

Comparative Efficacy of PFNA Versus DHS for Intertrochanteric Hip Fractures: An Umbrella Review

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ABSTRACT

Introduction: Intertrochanteric hip fractures are common in older patients and pose a major therapeutic challenge. The dynamic hip screw (DHS) and proximal femoral nail antirotation (PFNA) are the most widely used implants, but the evidence regarding their comparative efficacy remains controversial. **Objective:** To summarize evidence from systematic reviews and meta-analyses comparing PFNA with DHS for the treatment of intertrochanteric hip fractures. **Materials and Methods:** An umbrella review of systematic reviews and meta-analyses published between 2013 and 2025 was conducted. Reviews directly comparing PFNA or other proximal femoral nail variants with DHS and reporting at least one relevant clinical or perioperative outcome were included. Because of overlapping primary studies and methodological heterogeneity, a qualitative narrative synthesis was conducted without a new meta-analysis. **Results:** Ten systematic reviews (nine with meta-analyses) were included, encompassing data from more than 12,000 patients. PFNA showed consistent perioperative advantages, with shorter operative times and less intraoperative blood loss. There were no clinically relevant differences in long-term function or major complications. In unstable fractures, PFNA provided greater biomechanical stability and showed a trend toward less mechanical failure, varus collapse, or shortening. **Conclusions:** PFNA offers perioperative advantages over DHS, particularly in unstable fractures and in older or high-risk patients. In the long term, both implants yield similar functional outcomes and rates of major complications. Implant selection should therefore be individualized according to fracture pattern, patient condition, surgeon experience, and available resources.

Keywords: Intertrochanteric fracture; proximal femoral nail; PFNA; dynamic hip screw; umbrella review; meta-analysis.

Level of Evidence: I

Eficacia comparativa del clavo PFNA y el tornillo DHS en fracturas intertrocantericas de cadera: umbrella review

RESUMEN

Introducción: Las fracturas intertrocantericas de cadera son frecuentes en pacientes añosos y representan un importante desafío terapéutico. El tornillo dinámico de cadera (DHS) y el clavo femoral proximal antirrotatorio (PFNA) son los implantes más utilizados, pero la evidencia comparativa es aún controvertida. **Objetivo:** Sintetizar la evidencia de revisiones sistemáticas y metanálisis que comparan PFNA con DHS para tratar las fracturas intertrocantericas de cadera. **Materiales y Métodos:** Se realizó una *umbrella review* de revisiones sistemáticas y metanálisis publicados entre 2013 y 2025. Se incluyeron revisiones que compararan directamente PFNA o variantes de clavos femorales proximales con DHS y con, al menos, un desenlace clínico o perioperatorio relevante. Por solapamiento de estudios primarios y heterogeneidad metodológica, se efectuó una síntesis narrativa cualitativa sin nuevo metanálisis. **Resultados:** Se incluyeron 10 revisiones sistemáticas (9 con metanálisis) que agruparon datos de más de 12.000 pacientes. El PFNA mostró ventajas perioperatorias consistentes, con menor tiempo quirúrgico y menos pérdida sanguínea intraoperatoria. No hubo diferencias clínicamente relevantes en la función a largo plazo ni en las complicaciones mayores. En fracturas inestables, el PFNA tuvo mejor estabilidad biomecánica y menor tendencia a fallos mecánicos, colapso en varo o acortamiento. **Conclusiones:** El PFNA ofrece ventajas perioperatorias frente al DHS, especialmente en fracturas inestables y pacientes añosos o de alto riesgo. A largo plazo, ambos implantes logran resultados funcionales y tasas de compli-

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caciones mayores similares; por lo tanto, la elección debe individualizarse según el patrón de fractura, la condición del paciente, la experiencia del cirujano y los recursos disponibles.

Palabras clave: Fractura intertrocantérica; clavo femoral proximal; PFNA; tornillo dinámico de cadera; *umbrella review*; metanálisis.

Nivel de Evidencia: I

INTRODUCTION

Intertrochanteric hip fractures are among the most common injuries in older adults and are associated with functional decline, increased morbidity and mortality, and substantial healthcare resource use. Surgical treatment aims to provide stable fixation that allows early mobilization, reduces complications associated with bed rest, and supports functional recovery.

The two most widely used devices are the dynamic hip screw (DHS), an extramedullary system long considered the standard treatment, and the proximal femoral nail antirotation (PFNA), an intramedullary system that offers greater biomechanical stability, particularly in unstable fractures.

Since 2013, several systematic reviews with meta-analyses have directly compared PFNA with DHS.¹⁻¹⁰ These reviews consistently report perioperative benefits with PFNA, including shorter operative time and lower blood loss, attributed to its minimally invasive approach. However, long-term functional outcomes, usually assessed using the *Harris Hip Score* (HHS), and major complications are generally similar between the two implants. Some reviews favor PFNA for unstable fractures, particularly because of a lower tendency toward cut-out, varus collapse, or mechanical failure. In stable fractures, outcomes appear equivalent.

The available evidence is spread across systematic reviews that differ to some extent in their populations, eligibility criteria, outcomes, and methods. This umbrella review aims to bring these findings together and provide a clinical interpretation that can guide implant selection for intertrochanteric hip fractures.

MATERIALS AND METHODS

This umbrella review of systematic reviews followed the recommendations of the PRISMA 2020 statement adapted for reviews of reviews and Chapter V of the *Cochrane Handbook for Systematic Reviews of Interventions*, which addresses overviews of reviews.^{11,12} The protocol was registered in PROSPERO [CRD420251182097].

The research question was structured using the PICO framework:

Population: Adults with stable or unstable intertrochanteric femoral fractures classified as AO/OTA 31-A1 to 31-A3.

Intervention: Intramedullary fixation with PFNA or variants of proximal femoral nails.

Comparison: Extramedullary fixation with DHS.

Primary Outcomes: Operative time, intraoperative blood loss, long-term function, preferably assessed using the HHS, and major complications such as cut-out, reoperation, peri-implant fracture, deep infection, or non-union.

Secondary Outcomes: Length of hospital stay, time to full weight-bearing, minor complications, and mortality.

Systematic reviews with conventional or network meta-analyses were included if they directly compared PFNA or variants of proximal femoral nails with DHS and reported at least one primary outcome. Eligible reviews had to document systematic methods, searches of at least two databases, and an assessment of the risk of bias or quality of the included studies.

We excluded reviews without a direct comparison between PFNA and DHS, narrative reviews without a meta-analysis or structured synthesis, studies focused exclusively on other implants or populations outside the scope of the review, and publications with insufficient information for analysis.

Reviews were identified from the documents available for analysis. Duplicates, methods, included populations, comparisons, and reported outcomes were checked manually. Ten systematic reviews published between 2013 and 2025 were ultimately included, nine of which contained a meta-analysis.

The methodological quality of the included reviews was assessed qualitatively, considering the comprehensiveness of the search, duplicate study selection or data extraction, risk-of-bias assessment, handling of heterogeneity, and transparency of the synthesis.¹³

Two reviewers independently extracted the following data: authors, publication year, review type, number of primary studies, approximate number of patients, fracture types included, reported outcomes, and main conclusions. Because of methodological heterogeneity and partial overlap among primary studies, we used a qualitative narrative synthesis with summary tables. No new quantitative meta-analysis was performed, to avoid double-counting patients or studies included in more than one review.

RESULTS

Characteristics of the Included Reviews

The 10 included reviews brought together data from 186 studies and more than 12,000 patients in total, with partial overlap across publications. Most included both stable and unstable mixed intertrochanteric fractures, although some analyzed these fracture types separately. Table 1 summarizes the main characteristics of the included reviews.

Table 1. Characteristics of the included systematic reviews. Level of evidence 1

Ref.	Authors (year)	Review type	Primary studies (n)	Total patients (n)	Fracture types	Main outcomes reported	Main conclusion regarding PFNA vs. DHS
1	Shen et al. (2013)	Conventional meta-analysis	5 RCTs	~500	Mixed	Operative time, blood loss, complications	PFNA: lower blood loss and fewer complications
2	Zhang et al. (2014)	Conventional meta-analysis	6 RCTs	669	Mixed	Operative time, blood loss, incision length	PFN: shorter operative time, lower blood loss, and shorter incision
3	Yuan et al. (2014)	Conventional meta-analysis	17 RCTs	1,344	Mixed (older adults)	Fixation failure, HHS, healing time	PFNA superior for fixation failure, healing, and function
4	Arirachakaran et al. (2017)	Network meta-analysis	36 RCTs	~3,000	Mixed (older adults)	Operative time, blood loss, complications	PFN: lower blood loss and shorter hospital stay
5	Hao et al. (2018)	Network meta-analysis	24 RCTs	3,097	Mixed	Blood loss, operative time	PFNA: lower blood loss and shorter operative time
6	Cheng and Sheng (2020)	Network meta-analysis	36 RCTs	~4,000	Mixed	Blood loss, HHS, complications	PFNA optimal (lower blood loss, higher HHS)
7	Xu et al. (2022)	Conventional meta-analysis	12 RCTs	1,889	Mixed	Operative time, blood loss, complications	PFN: shorter operative time and lower blood loss; similar complications
8	Zhang et al. (2023)	Conventional meta-analysis	17 (RCTs + observational studies)	~2,600	Unstable	HHS, healing time, complications	PFNA superior across multiple clinical outcomes
9	Mustamsir et al. (2024)	Conventional meta-analysis	10 (RCTs + observational studies)	1,149	Stable (A1)	Operative time, blood loss, HHS, complications	PFNA: better perioperative outcomes; similar long-term outcomes
10	Musa et al. (2025)	Systematic review	~23	~1,500	Stable	HHS, mobilization, complications	PFN: early advantages; similar costs and complications

RCT = randomized controlled trial; HHS = Harris Hip Score; PFNA = proximal femoral nail antirotation; PFN = proximal femoral nail; DHS = dynamic hip screw.

Assessment of Methodological Quality

The methodological quality of the reviews was generally moderate to high. Their main strengths were searches across multiple databases, the inclusion of randomized controlled trials or comparative studies, and the assessment of clinically relevant outcomes. The most common limitations were heterogeneity among primary studies, differences in fracture classification, overlap among studies included in different reviews, and the limited representativeness of some populations.

Summary of Findings

The reviews consistently reported perioperative advantages with PFNA or proximal femoral nails. Eight of the 10 reviews found shorter operative times with these devices, with approximate mean differences of 18-21 minutes. Nine of the 10 reported lower intraoperative blood loss, with approximate reductions of 89-250 mL. Some reviews also reported lower transfusion requirements, smaller incisions, and shorter hospital stays.

For functional outcomes, most reviews found no significant long-term differences between PFNA and DHS. HHS values were similar in most analyses, suggesting functional equivalence beyond the early postoperative period.

No consistent differences were observed between the two implants in major complications, including cut-out, reoperation, deep infection, nonunion, or mortality. However, PFNA showed a lower tendency toward varus collapse, shortening, limb length discrepancy, and fixation failure, particularly in unstable fractures.

Subgroup analysis suggests that fracture stability is a key factor in implant selection. In unstable fractures, PFNA showed biomechanical advantages and a lower risk of mechanical failure. In stable fractures, both devices achieved similar outcomes, although PFNA retained some perioperative advantages.

Overall, the evidence favors PFNA for perioperative outcomes and unstable fractures, while long-term safety and function appear comparable to those of DHS (Table 2).

DISCUSSION

The main findings of this umbrella review show that PFNA offers perioperative advantages over DHS. PFNA is associated with shorter operative time and lower intraoperative blood loss, without appearing to compromise long-term functional outcomes or increase major complications.

These advantages may be explained by the less invasive technique and intramedullary design of PFNA, which require less soft-tissue dissection than the more extensive approach used for DHS. The benefit was particularly evident in the included network meta-analyses, where PFNA ranked more favorably for operative time and blood loss.⁴⁻⁶ Reducing operative time by 15-30 minutes and blood loss by 89-250 mL may be clinically important in older or frail patients and those with cardiovascular comorbidities, preoperative anemia, or high anesthetic risk.

For functional outcomes, the available evidence shows similar long-term HHS results. This is consistent with the biomechanical principles of each device: DHS provides good compression in stable fractures, whereas PFNA offers greater rotational and axial stability in unstable fractures.^{9,10} Several studies also favor PFNA for early mobilization and weight-bearing in patients with unstable fractures, which may allow faster rehabilitation and shorter hospital stays.

No consistent significant differences were found between the two groups in cut-out, reoperation, deep infection, nonunion, or mortality. PFNA showed a lower tendency toward varus collapse and shortening, particularly in unstable fractures, where its intramedullary design provides better control of axial loading.^{3,8}

Subgroup analyses by fracture type help inform clinical practice. In unstable fractures, classified as AO/OTA 31-A2 and 31-A3, PFNA showed advantages in stability and a lower risk of mechanical failure. In stable fractures, classified as AO/OTA 31-A1, both devices achieved similar results. The choice may therefore depend on surgeon experience, implant availability, cost, and preference for a less invasive approach.^{9,10}

Table 2. Summary of outcomes comparing PFNA and DHS. Level of evidence 1

Outcome	Number of reviews reporting the outcome	Overall trend (favors PFNA/PFN, favors DHS, or similar)	Key evidence	Comment
Operative time	8/10	Favors PFNA/PFN (7/8)	MD of –18 to –21 min ($p < 0.01$ in most analyses); high ranking in network meta-analyses	Consistent advantage attributable to the minimally invasive approach
Intraoperative blood loss	9/10	Favors PFNA/PFN (8/9)	MD of –89 to –250 mL ($p \leq 0.01$); fewer transfusions; high SUCRA in the network meta-analysis	Clinically relevant benefit; higher ranking in the network meta-analysis
Length of hospital stay	3/10	Favors PFNA/PFN (3/3)	Mean of ~7–8 vs. 12 days in some reviews; shorter with PFNA	Reported in fewer reviews; perioperative advantage
Long-term Harris Hip Score (≥ 6 –12 months)	5/10	Similar (4/5)	MD of 0 to +7 points (not significant in most analyses); high SUCRA in the network meta-analysis	Long-term functional equivalence
Early mobilization/weight-bearing	3/10	Favors PFNA/PFN (3/3)	Earlier full weight-bearing; better outcomes in unstable fractures	Early advantage, particularly in unstable fractures
Major complications (cut-out, reoperation, infection)	10/10	Similar (9/10)	OR 0.4–1.2 (not significant in most analyses); similar nonunion and mortality	Equivalent safety profile
Varus collapse/shortening/fixation failure	3/10	Favors PFNA/PFN (3/3)	OR ~0.4 for coxa vara; fewer failures in unstable fractures	Greater biomechanical stability with PFNA, particularly in unstable fractures
Complications by subgroup	3/10	Favors PFNA in unstable fractures (3/3); similar in stable fractures (2/2)	Fewer mechanical failures in unstable fractures; comparable outcomes in stable fractures	Key difference according to fracture stability

MD = mean difference; OR = odds ratio; SUCRA = surface under the cumulative ranking curve; PFNA = proximal femoral nail antirotation; PFN = proximal femoral nail; DHS = dynamic hip screw.

The strengths of this review include the synthesis of recent systematic reviews and meta-analyses, the direct comparison of two widely used implants, and the practical interpretation of findings according to fracture stability. The decision not to perform a new quantitative meta-analysis also avoids double-counting caused by overlap among primary studies.

The main limitations are moderate overlap among primary studies, heterogeneity in outcome definitions, differences in fracture classification, and methodological variability across reviews. Other considerations include the limited representation of some populations and the scarcity of studies with long-term follow-up, cost-effectiveness analyses, and patient-reported outcomes.

Clinical Implications and Future Research

In clinical practice, PFNA appears preferable for unstable fractures and for older patients or those at greater perioperative risk, whereas DHS remains a valid option for stable fractures. In all cases, adequate reduction, early surgery, and early rehabilitation are key determinants of outcome.

Future research should include multicenter trials with longer follow-up, economic analyses, subgroups defined by fracture stability, evaluation of newer implant versions, and patient-reported outcomes.

CONCLUSIONS

PFNA offers perioperative advantages over DHS in the treatment of intertrochanteric hip fractures, chiefly shorter operative time, lower blood loss, and reduced transfusion requirements.

In unstable fractures, PFNA provides greater stability and a lower risk of mechanical failure. In stable fractures, both implants yield similar outcomes, although PFNA retains benefits in the immediate postoperative period.

PFNA may therefore be considered the preferred option for older patients, unstable fractures, and situations involving greater perioperative risk. DHS remains an acceptable alternative for stable fractures, depending on the clinical, technical, and economic context.

Recommendations

For unstable intertrochanteric fractures and older patients at high surgical risk, PFNA should be considered the first option when it is available and the surgical team has experience with its use.

For stable fractures, both PFNA and DHS are acceptable options. The choice should be individualized according to the fracture pattern, surgeon experience, implant availability, and institutional resources.

In all cases, surgery should be performed early, adequate reduction achieved, and rehabilitation started as soon as possible.

Use of Artificial Intelligence

During the preparation of this work, the authors used GROK to organize tables and synthesize information. They then reviewed and edited the content as needed and take full responsibility for the content of the manuscript.

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