: April 21, 2025

Published: April 24, 2025

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Abstract

Purpose: This paper aims to evaluate the postoperative outcomes of femoral trochanteric fractures with fracture lines extending to the base of the femoral neck (Type 2-3 fractures), treated with intramedullary nails featuring double screws into the femoral head. **Methods:** A multicenter prospective study enrolled 225 patients with proximal femoral fractures. Type 2-3 fractures were classified based on the Area classification using 3D-CT. We compared surgical outcomes among three types of short femoral nails with double lag screws. **Results:** Type 2-3 fractures accounted for 28.4% of cases. Among them, 79.7% were treated with nails incorporating double lag screws. No significant differences were found in failure rate, reduction quality, or operative parameters among different implant types. **Conclusion:** Good postoperative outcomes were achieved in Type 2-3 fractures using intramedullary nails with double screws into the femoral head, regardless of implant brand.

Keywords

Proximal Femoral Fracture, Trochanteric Fracture, Area Classification, Intramedullary Nail, Lag Screw, Rotational Instability

1. Introduction

Proximal femoral fractures are common among the elderly and are expected to

become increasingly prevalent due to global population aging. In Japan, proximal femoral fractures are predicted to occur in approximately 300,000 people by 2030 and 320,000 people by 2040 [1].

Traditionally, these fractures are categorized as femoral neck or trochanteric fractures. However, certain patterns, such as fractures extending from the trochanteric region to the base of the femoral neck, represent unique biomechanical challenges due to increased rotational instability [2]. Another postoperative complication of femoral trochanteric fractures is cut-out of the lag screw. Since cut-out is reportedly caused by excessive sliding of the proximal fragment after surgery, especially in intramedullary type (where the anterior cortex of the proximal fragment is located at the rear of the anterior cortex of the distal fragment in lateral X-ray views), it is important to obtain good reduction [3]. However, even if the fracture line is repaired to an extramedullary type (anterior cortex of the proximal fragment located in front of the anterior cortex of the distal fragment in lateral X-ray views), fractures extending to the base of the neck require more than one lag screw to maintain the reduction due to the fracture at the base of the neck. Multiple screws are also required to restore gait in the early postoperative period.

Although implants allowing multiple lag screws are now available, few prospective studies have evaluated their clinical outcomes in these specific fracture patterns. Our study focuses on Type 2-3 fractures, defined using the Area classification, to assess surgical outcomes when treated with intramedullary nails incorporating double lag screws.

2. Materials and Methods (Figure 1)

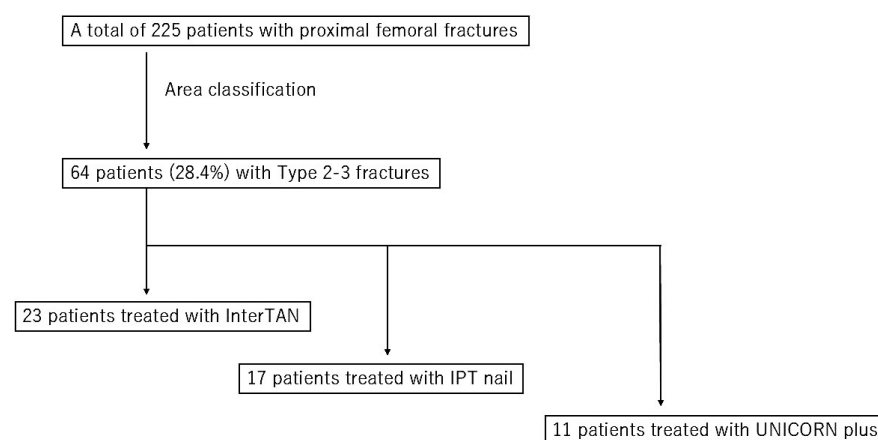


Figure 1. Study design and participants.

This prospective multicenter study was conducted from January 1 to December 31, 2019. A total of 225 consecutive patients with proximal femoral fractures treated surgically at four institutions in Japan were enrolled.

Inclusion criteria: patients aged 60 years or older with proximal femoral fractures confirmed by CT.

Exclusion criteria: pathological fractures and periprosthetic fractures.

Fracture Classification

Fractures were classified using the Area classification based on 3D-CT [4]. This system divides the proximal femur into four areas using three anatomical planes. Type 2-3 fractures involve the base of the femoral neck (Area 2) and the trochanteric region (Area 3).

Surgical Procedure

Patients were treated with short femoral nails that allow the insertion of two lag screws: InterTAN (Smith & Nephew, Memphis, Tennessee), IPT Nail (Homs Engineering Inc., Chino-shi, Nagano, Japan), and Unicorn Plus (Omic Corporation Ltd., Ritto, Shiga, Japan).

Outcome Measures

Outcomes included operative time, blood loss, quality of reduction (categorized on AP and lateral views), failure rate (defined as screw cut-out or telescoping ≥ 10 mm), and bone union rate were recorded [5].

Statistical Analysis

One-way ANOVA and chi-squared tests were used to compare outcomes between implants. Significance was set at $p < 0.05$.

Ethical Approval

The study was approved by ethics committees at all participating sites and conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all patients.

3. Results

Of the 225 patients, 64 (28.4%) had Type 2-3 fractures (**Table 1**). The mean age was 84.8 years. Among these, 51 patients (79.7%) were treated with double-screw intramedullary nails (23 InterTAN, 17 IPT, 11 Unicorn Plus).

No significant differences were found between implant types regarding gender distribution, age, operative time, blood loss, or quality of reduction (**Table 2**). Only one failure was recorded (telescoping > 10 mm), and all cases achieved bone union with independent ambulation.

Table 1. The number of fractures according to the Area classification.

Type	n
1	73
2	1
3	38
4	2
1-2	6
2-3	64
3-4	39
1-2-3	0
2-3-4	0
1-2-3-4	2

Table 2. Patient demographic and intraoperative characteristics, and operative outcomes, in cases of implants with two lag screws.

	InterTAN (n = 23)	IPT nail (n = 17)	UNICORN plus (n = 11)	P value
Women (n, %)	15, 65.2	15, 88.2	9, 81.8	0.212
Age	85.7 ± 7.9	87.5 ± 5.4	82.8 ± 9.3	0.280
Operative time (minutes)	75.1 ± 34.9	67.4 ± 15.8	60.1 ± 14.0	0.286
Intraoperative blood loss (ml)	60.0 ± 55.5	66.7 ± 51.3	60.8 ± 63.7	0.928
Poor reduction in frontal view (n, %)	2, 8.7	0	0	0.282
Poor reduction in lateral view (n, %)	5, 21.7	2, 11.8	1, 9.1	0.550
Failure (n, %)	0	1	0	0.361

4. Discussion

This prospective analysis revealed that Type 2-3 fractures accounted for a substantial proportion (28.4%) of proximal femoral fractures. Our findings align with prior biomechanical and retrospective studies suggesting that these fractures require rotational stability to avoid fixation failure.

Previous cadaver and clinical studies have shown higher failure rates with single-screw implants in basicervical or similar fractures due to rotational instability. Our findings support the use of double-screw intramedullary nails to improve fixation outcomes in such fractures [6]-[10].

It was previously reported that the postoperative position of the reduction is important for the clinical outcomes of femoral trochanteric fractures, and that anatomical or medial type reductions on AP X-ray views are recommended [11]. Furthermore, intramedullary type fractures seen in lateral views are associated with the risk of excessive postoperative slides, which is considered a risk factor for poor postoperative outcomes [12] [13]. The reason for excessive sliding in intramedullary type fractures on lateral views of femoral trochanteric fractures is that the posterolateral cortical bone of the greater trochanter is thinner and weaker than the anterior cortical bone, and stability of the fracture site depends on contact between the proximal fragment and the anterior cortical bone [14]. Despite a 12.5% poor reduction rate, all patients achieved union, suggesting that implant design plays a critical role. However, achieving optimal reduction is still essential for early weight-bearing and rehabilitation.

Limitations of this study include the small sample size, absence of long-term functional follow-up, and lack of comparison with Type 2-3-4 fractures. Future multicenter studies should address these gaps and further explore the impact of reduction quality and implant design.

5. Conclusion

Type 2-3 proximal femoral fractures are relatively common and present significant biomechanical challenges. This study demonstrates that intramedullary nails with double lag screws provide reliable fixation and favorable short-term outcomes, regardless of implant brand. Despite the lack of consensus on implant selection and postoperative protocols, our results suggest that using double-screw nails offers consistent outcomes. Further research should investigate long-term function and compare different reduction strategies.

Acknowledgements

The authors would like to thank Natsuo Konishi, Hitoshi Kubota, Shin Yamada, Hiroshi Tazawa, Keiji Kamo, Yoshihiko Okudera, Masashi Fujii, Ken Sasaki, Itsuki Nagahata, Takanori Miura and Shun Igarashi for their advices.

Conflicts of Interest

The authors declare no competing interests.

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