Review article
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Proximal femoral nail antirotation versus bipolar hemiarthroplasty for intertrochanteric fractures: a meta-analysis

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Abstract

Introduction Intertrochanteric fractures account for almost half of all hip fractures, with a mortality rate of 15 to 20 % within one year following fracture, primarily in elderly patients aged 65 years old and older.

The **purpose** of this study is to compare the operative time, intraoperative blood loss, intraoperative blood transfusion, hospitalization time, weight-bearing time, Harris Hip Score at 1, 3, 6, 12 months follow-up, and complications after proximal femoral nail antirotation versus bipolar hemiarthroplasty for intertrochanteric fracture in elderly patients based on the published literature of their comparison.

Methods We conducted a comprehensive search in the electronic databases such as PubMed, Scopus, and Google Scholar. Original articles up to November 2024 were screened, focusing on retrospective or prospective cohort studies.

Results and Discussion The initial search yielded 702 studies. Six cohort studies with a total of 495 participants were assessed. The Proximal Femoral Nail Antirotation (PFNA) showed statistically significant shorter operative time (p = 0.006), lower intraoperative blood loss ($p < 0.0001$) compared with bipolar hemiarthroplasty. Bipolar Hemiarthroplastty had statistically significant better Harris Hip Score at 1- and 3- month follow-up post-operatively ($p < 0.00001$), (p = 0.001). It provides early weight-bearing (p = 0.003) and helps mobilize post-operative patients. Blood transfusion, hospitalization time, Harris Hip Score after 6- month follow-up, and complications had balanced results between two apporaches.

Conclusion PFNA and bipolar Hemiarthroplasty have comparable results in intertrochateric fractures in the elderly. PFNA has the advantages of shorter operative time, and lower intraoperative blood loss. Bipolar hemiarthroplasty has the advantages of better Harris Hip Score at 1- and 3-month follow-up and earlier weight-bearing.

Level of Evidence: I.

Keywords: Proximal Femoral Nail Antirotation, Bipolar Hemiarthroplasty, Intertrochanteric Fracture, Elderly, Harris Hip Score, Complications.

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INTRODUCTION

Intertrochanteric hip fractures are common and often fatal injuries, especially among the elderly. Intertrochanteric fractures account for almost half of all hip fractures, with a mortality rate of 15 to 20 % within one year following fracture [1]. By 2050, Asia is expected to account for more than half of all hip fractures worldwide, owing to an ageing population and increased life expectancy. In Japan, the chance of lifetime hip fractures for people over the age of 50 is stated to be 5.6 % for men and 20 % for women. Hip fracture cases in China are expected to increase sixfold, from 0.7 million in 2013 to 4.5 million by 2050 [2].

The number of hip fractures in the United States alone is expected to rise from approximately 320,000 per year to 580,000 by 2040. This growing demand puts tremendous strain on the health-care system in terms of staffing and resources needed to manage these patients. In the United States, healthcare expenses for the management of hip fractures are anticipated to surpass $10 billion annually [3–8], while the impact on the UK healthcare system is expected to be $2 billion per year [9]. These expenditures are driven not just by the acute surgical treatment, but also by post-acute care, such as rehabilitation. While hip fracture surgery is very effective, patients are likely to endure severe morbidity in terms of pain, discomfort, and limited mobility during their recovery, and in many cases are unable to restore pre-fracture levels of function [3, 6, 9]. Studies also reveal that there is a relationship between hip fracture and higher rates of mortality, with 30 % more deaths seen than the age-matched populations with and without hip fracture [9–14]. However, such findings should be interpreted with caution, as those who have had a hip fracture may be more vulnerable and prone to illness.

The optimum surgical method for intertrochanteric fracture should restore the patient's mobility to preoperative levels while minimising intra- and postoperative morbidity and death. Although proximal femoral nail antirotation (PFNA) has been widely used by orthopaedic specialists for patients with intertrochanteric fractures, PFNA failure has been reported due to extensive comminution, osteoporosis, implant cutout, femoral medialization, and lateral migration of proximal screws or helical blades [15, 16]. As a result, bipolar hemiarthroplasty, which allows for early weight-bearing while reducing the chance of osteosynthesis failure, has become a popular option for older patients with intertrochanteric fractures [17].

The proximal femoral nail antirotation (PFNA) has acquired widespread approval for its minimally invasive nature and biomechanical advantages, which allow for early weight-bearing [18]. This treatment comprises closed fracture reduction under fluoroscopy and the subsequent insertion of an intramedullary nail with a helical blade into the femur, minimising surgical time and blood loss while improving outcomes in terms of fracture union and functional recovery [19, 20]. However, problems such as blade migration and fixation failure have been reported, motivating efforts to identify and mitigate risk factors through continuous research and advancements in surgical procedures and implant designs [21].

For older patients with unstable intertrochanteric femur fractures, hemiarthroplasty with a bipolar prosthesis improves early postoperative ambulation. This would have a direct impact on both postoperative rehabilitation and general health [22].

The **objective** of this study was to compare the operative time, intraoperative blood loss, intraoperative blood transfusion, hospitalization time, weight-bearing time, Harris Hip Score at 1, 3, 6, 12 months follow-up, and complications after the proximal femoral nail antirotation versus bipolar hemiarthroplasty for intertrochanteric fracture in elderly patients, so that it can help the physician to choose the right treatment for the intertrochanteric fracture in the elderly.

MATERIALS AND METHODS

The Cochrane Handbook for Systematic Reviews of Interventions was used to perform this systematic review and meta-analysis, which was then reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Search Strategy

Two researchers (IGADD and NSNW) conducted literature search using three databases including PubMed, Scopus, and Google Scholar. The focus of the search was on the topic "proximal femoral nail antirotation versus bipolar hemiarthroplasty for intertrochanteric fracture in elderly". The study used only retrospective and prospective cohort studies. The literature search was performed using the keywords "proximal femoral nail antirotation" OR "PFNA" OR "bipolar hemiarthroplasty" OR "BHA" AND "Intertrochanteric Fracture". Applying filters to English language papers, human studies and cohort (retrospective or prospective) studies. The literature search ensuring inclusion of the terms in titles, abstracts, and keywords for study design and publication year. All search results were evaluated based on titles and abstracts to ensure relevance to the inclusion criteria.

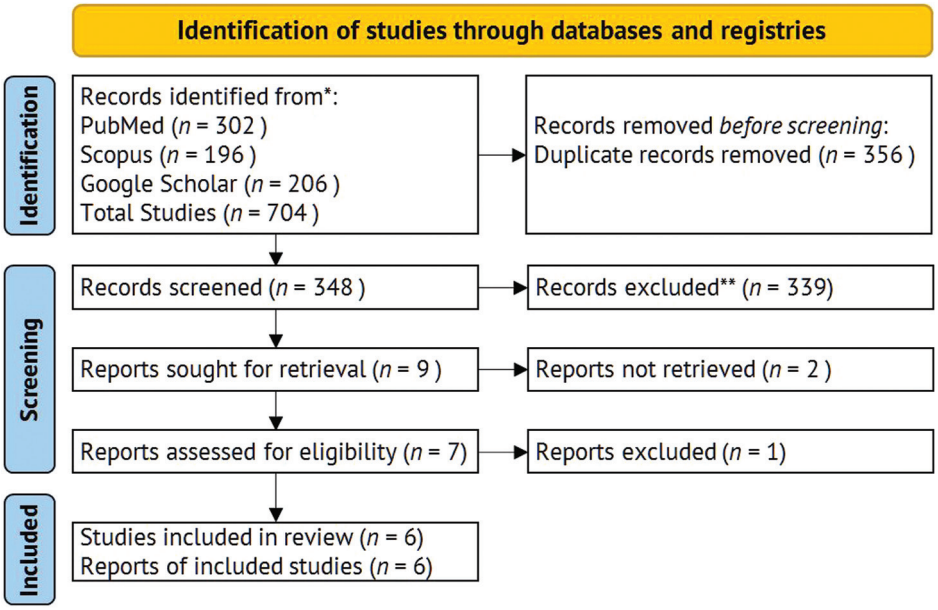

Fig. 1 PRISMA Flowchart 2020

Inclusion and Exclusion Criteria

The Inclusion criteria

(1) retrospective or prospective cohort studies comparing the use of the proximal femoral nail antirotation (PFNA) and bipolar hemiarthroplasty (BHA) in patients with intertrochanteric fractures;

(2) studies reporting at least one of the following outcomes: operative time, intraoperative blood loss, intraoperative blood transfusion, hospitalization time, weight-bearing time, Harris Hip Score, and complications;

(3) the study population included participants aged above 65 years old diagnosed with intertrochanteric fractures;

(4) articles published in English;

(5) with full texts available.

Exclusion criteria

(1) studies design were other than cohort (case report, case series, randomized controlled trials, literature review);

(2) studies that did not distinguish outcomes between PFNA and BHA;

(3) studies with fewer than 15 patients for each group;

(4) article data that could not be quantitatively analysed.

All articles meeting the inclusion criteria were assessed for methodological quality using the Newcastle Ottawa Scale (NOS).

Study Selection

Two reviewers (IGADD and NSNW) independently reviewed the title and abstract of all studies generated from the literature search to exclude irrelevant studies. For potentially eligible studies, 2 reviewers (IGADD and NSNW) independently reviewed the full text of articles (up to November 2024) using the inclusion criteria. The references in the retrieved articles were also carefully searched. Inconsistencies were resolved by discussion by a third author (IWSD). The reviewers were not blinded to the authors, journals, or sources of financial support.

Data Extraction and Quality Assessment

Data extraction and quality assessment were conducted by two reviewers (IGADD and NSNW). Key information for data extraction was collected from each study, including the first author's name, year of publication, retrospective or prospective cohort studies, sample size, demographic characteristics of participants, fracture classification (Evan-Jensens), treatment groups (proximal femoral nail antirotation and bipolar hemiarthroplasty). Quality assessment of included studies was performed using the Newcastle Ottawa Scale (NOS). NOS used for evaluating three domains: selection of participants, comparability of study groups, and assessment of outcomes. Studies with score ⩾ 6 on the NOS were considered of high methodological quality. Disagreement during data extraction was resolved through discussion with a third reviewer (IWSD).

Statistical Analysis

Statistical analysis was conducted employing Review Manager (RevMan) version 5.4.1. Dichotomous data were condensed using odd ratio (OR) with 95 % confidence interval (CI), for continuous data were evaluated using standard mean difference (SMD) and Mean Difference (MD) to define for variation in measurement scale across studies. Heterogeneity was evaluated using the Chi^2 test and quantified with the I^2. If I^2 test > 50 % using random effect model indicating high heterogeneity, if I^2 test < 50 % using fixed effect model indicating low heterogeneity. Forest plots were generated to visually provide the pooled effect estimate for each outcome. Statistical significance was set using *p* value ⩽ 0.05. All analyses adhered to PRISMA guidelines for systematic reviews and meta-analysis.

RESULTS

Selection of the Studies

The PRISMA flow diagram shows the study selection process in Figure 1. The initial research obtained a total 704 studies, and through the elimination of duplication 348 studies underwent independent screening and 339 were excluded due to subsequent reason: irrelevant title and abstract, non PFNA and BHA procedures. After exclusion, 7 full-text studies were assessed for the eligibility. At the end, 6 studies (original articles up to November 2024) were included in our data synthesis.

Table 1

Baseline Characteristics of the studies

Study	Country	Design	Study Period	Ages (Mean ± SD)		Intervention to patients		
				PFNA	BHA	PFNA	BHA	Total
Cai, et al., 2022 [29]	China	Retrospective Cohort	2014–2019	80.88 ± 4.90	82.19 ± 3.96	34	36	70
Lu, et al., 2023 [30]	China	Retrospective Cohort	2006–2021	92.3 ± 2.7	92.1 ± 2.5	36	77	110
Saraf, Munot, 2018 [31]	India	Retrospective Cohort	2016–2017	82.4 ± 3.9	80.8 ± 4.3	20	20	40
Song, et al. 2022 [32]	China	Retrospective Cohort	2012–2016	79.9 ± 6.1	81.0 ± 9.1	32	30	62
Zhou, et al., 2019 [33]	China	Retrospective Cohort	2008–2012	83.5 ± 4.8	83.8 ± 6.4	61	47	108
Zhou, et al., 2024 [34]	China	Retrospective Cohort	2012–2018	78.00 ± 6.95	80.04 ± 6.39	52	50	102

Table 2 represents the results of the New Castle Ottawa Scale. Of all included studies, one study has a score of 7, three studies have a score of 8, one study has a score of 9, and one study has a score of 10. It can be concluded that all studies have high quality studies.

Table 2

Newcastle-Ottawa Scale (NOS)

Study	Selection				Comparability	Outcomes			Total
	Representativeness ofexposed cohort	Selection of nonexposed cohort	Ascertainment of exposure	Outcome not present at the start of the study		Assessment of outcomes	Length of follow-up	Adequacy of follow-up	
Cai, et al., 2022 [29]	+	+	+	–	+	+	+	+	8
Lu, et al., 2023 [30]	+	+	+	+	+	+	+	+	9
Saraf, Munot, 2018 [31]	–	–	+	+	+	+	+	+	7
Song, et al. 2022 [32]	–	+	+	+	+	+	+	+	8
Zhou, et al., 2019 [33]	–	+	+	+	+	+	+	+	8
Zhou, et al., 2024 [34]	++	+	+	+	+	+	+	+	10

Operative Time

Of the 6 included studies, 5 reported the operative time [29–31, 33–34]. The forest plot analysis found that BHA had statistically significant difference in longer operative time, compared with PFNA (SMD –1.45, 95 % CI –2.49 to –0.42, $p = 0.006$) A random effects model was used because of the clinical heterogeneity ($I^2 = 94$ %, Fig. 2).

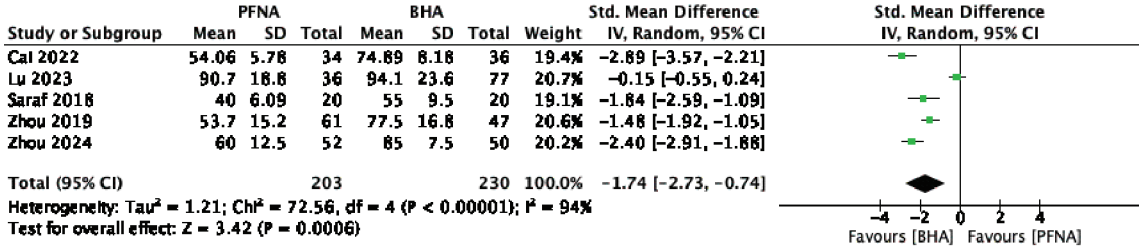

Fig. 2 Comparison of PFNA vs BHA on Operative Time

Intraoperative Blood Loss

All the included studies reported the intraoperative blood loss [29–34]. The forest plot analysis found that BHA statistically significant difference in intraoperative blood loss, compared with PFNA (SMD –2.34, 95 % CI –3.50 to –1.19, $p < 0.0001$) A random effects model was used because of the clinical heterogeneity ($I^2 = 96$ %, Fig. 3).

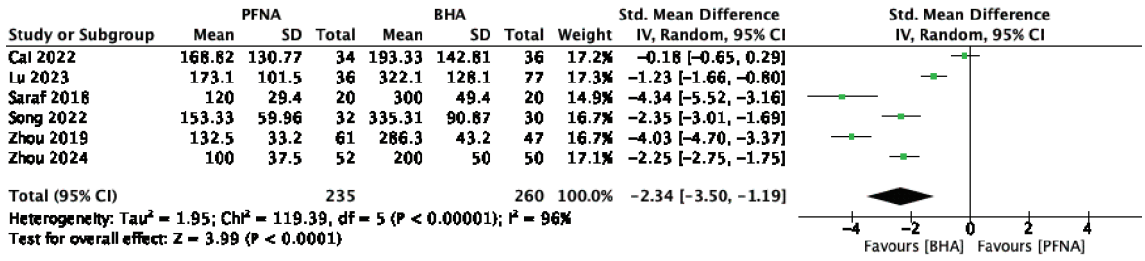

Fig. 3 Comparison of PFNA vs BHA on Intraoperative Blood Loss

Blood Transfusion

Of the 6 included studies, 2 reported the blood transfusion [29–30]. The forest plot analysis found that there was no statistically significant difference in blood transfusion between two groups (SMD –0.10, 95 % CI –1.11 to 0.90, $p = 0.84$) and low heterogeneity ($I^2 = 31$ %, Fig. 4).

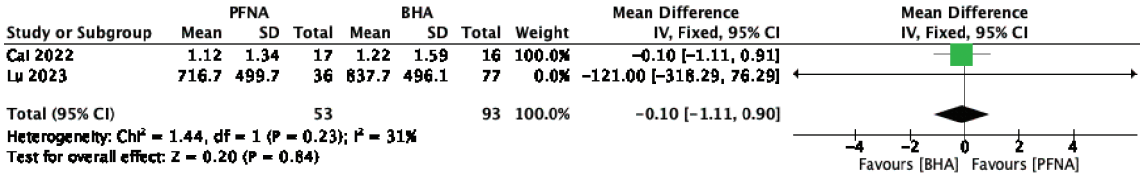

Fig. 4 Comparison of PFNA vs BHA on Blood Transfusion

Hospitalization Time

Of the 6 included studies, 5 reported the hospitalization time [29, 31–34]. The forest plot analysis found no statistically significant difference in hospitalization time between the two groups (SMD –0.16, 95 % CI –0.59 to 0.27, $p = 0.47$) A random effects model was used because of the clinical heterogeneity ($I^2 = 76$ %, Fig. 5).

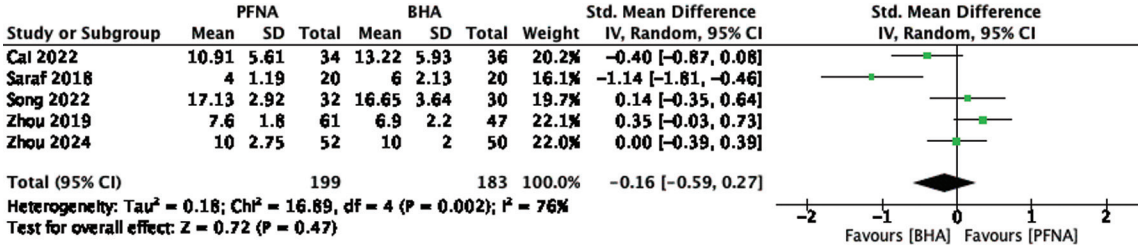

Fig. 5 Comparison of PFNA vs BHA on Hospitalization Time

Weight- Bearing Time

Of the 6 included studies, 3 reported the weight-bearing time [32–34]. The forest plot analysis found statistically significant difference that that PFNA was slower in early weight-bearing time, compared with BHA (SMD 5.16, 95 % CI 1.81 to 8.50, $p = 0.003$) A random effects model was used because of the clinical heterogeneity ($I^2 = 98$ %, Fig. 6).

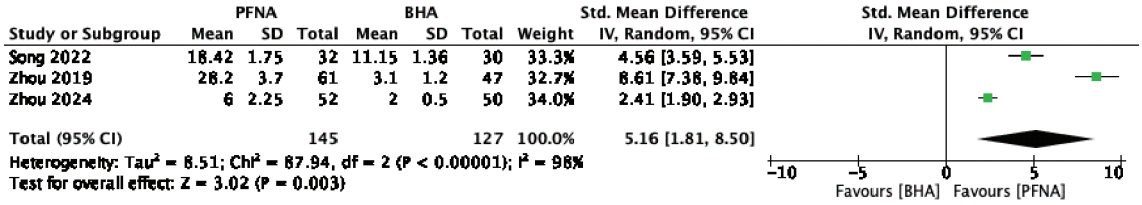

Fig. 6 Comparison of PFNA vs BHA on Weight-Bearing Time

Harris Hip Score at 1 Month Follow Up

Of the 6 included studies, 2 reported Harris Hip Score at 1-month follow-up [31, 34]. The forest plot analysis found that BHA statistically significant difference more superior in Harris Hip Score at 1-month follow-up, compared with PFNA (SMD –3.39, 95 % CI –3.91 to –2.86, $p < 0.00001$) and no heterogeneity ($I^2 = 0$ %, Fig. 7).

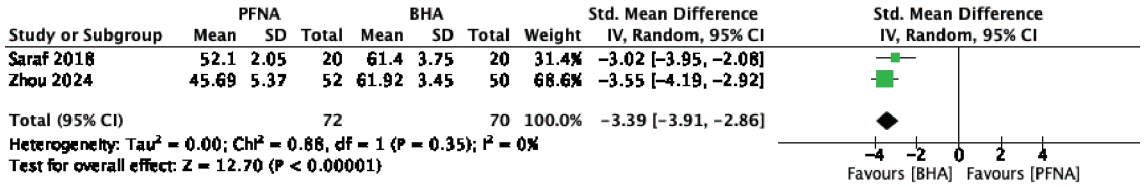

Fig. 7 Comparison of PFNA vs BHA on Harris Hip Score at 1-Month Follow-up

Harris Hip Score at 3 Month Follow Up

Of the 6 included studies, 4 reported Harris Hip Score at 3-month follow-up [29, 31, 32, 34]. The forest plot analysis found that there was statistically significant difference and BHA was more superior in Harris Hip Score at 3-month follow-up, compared with PFNA (SMD –1.80, 95 % CI –2.90 to –0.70, $p = 0.001$). A random effects model was used because of the clinical heterogeneity ($I^2 = 93$ %, Fig. 8).

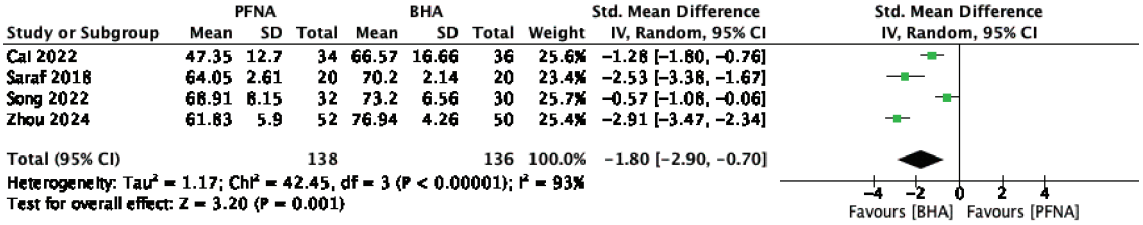

Fig. 8 Comparison of PFNA vs BHA on Harris Hip Score at 3-Month Follow-Up

Harris Hip Score at 6 Month Follow Up

Of the 6 included studies, 3 reported Harris Hip Score at 6-month follow-up [31, 32, 34]. The forest plot analysis found that no statistically significant difference in Harris Hip Score at 6-month follow-up between two groups (MD –0.29, 95 % CI –1.16 to 0.59, $p = 0.52$) and no heterogeneity ($I^2 = 0$ %, Fig. 9).

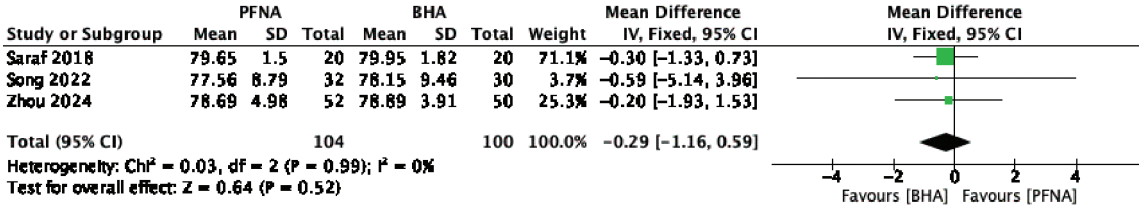

Fig. 9 Comparison of PFNA vs BHA on Harris Hip Score at 6-Month Follow-Up

Harris Hip Score at 12 Month Follow Up

All of the included studies reported Harris Hip Score at 12-month follow-up [29, 31–34]. The forest plot analysis found that there was no statistically significant difference in Harris Hip Score at 12-month follow-up between two groups (MD –0.50, 95 % CI –1.81 to 0.81, $p = 0.45$) and low heterogeneity ($I^2 = 34$ %, Fig. 10).

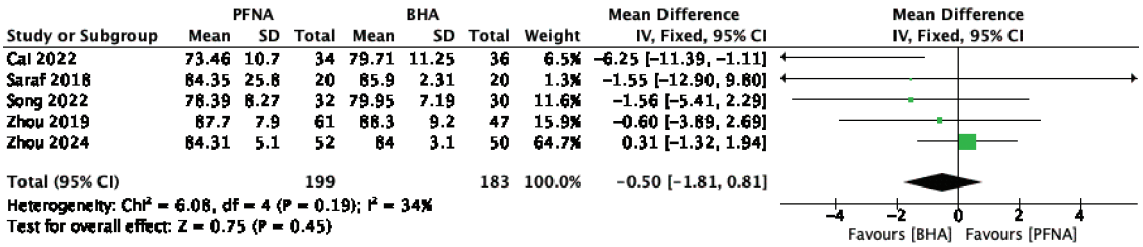

Fig. 10 Comparison of PFNA vs BHA on Harris Hip Score at Final Follow-up

Complications

Our findings show that there are 5 major groups of complications that occur in patients undergoing BHA and PFNA. There was no statistically difference in re-fracture complications (OR 1.14, 95 % CI, [0.40, 3.31], $p = 0.80$, $I^2 = 0$ %) and no heterogeneity. Re-operation rate was similar and showed no statistical difference (OR 2.06, 95 % CI [0.60, 7,08], $p = 0.25$, $I^2 = 51$ %) and moderate heterogeneity, wound infection (OR 0.49, 95 % CI [0.15, 1,58], $p = 0.23$, $I^2 = 38$ %) and low heterogeneity, deep vein thrombosis (OR 1.60, 95 % CI [0.18, 1.16], $p = 0.10$, $I^2 = 0$ %) and no heterogeneity, urinary tract infection (OR 1.60, 95 % CI [0.37, 6.88], $p = 0.53$, $I^2 = 0$ %) and no heterogeneity (Fig. 11) [29–34].

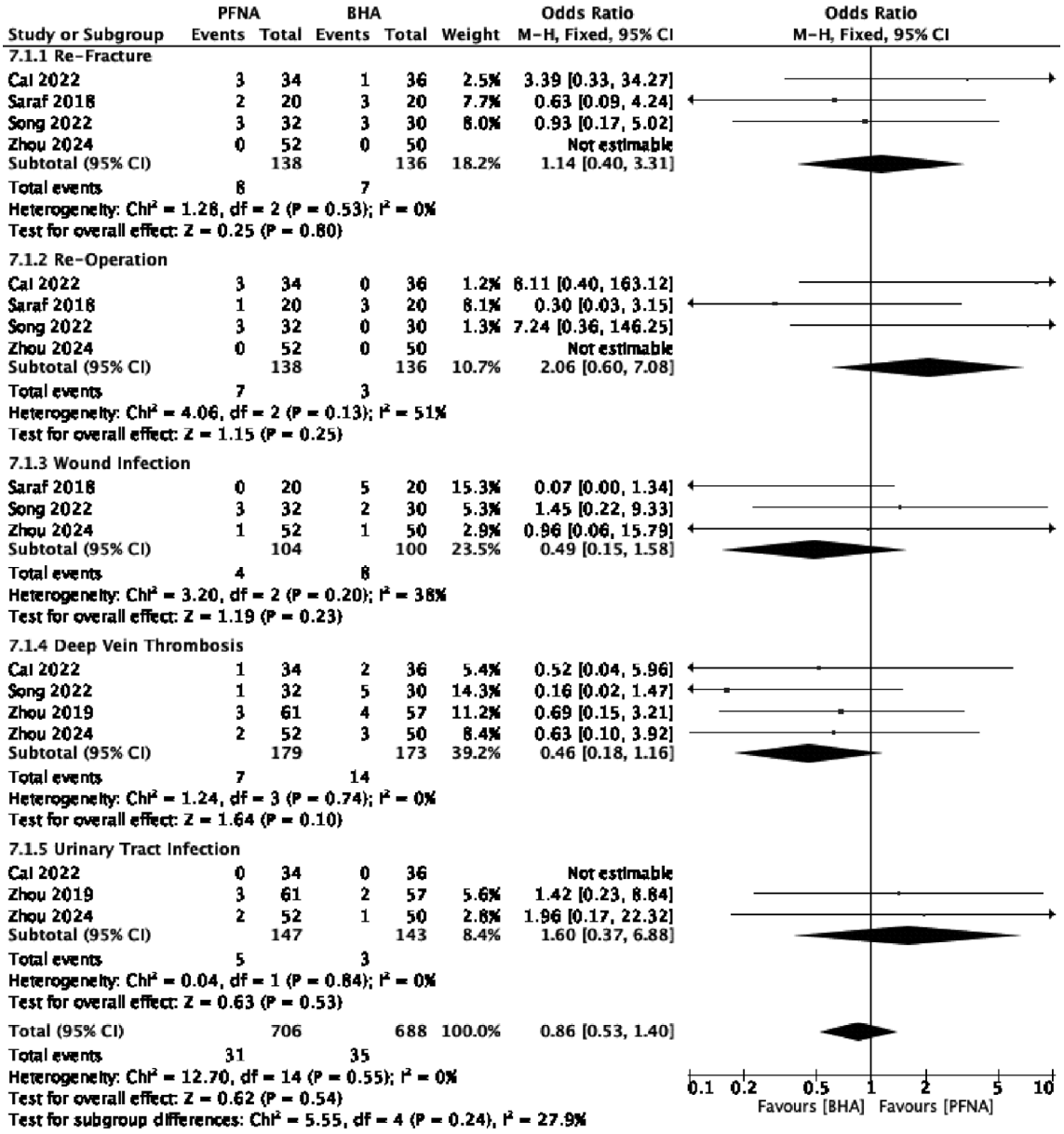

Fig. 11 Comparison of PFNA vs BHA on Complications

DISCUSSION

Our study results on the use of proximal femoral nail antirotation versus bipolar hemiarthroplasty in intertrochanteric fractures in elderly showed statistically significant results on operative time, intraoperative blood loss, early weight-bearing time, and Harris Hip Score at 1 and 3 months after surgery. There was no statistical difference in hospitalization time, blood transfusion, Harris Hip Score 6 and 12-months after surgery, and complications.

In our study, PFNA had the advantage of shorter operative time compared to BHA. Consistent with the studies of Cai et al (2022), Saraf et Munot (2018), Zhou et al. (2019), Zhou et al. (2024). This is because there is no complicated prosthesis placement and the procedure is minimally invasive. PFNA also avoids the extensive soft tissue dissection and precise prosthetic alignment required in BHA. BHA usually necessitates a longer surgical time due to the intricacy of arthroplasty operations, which involve the removal of the femoral head, femoral canal preparation, and appropriate prosthesis fixation [29, 31, 33, 34].

Given that osteoporosis is more common in the elderly and causes a more comminuted intertrochanteric fracture pattern, this has important ramifications for improving the prognosis of elderly patients with intertrochanteric femoral fractures. The surgical intervention with BHA requires not only performing the femoral head osteotomy but also repeatedly broaching the medullary and even repositioning and fixing the great trochanteric fragment, which may be more traumatic for elderly patients than patients with PFNA internal fixation and may explain the higher intraoperative blood loss in the BHA group compared to the PFNA group. This result is similar with the results of a prior study revealing that PFNA therapy leads to less blood loss and shorter operating time than BHA treatments [23].

Our study demonstrates significantly lower intraoperative blood loss in proximal femoral nail antirotation (PFNA) compared to bipolar hemiarthroplasty (BHA). This result is consistent with Saraf et Munot (2018), Song et al. (2022), Zhou et al. (2019), and Zhou et al. (2024) that PFNA reduced bleeding due to a less invasive approach compared with BHA. The increased blood loss in BHA is due to the significant soft tissue dissection and femoral canal preparation necessary during the surgery [31, 32, 33, 34].

There were no significant differences in intraoperative blood transfusion between PFNA and BHA. Song et al. (2022) and Zhou et al. (2024) discovered that patient specific factors including preoperative anaemia and comorbidities had a greater impact on blood loss and transfusion during surgery [32, 34].

The analysis of hospitalization time shows no significant difference. The primary premise of postoperative functional exercise for unstable intertrochanteric fractures is to begin out-of-bed activities as soon as feasible, but the affected leg cannot bear full weight. As a result, the patient bears weight on one leg and walks using crutches or other walking aids. Patients with limited upper limb strength or poor body balance cannot follow this training plan. As a result, many patients remain in bed for extended periods of time following PFNA surgery [24]. Unfortunately, this raises the likelihood of bed-related issues, medical expenses, and longer hospital stays.

The forest plot indicates that BHA allows significantly earlier weight-bearing compared to PFNA. BHA, which is favourable in terms of less operation time and permitting early weight-bearing, was initially utilised in 1978 and subsequently employed by other surgeons for intertrochanteric fracture treatment with satisfying results [25]. It has been suggested as an alternate approach for older intertrochanteric fracture patients [26, 27]. BHA is advised as a primary treatment for intertrochanteric fracture with poor stability in the elderly with severe osteoporosis, poor prognosis after internal fixation, and a short life expectancy [28].

The Harris Hip Score (HHS) has been widely utilized to evaluate hip functional outcome in elderly patients with intertrochanteric fractures treated with bipolar hemiarthroplasty (BHA) or proximal femoral nail antirotation (PFNA). Studies constantly highlight that both techniques can achieve good functional outcomes, but the results vary in magnitude and timeline.

In our study, the Harris Hip Score after 1 month and 3 months postoperatively was better in the bipolar hemiarthroplasty group compared to PFNA. However, after 6 months and at the end of follow-up, BHA and PFNA produced functional HHS outcomes which differences were not statistically significant. In line with the research of Saraf et Munot (2018), Song et al. (2022), Zhou et al. (2024) that the Harris Hip Score in the early postoperative period was better in the BHA group compared to PFNA, but after 6 months postoperatively there was no statistically significant difference. However, it is necessary to consider age and type of fracture as a therapeutic modality used for intertrochanteric fractures [31, 32, 34].

PFNA is appropriate for treating unstable intertrochanteric fractures, although BHA is better for treating comminuted fractures in individuals with severe osteoporosis, particularly those with an intertrochanteric fracture. Zhou et al. (2019) recommend the following indications for BHA in the treatment of intertrochanteric fractures: age > 75 years with severe osteoporosis; severe comminuted fracture; the presence of internal diseases and the inability to tolerate long-term bed rest; implant failure or non-union; femoral head disease; and voluntary arthroplasty [33].

PFNA may be more appropriate for younger, more active patients because of its capacity to preserve the native hip joint. BHA, on the other hand, is generally chosen for older, weak patients or that with poor bone stock because it eliminates the requirement for fracture healing and reduces the risk of problems like implant failure.

Complications including re-operation rates, re-fracture, wound infection, deep vein thrombosis, urinary complications between proximal femoral nail antirotation (PFNA) and bipolar hemiarthroplasty (BHA) for intertrochanteric fractures are generally comparable, as indicated by the forest plot and supporting studies.

The advantages of this study are:

(1) comprehensive evidence synthesis, by pooling data from multiple studies, this study improves the statistical power and provides more potent evaluation of the relative efficacy and safety of PFNA and BHA, which addresses the variations that may exist in each studies;

(2) evaluation of multiple outcomes, such as operative time, intraoperative blood loss, intraoperative blood transfusions, hospitalization time, weight-bearing time, Harris Hip Score and complications, allowing a holistic approach of the risks and benefits of each procedures.

The results of this study confirm previous studies that reported PFNA had a longer operative time and greater intraoperative blood loss. BHA had the advantage of better Haris Hip Score at 1- and 3-month follow-up, and could be early weight-bearing.

This study has some limitations. These limitations include:

(1) the number of articles that meet the inclusion criteria is only 6 articles, due to the lack of cohort studies discussing PFNA versus BHA;

(2) high bias in the results of forest plots of several subgroup analyses, this can occur due to various factors, namely patient demographics, clinician experience in performing surgery, and varying pre-operative to post-operative protocols;

(3) the number of participants is small so it can cause bias.

CONCLUSION

PFNA and BHA have comparable results. PFNA and BHA each have advantages and disadvantages. PFNA has the advantages of: (1) shorter operative time, (2) lower intraoperative blood loss. However, the disadvantage of PFNA is later weight-bearing than BHA. BHA has the advantages of: (1) better Harris Hip Score in 1 and 3 month follow-up post-operatively, (2) early weight-bearing and helps mobilize post-operative patients. However, the disadvantages of BHA are longer operative time and higher intraoperative blood loss which can increase the risk in elderly patients. It is necessary to consider performing BHA in patients with unstable intertrochanteric fractures or patients with osteoporosis so that patients can be immobilized as soon as possible. Blood transfusion, hospitalization time, Harris Hip Score at 6 and 12-month follow-up, and complications had balanced results between PFNA and BHA.

***Conflicts of interest**. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.*

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REFERENCES

1. Zheng L, Wong DW, Chen X, et al. Risk of proximal femoral nail antirotation (PFNA) implant failure upon different lateral femoral wall thickness in intertrochanteric fracture: a finite element analysis. *Comput Methods Biomech Biomed Engin*. 2022;25(5):512-520. doi: 10.1080/10255842.2021.1964488.
2. Chang SM, Hou ZY, Hu SJ, Du SC. Intertrochanteric Femur Fracture Treatment in Asia: What We Know and What the World Can Learn. *Orthop Clin North Am*. 2020 Apr;51(2):189-205. doi: 10.1016/j.ocl.2019.11.011.
3. Ruecker AH, Rupprecht M, Gruber M, et al. The treatment of intertrochanteric fractures: results using an intramedullary nail with integrated cephalocervical screws and linear compression. *J Orthop Trauma*. 2009;23(1):22-30. doi: 10.1097/BOT.0b013e31819211b2.

4. Mundi S, Pindiprolu B, Simunovic N, Bhandari M. Similar mortality rates in hip fracture patients over the past 31 years. *Acta Orthop*. 2014;85(1):54-59. doi: 10.3109/17453674.2013.878831.
5. De Laet CE, van Hout BA, Burger H, et al. Bone density and risk of hip fracture in men and women: cross sectional analysis. *BMJ*. 1997;315(7102):221-225. doi: 10.1136/bmj.315.7102.221.
6. Burge R, Dawson-Hughes B, Solomon DH, et al. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005-2025. *J Bone Miner Res*. 2007;22(3):465-475. doi: 10.1359/jbmr.061113.
7. Søgaard AJ, Holvik K, Meyer HE, et al. Continued decline in hip fracture incidence in Norway: a NOREPOS study. *Osteoporos Int*. 2016;27(7):2217-2222. doi: 10.1007/s00198-016-3516-8.
8. Nieves JW, Bilezikian JP, Lane JM, et al. Fragility fractures of the hip and femur: incidence and patient characteristics. *Osteoporos Int*. 2010;21(3):399-408. doi: 10.1007/s00198-009-0962-6.
9. Lisk R, Yeong K. Reducing mortality from hip fractures: a systematic quality improvement programme. BMJ *Qual Improv Rep*. 2014;3(1):u205006.w2103. doi: 10.1136/bmjquality.u205006.w2103.
10. Amphansap T, Nitiwarangkul L. One-year mortality rate after osteoporotic hip fractures and associated risk factors in Police General Hospital. *Osteoporos Sarcopenia*. 2015;1(1):75-79. doi: 10.1016/j.afos.2015.07.006.
11. Klop C, Welsing PM, Cooper C, Harvey NC, Elders PJ, Bijlsma JW, Leufkens HG, de Vries F. Mortality in British hip fracture patients, 2000-2010: a population-based retrospective cohort study. *Bone*. 2014;66:171-177. doi: 10.1016/j.bone.2014.06.011.
12. Imai N, Endo N, Hoshino T, et al. Mortality after hip fracture with vertebral compression fracture is poor. *J Bone Miner Metab*. 2016;34(1):51-4. doi: 10.1007/s00774-014-0640-4.
13. Papadimitriou N, Tsilidis KK, Orfanos P, et al. Burden of hip fracture using disability-adjusted life-years: a pooled analysis of prospective cohorts in the CHANCES consortium. *Lancet Public Health*. 2017;2(5):e239-e246. doi: 10.1016/S2468-2667(17)30046-4.
14. Songpatanasilp T, Sritara C, Kittisomprayoonkul W, et al. Thai Osteoporosis Foundation (TOPF) position statements on management of osteoporosis. *Osteoporos Sarcopenia*. 2016;2(4):191-207. doi: 10.1016/j.afos.2016.10.002.
15. Ülkü TK, Tok O, Seyhan M et al. Comparison of Third Generation Proximal Femoral Nails in Treatment of Reverse Oblique Intertrochanteric Fractures. *Bezmialem Sci*. 2019;7(4):271-275. doi: 10.14235/bas.galenos.2018.2798.
16. Liu JJ, Shan LC, Deng BY, et al. Reason and treatment of failure of proximal femoral nail antirotation internal fixation for femoral intertrochanteric fractures of senile patients. *Genet Mol Res*. 2014;13(3):5949-5956. doi: 10.4238/2014.August.7.10.
17. Xie Y, Dong Q, Xie Z. Proximal femoral nail anti-rotation (PFNA) and hemi-arthroplasty in the treatment of elderly intertrochanteric fractures. *Acta Orthop Belg*. 2019;85(2):199-204.
18. She Z, Yang F, Zhang S, et al. A novel intramedullary nail design of intertrochanteric fracture fixation improved by proximal femoral nail antirotation. *Comput Methods Biomech Biomed Engin*. 2023:1-11. doi: 10.1080/10255842.2023.2286917.
19. Nie SB, Zhao YP, Li JT, et al. Medial support nail and proximal femoral nail antirotation in the treatment of reverse obliquity intertrochanteric fractures (Arbeitsgemeinschaft fur Osteosynthesfrogen/Orthopedic Trauma Association 31-A3.1): a finite-element analysis. *Chin Med J (Engl)*. 2020;133(22):2682-2687. doi: 10.1097/CM9.0000000000001031.
20. Liang Y, Liu S, Li L, Zhong F. Proximal femoral nail antirotation versus external fixation for unstable intertrochanteric fractures in elderly patients: A randomized controlled trial. *Medicine (Baltimore)*. 2022;101(28):e29384. doi: 10.1097/MD.0000000000029384.
21. Lee YK, Kim JT, Park CH, et al. Analysis of risk factor for nail breakage in patients with mechanical failures after proximal femoral nail antirotation in intertrochanteric fractures. *Medicine (Baltimore)*. 2022;101(25):e29436. doi: 10.1097/MD.0000000000029436.
22. Singh M, Nagrath AR, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. *J Bone Joint Surg Am*. 1970;52(3):457-467.
23. Hao Z, Wang X, Zhang X. Comparing surgical interventions for intertrochanteric hip fracture by blood loss and operation time: a network meta-analysis. *J Orthop Surg Res*. 2018;13(1):157. doi: 10.1186/s13018-018-0852-8.
24. Aguado-Maestro I, Escudero-Marcos R, García-García JM, et al. Results and complications of pertrochanteric hip fractures using an intramedullary nail with a helical blade (proximal femoral nail antirotation) in 200 patients. *Rev Esp Cir Ortop Traumatol*. 2013;57(3):201-207. (In Span.) doi: 10.1016/j.recot.2013.03.001.
25. Green S, Moore T, Proano F. Bipolar prosthetic replacement for the management of unstable intertrochanteric hip fractures in the elderly. *Clin Orthop Relat Res*. 1987;(224):169-177.
26. Tang P, Hu F, Shen J, et al. Proximal femoral nail antirotation versus hemiarthroplasty: a study for the treatment of intertrochanteric fractures. *Injury*. 2012;43(6):876-881. doi: 10.1016/j.injury.2011.11.008.
27. Fahad S, Nawaz Khan MZ, Khattak MJ, et al. Primary Proximal femur replacement for unstable osteoporotic intertrochanteric and subtrochanteric fractures in the elderly: A retrospective case series. *Ann Med Surg (Lond)*. 2019;44:94-97. doi: 10.1016/j.amsu.2019.07.014.
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(18-19):1167-1180. doi: 10.1080/09638280500055966.
29. Cai C, Tian L, Chen Z, et al. Cementless bipolar hemiarthroplasty compared with proximal femoral nail anti-rotation of unstable intertrochanteric fractures in senile patients with osteoporosis: a retrospective study. *BMC Musculoskelet Disord*. 2022;23(1):461. doi: 10.1186/s12891-022-05426-2.
30. Lu X, Gou W, Wu S, et al. Complication Rates and Survival of Nonagenarians after Hip Hemiarthroplasty versus Proximal Femoral Nail Antirotation for Intertrochanteric Fractures: A 15-Year Retrospective Cohort Study of 113 Cases. *Orthop Surg*. 2023;15(12):3231-3242. doi: 10.1111/os.13913.
31. Saraf H, Munot S. Comparative study of PFN antirotation vs bipolar hemiarthroplasty in unstable senile intertrochanteric fractures. *Indian J Orthop Surg*. 2018;4(4):380-385. doi: 10.18231/2395-1362.2018.0073.
32. Song QC, Dang SJ, Zhao Y, et al. Comparison of clinical outcomes with proximal femoral nail anti-rotation versus bipolar hemiarthroplasty for the treatment of elderly unstable comminuted intertrochanteric fractures. *BMC Musculoskelet Disord*. 2022;23(1):628. doi: 10.1186/s12891-022-05583-4.
33. Zhou S, Liu J, Zhen P, et al. Proximal femoral nail anti-rotation versus cementless bipolar hemiarthroplasty for unstable femoral intertrochanteric fracture in the elderly: a retrospective study. *BMC Musculoskelet Disord*. 2019;20(1):500. doi: 10.1186/s12891-019-2793-8.
34. Zhou X, Chen T, Jiang YL, et ak. Comparison of the clinical outcomes between proximal femoral nail anti-rotation with cement enhancement and hemiarthroplasty among elderly osteoporotic patients with intertrochanteric fracture. *BMC Musculoskelet Disord*. 2024;25(1):290. doi: 10.1186/s12891-024-07414-0.

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