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Comparison Between Cementless Bipolar Hemiarthroplasty and Proximal Femoral Nail Anti-Rotation for Unstable Intertrochanteric Femoral Fractures in the Elderly: A Retrospective Study

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Background: Proximal femoral nail anti-rotation (PFNA) is the gold-standard treatment for intertrochanteric fractures in elderly patients. However, some authors have recently recommended the use of cementless bipolar hemiarthroplasty (CLBHA) for unstable intertrochanteric fractures and achieved satisfactory results. This study aimed to compare the results and mortality rate postoperatively five years between CLBHA and PFNA for unstable intertrochanteric fractures of the femur in elderly patients (age > 60 years).

Methods: This retrospective study reviewed in and outpatient medical records and civil registrations between October 2012 and October 2017 at our hospital. In total, 122 patients (43 men, 79 women; aged 60–93 years) with unstable intertrochanteric femurs were treated. Fractures were divided into the CLBHA and PFNA groups. Differences in operative time, intraoperative bleeding, blood transfusion, ambulation-to-walk duration, postoperative hospitalization, postoperative complications and revision rate, ambulation at six months, and five-year mortality rate were collected. The unpaired *t*-test was analyzed using the χ^2 test, and statistical significance was set at $P < 0.05$. The mortality rate is shown as an additional Kaplan–Meier estimate together with the p-value.

Results: The operative time (67.8±24.21 vs. 57±3.22 min, P =0.028), ambulation-to-walk duration with a gait aid (12.47±9.41 vs. 9.02±7.59 days, P <0.001), and postoperative hospitalization (911.55±6.61 vs. 7.11±3.45 days, P =0.037) were significantly different between the CLBHA and PFNA groups. Intraoperative bleeding, blood transfusion, postoperative complication, revision rate, ambulation at six months, and five-year mortality rate had no statistically significant differences.

Conclusions: Although CLBHA showed a longer surgical period, longer postoperative hospitalization, and slower ambulation compared to PFNA, the results showed no statistically significant difference in long-term outcomes and five-year mortality between both procedures for intertrochanteric femoral fractures in the elderly. Moreover, although PFNA remains the gold-standard treatment, CLBHA can be used as an alternative procedure in certain situations; however, the choice of procedure should depend on individual patient factors and surgeon expertise.

Keywords: unstable intertrochanteric fracture of femur, cementless bipolar hemiarthroplasty, proximal femoral nail anti-rotation, mortality rate of hip fracture

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Osteoporotic hip fracture is an established health problem in the West and has been increasingly recognized as a growing problem in Asia[1]. In Thailand, the incidence was 7.45 in 100,000 persons (6.68 in 100,000 men, 14.93 in 100,000 females)[2]. The mortality rate in elderly patients with hip fractures from low-energy injuries was high, at approximately 13–37%. Factors affecting the mortality rate were male sex, age > 80 years, chronic medical conditions, ability to walk before fractures, and non-surgical treatment[3].

Intertrochanteric fractures account for 50% of hip fractures, and one-year mortality rate after the fracture is 15–20%. Because hip fractures in elderly patients are often accompanied by underlying diseases, such as severe osteoporosis, hypertension, diabetes, and chronic lung disease, patients often have a poor general condition and low surgical tolerance. Therefore, elderly women are prone to short-term bedridden complication[4]. Proximal femoral nail anti-rotation (PFNA) is the gold-standard treatment for intertrochanteric fracture in the elderly[5]. However, some authors have recently recommended the use of cementless bipolar hemiarthroplasty (CLBHA) for unstable intertrochanteric fractures[6]. Here, we retrospectively analyzed the clinical efficacy and safety of CLBHA and PFNA in the treatment of unstable intertrochanteric fractures in patients aged > 60 years between October 2012 and October 2017 at our hospital.

METHODS

Data were collected from the medical history records of patients, including age, sex, side of fracture, BMI, modified Evans–Jansen classifycation of intertrochanteric femoral fracture (unstable type III–V)[7] and ASA classification. Inclusion criteria: aged > 60 years with unstable intertrochanteric femoral fractures that occurred after low-energy trauma. Exclusion criteria: presence of mental disorders, have multiple organ dysfunctions, and patients who are unable to walk. The fracture was detected and evaluated using conventional anteroposterior and lateral pelvic radiographic examinations and classified using the modified Evans–Jensen classification. Treatment options between PFNA and CLBHA were selected based on the preferences of the surgeon and patient. All patients were preoperatively treated for underlying diseases through relevant medical consultations. All patients or their families provided informed consent preoperatively. Both procedures were standardized as follows:

1. PFNA: After administering nerve block or spinal anesthesia, patients were placed in the supine position on a fracture table and hip traction was performed. The ipsilateral hip was internally rotated by 10–15°. After satisfactory reduction, a straight incision was made from the top of the greater trochanter toward the proximal side. An awl was used to drill a hole at the tip of the greater trochanter. Proximal reaming was performed, and the medullary cavity progressively expanded. A proximal femoral nail is inserted. A helical blade was inserted, and the tip of the blade was positioned to achieve a TAD of < 25 mm[10–12]. Distal locking screws were inserted. All steps in this procedure were monitored using a C-arm fluoroscope (Figure 1).

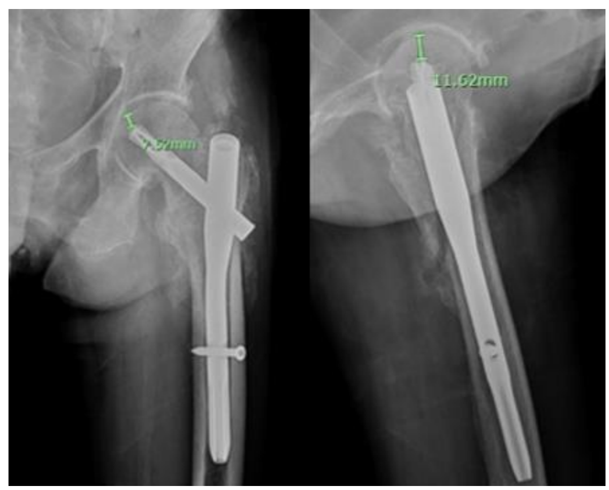

Fig. 1 Postoperative film of hip AP and lateral of PFNA, in which the TAD is approximately 20.84 mm.

2. CLBHA: After administering nerve block or spinal anesthesia, a posterior hip approach was implemented. Layered incisions were made to expose the fracture site, followed by posterior arthrotomy. Perioperatively, it was crucial to avoid internal rotation of the thigh to prevent further

displacement. Femoral neck osteotomy was performed in the midcervical or subcapital region to preserve as much of the calcar and lateral femoral neck as possible, and femoral trochanter fractures were reduced and fixed with or without a nonabsorbable suture or cerclage wire. The medullary cavity was expanded using a raspstem hammer. The size of femoral prosthesis was selected according to the hammer-strike sound; a resonance-low frequency sound indicated that the rasp stem was fitted with the bone, as the sound disperses into the medullary cavity and reflects back to the rasp handle if the stem and bone are tightly attached[(8–9)]. If the hammer-strike sound changed, hammering must be performed cautiously. The trial stem (rasp stem) was twisted to check the rotational stability of the femoral stem; if it was unstable, the size of the stem could be increased, but not by more than one size, and caution was needed during hammering. Cerclage wiring may be applied to enhance stability if intraoperative fractures were identified or increase in stem size was not fitted. The metaphyseal coat stem was gently inserted through the calcar of the femoral neck to the femoral shaft; however, if it could not be fitted by the metaphyseal coat stem, the full coat stem was selected. The anteversion angle of the femoral stem was maintained at 15–20°, and the tibial line and 90°flexion of the knee were used to evaluate the anteversion of the femoral stem. The reduction stability was tested to ensure the absence of hip dislocation and stabilization of the femoral stem. After satisfactory results were obtained, the corresponding femoral prosthesis, femoral bipolar head, and cup were implanted and joint reduction was performed. The joint capsule and external rotator muscles of the hip were sutured, irrigation was performed, and suction drainage was performed (Figure 2 a-c).

Postoperatively, the patient was allowed to ambulate with partial weight bearing and a walker aid for 3–6 months. Ankle pumping and quadriceps and hip extensions were trained. Additionally, a hip dislocation prevention protocol was proposed for the CLBHA group. If the surgical wound was intact and the rehabilitation program was completed by a physical therapist, the patient was discharged.

Fig. 2a Preoperative film of hip AP of CLBHA.

Fig. 2b Postoperative film of hip AP of CLBHA, in which the calcar could be preserved and the femoral stem was inserted though the calcar of femoral neck to the femoral shaft.

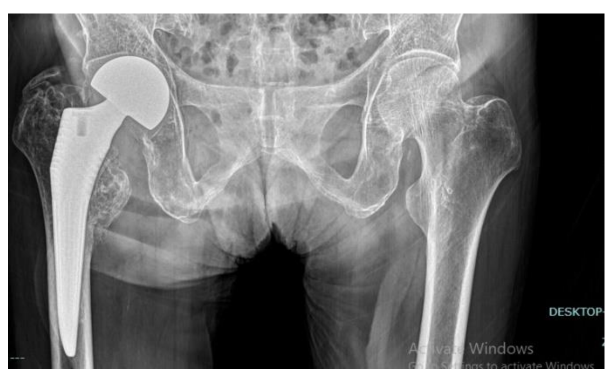

Fig. 2c Two-year postoperative fracture at the greater trochanter and lesser trochanter is healed, and the stem is stable owing to bone ingrowth, no subsidence, and normal leg length.

This study was approved by the Ethics Committee of our hospital. Data, including operation time, intraoperative bleeding (occult blood loss and total blood loss based on the gross equation), intra- and postoperative blood transfusion, ambulation-to-walk duration (partial weight as tolerated with the walker), postoperative hospitalization, ambulation at six months, and five-year mortality rate, and worst results, such as complications, revision rate, and inability to walk six months, were collected. STATA17.0 was used for data analysis, and measurement data were expressed as the mean ± standard deviation. The unpaired *t*-test was used for comparisons between the two groups. The count data were analyzed using the χ^2 test, and statistical significance was set at $P < 0.05$. The result of 1–5-year postoperative mortality rates was shown by Kaplan–Meier survival estimates and using the χ^2 test to find the difference.

RESULTS

This study included 122 patients aged 60–93 years (CLBHA group; 76.98±7.99 years, PFNA group 76.26±9.06 years). BMI were 21.11±3.27 and 21.68±4.19 kg/m^2 in the CLBHA and PFNA groups, respectively. Other demographic data were categorical data, including sex, side of fracture, modified Evans classification type, and ASA classification, which showed no statistically significant difference in all initial variable (Table 1).

The average operative time in the CLBHA and PFNA groups were 67.8±24.21 and 57±3.22 min (P =0.028), respectively. The mean length of postoperative hospitalization in the CLBHA and PFNA groups were 11.55±6.61 and 7.11±3.45 days (P <0.001), respectively. There was statistically significant difference in partial weight ambulation with walker duration between the CLBHA and PFNA groups (12.47±9.41 vs. 9.02±7.59 days, respectively, P =0.037). However, there were no statistically significant differences in the average of intraoperative bleeding (323.29±171.04 vs. 281.93±182.68 mL, P =0.199) and intra- and postoperative blood transfusion (349.69±242.47 vs. 329.34±246.71 mL, P= 0.332) (Table 2).

There were four patients with postoperative complications in the CLBHA group; three patients with curable infected wounds and one patient with pulmonary embolism who died after one month. There were four patients with postoperative complications in the PFNA group; three patients with curable urinary tract infection and one patient with postoperative MI who died after one month. Two patients in the CLBHA group needed revision because of periprosthetic fracture and postoperative prosthetic dislocation, and two patients in the PFNA group needed revision owing to a hip blade cut, although the hip joint and nail were broken. For patients who did not require revision, bone shortening in the PFNA group and subsidence of the femoral stem in the CLBHA group were not > 1 cm.

Eleven patients (16.92%) in CLBHA group and eight patients (14.04%) PFNA were unable to walk at six months postoperatively. There was no statistically significant difference in all three worst outcomes in either groups of patients (postoperative complication, P=0.847, risk ratio (RR); 0.299–4.353; need revision, P=0.894, RR; 0.166–7.836; unable to walk six months postoperatively, P=0.661, RR; 0.889–1.204) (Table 2).

Six months postoperatively, in the CLBHA group, 18 patients could not walk without a gait aid and 36 patients walked with a gait aid. In the PFNA group, 19 patients could walk without a gait aid and 30 patients walked with a gait aid. There were no statistically significant differences in patients who able to walk group (P=0.681). Among the patients who were unable to walk, four patients in the CLBHA group and one patient in the PFNA group were able to stand and use a wheelchair, two patients in the CLBHA group and two patients in the PFNA group were bedridden, and five patients in the CLBHA group and five patients in the PFNA group died within six months postoperatively. There was no significant difference in the number of patients who were unable to walk group (P=0.589). Overall, there was no statistical difference in ambulation at six months between the groups (P=0.867) (Table 3)

Table 1 Demographic data in the PFNA and CLBHA groups.

Treatment options	PFNA (n=57)	CLBHA(n=65)	*P*-value	[95% conf. interval]
Demographic data	Mean±SD	Mean±SD		
Age (years)	76.26±9.06	77.60±6.93	0.359	75.543–78.408
BMI	21.68±4.19	21.11±3.27	0.4059	20.711–22.044
Sex	n (%)	n (%)	0.087	
Men	25 (43.86%)	18 (27.69%)		
Women	32 (56.14%)	47 (72.31%)		
Side			0.145	
Left side	29 (50.88%)	24 (36.92%)		
Right side	28 (49.12%)	41 (63.08%)		
Modified Evan's classification			0.263	
Type III	22 (38.60%)	33 (50.77%)		
Type IV	20 (35.09%)	22 (33.85%)		
Type V	15 (26.32%)	10 (15.38%)		
ASA classification			0.738	
ASA class 2	7 (12.28%)	6 (9.23%)		
ASA class 3	35 (61.40%)	43 (66.15%)		
ASA class 4	15 (26.32%)	16 (24.62%)		

Table 2 Results of treatment in the hemiarthroplasty and PFNA groups.

Treatment options	PFNA (n=57)	CLBHA(n=65)	*P*-value	[95% conf. interval]
Result of treatment	Mean±SD	Mean±SD		
Operation time (min)	57±3.22	67.8±24.21	0.028	58.809–67.6500
Intraoperative bleeding (mL)	281.93±182.68	323.29±171.04	0.199	272.232–335.703
Intraoperative and postoperative blood transfusion (mL)	329.34±246.71	349.69±242.47	0.332	285.125–373.564
Hospitalization after surgery (days)	7.11±3.45	11.55±6.61	<0.001	8.4366–10.514
Ambulation to walk duration (days)	9.02±7.59	12.47±9.41	0.037	9.211–12.500
Worse outcome	n (%)	n (%)		**Risk ratio**
Postoperative complication	4 (7.02%)	4 (6.15%)	0.847	0.299–4.353
Need to revision	2 (3.51%)	2 (3.08%)	0.894	0.166–7.836
Unable to walk after 6 months	8 (14.04%)	11 (16.92%)	0.661	0.889–1.204

Table 3 Ambulation at six months between the CLHBA and PFNA groups.

Post operative ambulation after 6 months	PFNA, n (%)	CLBHA, n (%)	*P*-value
Able to walk	49 (85.96%)	54 (83.08%)	0.681
Walking without walker aid	19 (33.33%)	18 (27.69%)	
Walking with walker aid	30 (52.63%)	36 (55.38%)	
Unable to walk	8 (14.04%)	11 (16.92%)	0.589
Wheelchair ambulation	1 (1.75%)	4 (6.15%)	
Bed-ridden	2 (3.51%)	2 (3.08%)	
Dead before post op 6 months	5 (8.77%)	5 (7.69%)	
Overall *P*-value	57 (100%)	65 (100%)	0.867

The five-year mortality rate was determined using Kaplan–Meier mortality estimates. One-, two-, three-, four-, and five- year mortality rates between the CLBHA and PFNA groups were 12.37% and 12.28%, 18.46% and 15.79%, 30.7 % and 26.32%, 41.52% and 35.31%, and 43.09% and 38.60%, respectively, with no statistically significant differences (P=0.595) (Figure 1).

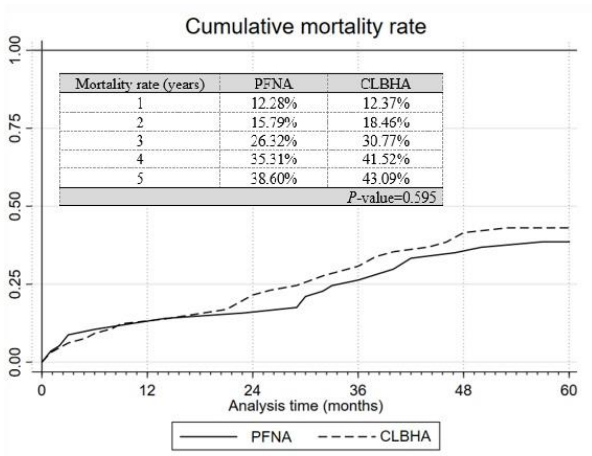

Diagram 1 Five-year mortality rates between the PFNA and CLBHA groups.

DISCUSSION

The incidence of hip fractures was 10.4 per 100,000 persons, which was higher than previous reports[13–14], which may be because of the increasing elderly population and osteoporosis comorbidities in patients aged > 60 years. The etiological events are mainly non-severe accidents, such as falling while standing or walking, falling from low heights, and traffic accidents, such as motorcycle falls. Moreover, most hip fracture patients have other medical comorbidities, including anemia, diabetes mellitus, hypertension, chronic renal failure, cardiovascular diseases, chronic obstructive pulmonary disease, and stroke, which may increase mortality risk. Intertrochanteric fractures require surgical treatment, and objective and careful preoperative evaluation of the fracture is necessary to develop a reasonable treatment plan[15]. CLBHA is standard for fractures of the femoral neck, whereas PFNA is standard for unstable intertrochanteric fractures.

Dynamic hip screws have a high bone-conditioning requirement. Both are eccentric fixations with large torque and require great strength for screw fixation in biomechanics. The lateral plate of the DHS is located in the outer femur, and medial cortical defects of the femur may cause complications, including screw cutting of the femoral head, internal displacement, and plate-side screw extrusion. Furthermore, DHS has a long operative time and extensive bleeding, which is not ideal for elderly patients. Many elderly patients have osteoporosis; therefore, the effects of fixation are often satisfactory[16–18].

Cephalomedullary nailing can improve treatment results more than DHS for unstable intertrochanteric fractures. It has a variety of cephalomedullary nailing designs, such as PFNA and Gamma nails. However, PFNA can maintain the stability of the fracture site better than other designs because hip screw insertion is not required for twisting. Moreover, PFNA retains the advantages of gamma nails, such as a short arm, reduced movement, and sliding compression, and increases the anti-rotation screw, which significantly enhances the anti-rotation, -compression, and -tension abilities of the fracture end, increases the stability of the fracture end, and increases the uniformity of the bearing end force. PFNA can maintain good biomechanical results and provide reliable fixation, making it the preferred technology for treating unstable intertrochanteric fractures associated with osteoporosis[19–20]. Currently, most authors recommend PFNA as the first surgical choice for the treatment of elderly patients with unstable intertrochanteric fractures[5,6,19–22]. However, some studies reported good outcomes with CLBHA. Thakur and Jayaram[23–24] described good outcomes of CLBHA for comminuted intertrochanteric fractures in patients with severe osteoporosis. However, a severe risk factor for cementation in the elderly is the bone cement implantation syndrome, which can lead to sudden death[25–27]. Although this condition had a low chance of occurring, it was serious and occasioned dissatisfaction with the relatives of the patient, leading to litigation. Furthermore, bone healing around the intertrochanteric region can be interrupted by cementation, and the cemented stem is complicated if revision is required (bone cement breakdown or periprosthetic fracture). However, some studies reported good outcomes with CLBHA for comminuted intertrochanteric fractures. Haentjens et al.[28] described that patients with intertrochanteric comminuted fractures and severe osteoporosis may benefit from femoral head surgery. Huang and Jhase [29,30] described CLBHA as a treatment for comminuted fractures with poor stability in elderly patients with severe osteoporosis, poor prognosis after internal fixation, and short life expectancy. Chu et al.[31] used a Wagner stem prosthesis for hip replacement to treat unstable intertrochanteric fractures and obtained good results.

In this study, PFNA treatment was better than CLBHA treatment regarding shorter operative time, fewer days of postoperative hospitalization, and faster ambulation. Moreover, we compared the long-term outcomes, such as the rate of revision, ambulation at six months, and mortality rate. There were no significant differences in treatment results between both groups. Therefore, both treatments could be performed without differences in the long-term outcomes. However, PFNA requires more operating rooms and equipment than CLBHA, and a fracture table and fluoroscope must be prepared. Therefore, PFNA requires a large operating room. Although hemiarthroplasty preparation is less common than PFNA, it can be performed in a small operating room. However, all types of hemiarthroplasty involve joint replacement surgeries, and sterile techniques and operating room environments must be restricted. Both types of surgery have different advantages and disadvantages and are complex procedures. Therefore, surgeons who perform each procedure should have fair experience with each type of surgery. For the author, CLBHA in unstable intertrochanteric fractures requires more technique and experience than the femoral neck. Because of the hemiarthroplasty technique for intertrochanteric fractures, oriented fractures, leg length assignment, and setting anteversion are more difficult than hemiarthroplasty techniques for femoral neck fractures. Therefore, surgeons should have skillful experience in cementless hip replacement surgery of the femoral neck femur[32]. The author's experience with the CLBHA in unstable fractures of the intertrochanteric femur requires consultation with a surgeon who specializes in this procedure. There are three points regarding the safety of this procedure.

1. Arthrotomy had to avoid internal rotation of the thigh to prevent further displacement and preserve the calcar of the femoral neck.

2. The hammer strike sound change had to be observed to determine the proper size of the femoral stem (oversizing could lead to cracking of the bone, whereas undersizing could lead to subsidence of the stem).

3. The proper anteversion setting could avoid dislocation.

A limitation of the CLBHA is that the gluteus muscle and external rotator muscle group must be heavily dissected before hip arthrotomy and femoral neck resection, which is more invasive than PFNA (PFNA only slightly separates the hip and thigh muscles to insert the instruments). Therefore, PFNA provided better short-term results than CLBHA. CLBHA requires a longer operative time, longer postoperative hospitalization, and has slower ambulation than PFNA. However, long-term outcomes, such as the rate of revision, ambulation at six months, and mortality rate, should be considered. No statistically significant differences were observed between both procedures.

However, surgeons performing CLBHA must have extensive experience in hip arthroplasty. PFNA is not performed easily, especially for fracture-modified Evan types IV and V, because of the comminuted greater trochanter fragment, making it difficult to identify the entry point. This results in a misaligned proximal reaming, improper nail alignment, and eventually malreduction[10–12]. Particularly, some fracture patterns require a long PFNA. Distal interlocking screw insertion is difficult, and there is a possibility of misaligned distal interlocking screws. Treatment failure may result from inadequate fracture reduction, improper implant placement (hip blade or nail), or inevitable factors, such as delayed treatment, resulting in a large callus and partial varus malunion, severe osteoporosis, increasing the risk of hip blade cut-off and treatment failure, and intertrochanteric and neck fractures, which increase the risk of osteonecrosis. In such cases, some surgeons recommend hip arthroplasty.

Therefore, in both types of surgery for unstable intertrochanteric femurs, surgeons must have the knowledge, skills, and experience to achieve good results.

CONCLUSIONS

This study demonstrated that although PFNA remains the gold-standard treatment for unstable intertrochanteric femoral fractures in the elderly owing to shorter operative time, shorter postoperative hospitalization, and faster ambulation compared to CLBHA, no statistically significant difference in long-term outcomes and five-year mortality rate were observed between both procedures. CLBHA can be used as an alternative procedure in certain situations. However, both types of surgeries must be performed depending on the situation, skills, and experience of the surgeon.

REFERENCES

1. Mithal A, Dhingra V, Lau E. The Asian Audit: Epidemiology, costs and burden of osteoporosis in Asia. Int Osteoporos Foundation 2009:24-9.
2. Suriyawongpaisal P, Pimjai S, Wichien L. A multicenter study on hip fractures in Thailand. J Med Assoc Thai 1994;77:488-95.
3. Chariyalertsak S, Suriyawongpaisal P, Thakkinstain A. Mortality after hip fracture in Thailand. Int Orthop 2001;25:294-7.
4. LeBlanc ES, Hillier TA, Pedula KL, et al. Hip fracture and increased short-term but not long-term mortality in healthy older women. Arch Intern Med 2011;171:1831-7.
5. Sahmir Sadic, Svemir Custovic, Mahir Jasarevuc, et al. Proximal femoral nail antirotation in treatment of intertrochanteric hip fractures. Med Arch 2015;69:352-6.
6. Hongku N, Woratanarat P, Nitiwarangkul L, et al. Fracture fixation versus hemiarthroplasty for unstable intertrochanteric fractures in elderly patients: A systematic review and network meta-analysis of randomized controlled trials. Orthop Traumatol Surg Res 2022;108:102838.
7. Kokoroghiannis C, Aktselis I, Deligeorgis A, et al. Evolving concepts of stability and intramedullary fixation of intertrochanteric fractures--a review. Injury 2012;43:686-93.
8. McConnell JS, Saunders PRJ, Young SK. The clinical relevance of sound changes produced during cementless hip arthroplasty: a correctly sized femoral broach creates a distinctive pattern of audio frequencies directly related to bone geometry. Bone Joint J 2018;100-B:1559-64.
9. Homma Y, Zhuang X, Yanagisawa N, et al. Patients with shorter stature exhibit minimal hammering sound changes during cementless stem insertion in total hip arthroplasty. Arthroplast Today 2023;21:101136.
10. Jiamton C, Boernert K, Babst R, et al. The nail-shaft-axis of the of proximal femoral nail antirotation (PFNA) is an important prognostic factor in the operative treatment of intertrochanteric fractures. Arch Orthop Trauma Surg 2017;138:339-49.
11. Saini R, Jain M, Shah S, et al. Significant of tip apex distance (TAD) in proximal nail antirotation (PFNA) system used in trauma case of proximal femoral fractures. Int J Orthop Traumatol Surg Sci 2019;5:296-9.
12. Ruecker AH, Rueger JM. Pertrochanteric fractures: tips and tricks in nail osteosynthesis. Eur J Trauma Emerg Surg 2014;40:249-64.
13. Suriyawongpaisal P, Pimjai S, Wichien L. A multicenter study on hip fractures in Thailand. J Med Assoc Thai 1994;77:488-95.
14. Khunkitti N, Aswaboonyalert N, Songparanasilp T, et al. Fracture threshold in the Thai elderly and bone mineral density evaluation. J Bone Miner Metab 2000;18:96-100.
15. Han SK, Lee BY, Kim YS, et al. Usefulness of multi-detector CT in Boyd-griffin type 2 intertrochanteric fractures with clinical correlation. Skelet Radiol 2010;39:543-9.

16. Kim WY, Han CH, Park JI, et al. Failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to pre-operative fracture stability and osteoporosis. Int Orthop 2001;25:360-2.
17. Huang X, Leung F, Xiang Z, et al. Proximal femoral nail versus dynamic hip screw fixation for trochanteric fractures: a meta-analysis of randomized controlled trials. Scientific World Journal 2013:2013:805805.
18. Setiobudi T, Ng YH, Lim CT, et al. Clinical outcome following treatment of stable and unstable intertrochanteric fractures with dynamic hip screw. Ann Acad Med Singap 2011;40:482-7.
19. Luo X, He S, Zeng D, et al. Proximal femoral nail antirotation versus hemiarthroplasty in the treatment of senile intertrochanteric fractures: Case report. Int J Surg Case Rep 2017;38:37-42.
20. Tan WL, Shi YX, Zhang, JY, et al. Bipolar Hemiarthroplasty should not be selected as the primary option for intertrochanteric fractures in elderly patients aged 85 years or more. Medicine (Baltimore) 2020;99:e21862.
21. Li J, Cheng L, Jing J. The Asia proximal femoral nail antirotation versus the standard proximal femoral antirotation nail for unstable intertrochanteric fractures in elderly Chinese patients. Orthop Traumatol Surg Res 2015;101:143-6.
22. Yang YH, Wang YR, Jiang SD, et al. Proximal femoral nail antirotation and third-generation gamma nail: which is a better device for the treatment of intertrochanteric fractures. Singapore Med J 2013;54:446-50.
23. Thakur A, Lal M. Cemented hemiarthroplasty in elderly osteoporotic unstable trochanteric fractures using fracture window. Malays Orthop J 2016;10:5-10.
24. Jayaram G, Sudhakar MV, Kumar RA, et al. Study of outcomes of cemented hemiarthroplasty for comminuted intertrochanteric fractures in the elderly. J Orthop 2023:41:67-72.
25. Donaldson AJ, Thomson HE, Harper NJ, et al. Bone cement implantation syndrome. Br J Anaesth 2009;102:18.
26. Duncan JA. Intra-operative collapse or death related to the use of acrylic cement in hip surgery. Anaesthesia 1989;44:149-53.
27. Govil P, Kakar PN, Arora D, et al. Bone cement implantation syndrome: A report of four cases. Indian J Anaesth 2009;53:214-8.
28. Haentjens P, Lamraski G. Endoprosthetic replacement of unstable, comminuted intertrochanteric fracture of the femur in the elderly, osteoporotic patient: a review. Disabil Rehabil 2005;27:1167-80.
29. Huang CG, Ye JJ. Comparison of three methods for the treatment of aged femoral intertrochanteric fracture. Zhongguo Gu Shang 2012;25:549-53.
30. Sniderman J, Vivekanantha P, Shah A, et al. Hemiarthroplasty for unstable intertrochanteric hip fractures: A matched cohort study. J Arthroplasty 2023;38:1522-7.
31. Chu X, Liu F, Huang J, et al. Good short-term outcome of arthroplasty with Wagner SL implants for unstable intertrochanteric osteoporotic fractures. J Arthroplast 2014;29:605-8.
32. Khamkhad A. Short metaphyseal femoral stem total hip arthroplasty in poor quality bone cortex without neck length sparing: A case report. JseaOrtho 2025;49:96-100.