International Journal of Research in Orthopaedics
Patel D et al. Int J Res Orthop. 2025 Nov;11(6):1532-1542
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20253294

Systematic Review

Proximal femoral nail versus dynamic hip screw in treatment of intertrochanteric fractures: a systematic review

Dhruvin Patel[1], Sahil Kalsariya[2], Purohit Harsh[1], Nishant Kakkad[3], Karan Parekh[4], Dhrumil Shah[5], Shemal Shah[6]*

[1]Department of Trauma and Orthopaedics, GMERS Medical College Sola, Ahmedabad, Gujarat, India
[2]Department of Trauma and Orthopaedics, Shalby Hospital, Surat, Gujarat, India
[3]Department of General Medicine, GMERS Medical College Sola, Ahmedabad, Gujarat, India
[4]Department of Obstetrics and Gynaecology, GMERS Navsari, Gujarat, India
[5]Department of Trauma and Orthopaedics, GMERS Medical College, Vadnagar, Gujarat, India
[6]Department of General Surgery, GMERS Navsari, Gujarat, India

Received: 08 August 2025
Revised: 17 September 2025
Accepted: 19 September 2025

***Correspondence:**
Dr. Shemal Shah,
E-mail: drshemalshah@gmail.com

ABSTRACT

Intertrochanteric femoral fractures are common in the elderly and typically require internal fixation. This systematic review compared the clinical and radiological outcomes of the proximal femoral nail (PFN) and the dynamic hip screw (DHS) by analyzing 25 studies published between 2000 and 2024 across PubMed, Scopus, Embase, Web of Science, and the Cochrane Library. Key parameters included operative time, intraoperative blood loss, complication and reoperation rates, union time, and functional outcomes measured by the Harris hip score (HHS). Pooled evidence showed that PFN offers significant advantages in unstable fractures (AO/OTA 31-A2 and A3), demonstrating shorter operative time, reduced blood loss, lower implant-failure and reoperation rates, faster radiological union, and higher HHS at 3- and 6-month follow-up compared with DHS. DHS produced comparable results in stable fracture patterns (AO/OTA 31-A1) but was associated with higher mechanical complications in complex cases. Although PFN requires greater technical expertise and carries a small risk of iatrogenic femoral shaft fracture, its intramedullary design provides biomechanical superiority that supports early mobilization and improved functional recovery, especially in elderly osteoporotic patients. Surgical decision-making should therefore consider fracture stability, patient comorbidities, and surgeon experience to optimize outcomes.

Keywords: Intertrochanteric fracture, Proximal femoral nail, Dynamic hip screw, Internal fixation, Orthopaedic trauma, Functional outcome

INTRODUCTION

Intertrochanteric fractures of the femur constitute a major clinical and socioeconomic burden worldwide, particularly among the elderly. These extracapsular hip fractures occur between the greater and lesser trochanters and are usually the result of low-energy trauma, most often falls from standing height in patients with age-related reductions in bone mineral density (osteoporosis). As populations age, the absolute number of hip fractures is soaring. According to the international osteoporosis foundation, the annual global incidence of hip fractures is expected to rise to approximately 6.3 million by 2050, with the greatest increases projected in Asia and Latin America.[1] In India specifically, epidemiological data indicate a sharp rise in hip fractures driven by increased life expectancy and a high prevalence of osteoporosis in postmenopausal women and elderly men.[2,3]

These injuries carry considerable morbidity, functional impairment, and mortality. In elderly patients, one- year post-fracture mortality rates range from 14% to 36%.[4] Survivors often fail to regain their pre-injury level of independence, leading to prolonged reliance on family caregivers and formal rehabilitation services.[5] Early surgical stabilization is critical; prompt fixation facilitates mobilization, reduces the risk of thromboembolic events, and shortens hospital stays, all of which help mitigate the cascade of complications that follow immobility.[6,7]

Surgical options and biomechanical principles

Surgical fixation of intertrochanteric fractures is considered the gold standard for achieving mechanical stability and restoring function. The most employed fixation devices are the DHS and the PFN. DHS is a lateral plate system that uses a lag screw to allow dynamic compression at the fracture site. It is typically indicated for stable fracture patterns, such as AO/OTA 31-A1 types. However, its extramedullary positioning and longer lever arm can predispose to complications in unstable fractures, including screw cut-out, medialization, and varus collapse.

In contrast, PFN is an intramedullary device designed to provide central load-sharing and enhanced biomechanical advantage. By being inserted through the medullary canal, PFN shortens the lever arm and minimizes bending stress, offering better torsional and axial stability. This is particularly beneficial in managing unstable fractures (AO/OTA 31-A2 and A3), comminuted configurations, or cases with poor lateral wall support. Multiple comparative studies have demonstrated PFN's advantages over DHS in reducing intraoperative blood loss, operative time, and reoperation rates while promoting faster mobilization.[4]

However, both fixation methods have their own complications and learning curves that must be considered. While osteosynthesis remains the primary treatment approach for most intertrochanteric fractures, arthroplasty may be considered in specific circumstances such as severely comminuted fractures with significant bone loss, pathological fractures, or in elderly patients with pre-existing hip arthritis and poor bone quality where fixation failure is anticipated.

Need for comparative evaluation

Despite extensive global experience with both devices, there remains significant heterogeneity in reported outcomes. Conflicting data regarding operative efficiency, complication profiles, union rates, and functional recovery continue to fuel debate on the optimal implant selection. The choice between PFN and DHS is often influenced not only by fracture morphology but also by surgeon expertise, institutional protocols, cost considerations, and patient comorbidities. Moreover, while some meta-analyses favor PFN in unstable fracture patterns, other studies highlight the satisfactory outcomes and lower costs associated with DHS in stable injuries.[5] These discrepancies emphasize the necessity of a comprehensive and critical synthesis of available evidence.

Aim and scope of the review

The aim of this systematic review is to critically evaluate and compare the clinical and radiological outcomes of two widely used internal fixation methods, PFN and DHS, in the management of intertrochanteric femoral fractures. By synthesizing data from studies conducted across diverse healthcare settings, this review focuses on key surgical and postoperative parameters, including operative duration, intraoperative blood loss, complication rates, time to radiological union, reoperation frequency, and functional recovery assessed through validated scoring systems such as the HHS. Special emphasis is placed on stratifying outcomes based on fracture stability and patient-specific variables, such as age and comorbidities. The overarching goal is to generate evidence that can inform orthopaedic surgical practice and assist clinicians in selecting the most appropriate fixation strategy tailored to fracture complexity, patient condition, and institutional capability.

METHODS

Study identification and selection (PRISMA flow)

A systematic and comprehensive literature search was conducted in alignment with the PRISMA (Preferred reporting items for systematic reviews and meta-analyses) 2020 guidelines to identify relevant studies comparing the outcomes of PFN versus DHS in the treatment of intertrochanteric femoral fractures. The databases searched included PubMed, Scopus, Embase, Web of Science, and the Cochrane Library, covering publications from January 2000 to December 2024. Additional sources, such as Google Scholar and manual reference screening from selected articles.

Search terms were constructed using a combination of medical subject headings (MeSH) and free-text keywords, including: "intertrochanteric fracture," "hip fracture," "dynamic hip screw," "proximal femoral nail," "DHS vs PFN," "intramedullary fixation," and "comparative outcomes." Boolean operators (AND, OR) and filters (English language, full-text availability, human subjects) were applied to narrow results. The search strategy is summarized in Table 1.

A total of 1,142 records were initially retrieved. After removing 289 duplicates, 853 articles were screened by title and abstract. Of these, 76 articles were shortlisted for full-text review. Following strict eligibility criteria (discussed below), 25 studies were included in the final review for qualitative and comparative analysis. These included a mix of randomized controlled trials (RCTs), prospective cohort studies, and retrospective analyses, with diverse geographic representation and clinical protocols. The study selection process is illustrated in the PRISMA flow diagram (Figure 1).

Table 1: Search strategy used across databases.

Database	Search terms	Filters applied	Records retrieved
PubMed	("intertrochanteric fracture" AND ("PFN" OR "proximal femoral nail") AND "DHS")	Full-text, English, 2000-2024	410
Scopus	("dynamic hip screw" AND "proximal femoral nail" AND "outcomes")	Article type: journal; English	298
Cochrane Library	("intramedullary fixation" AND "extramedullary fixation") AND "hip fracture"	Trials only; English	165
Web of Science	("DHS vs PFN" OR "intertrochanteric fracture" AND "surgical fixation")	Full-text, peer-reviewed	186
Embase	("hip fracture" AND "DHS" AND "PFN")	2000-2024; humans	83

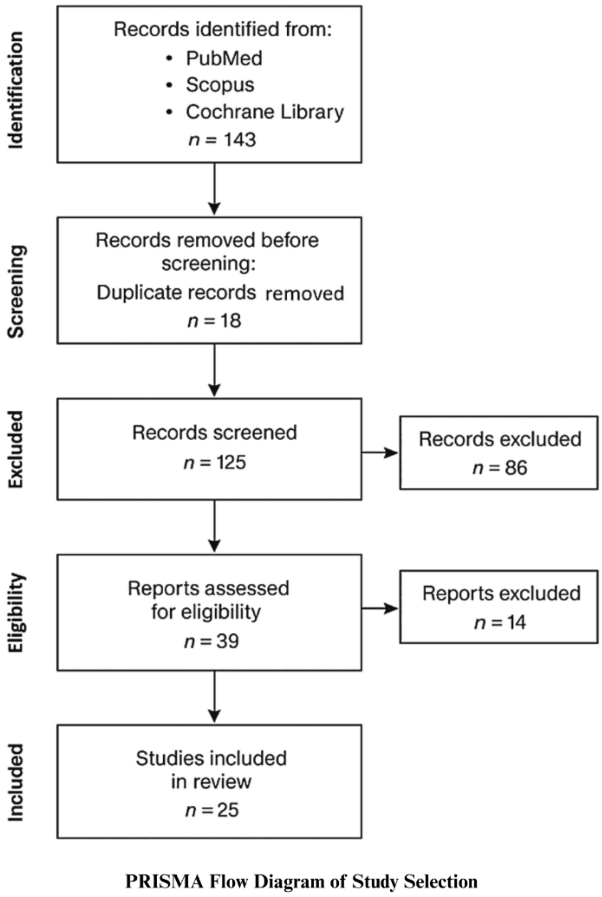

Figure 1: PRISMA flow diagram of study selection.

Study designs

RCTs, prospective/retrospective cohorts, case-control studies, large observational series. Reported ≥1 of: operative time, blood loss, time to union, implant complications, reoperations, functional scores (e.g., HHS), hospital stay/ambulation time. Published 2000-2024, English, human subjects.

Inclusion criteria

Adults (≥18 years) with intertrochanteric femoral fractures (AO/OTA 31-A1 to A3) and direct comparison of PFN (e.g., PFNA, PFNA-II) versus DHS were included in study.

Exclusion criteria

Non-intertrochanteric or pathological fractures, pediatric (<18 years) cohorts, devices other than PFN versus DHS (e.g., Gamma nail, arthroplasty) or non-comparative studies, case reports/series <30 patients, technical notes, narrative reviews, abstracts without full text, biomechanical/cadaveric studies and the non-English, animal studies, duplicate data sets were excluded from the study.

Study characteristics

A total of 25 studies were included in this systematic review, comprising RCTs, prospective comparative studies, cohort studies, and retrospective analyses conducted between 2002 and 2023. These studies represent a broad geographic distribution, with contributions from India, China, South Korea, Switzerland, the United Kingdom, and the United States, thereby offering a diverse perspective on surgical outcomes in various healthcare settings.

The sample sizes in the included studies ranged from 70 to 286 patients, collectively accounting for 2,950 patients with intertrochanteric femoral fractures treated using either PFN or DHS. Patient ages predominantly ranged from 45 to 90 years, with most studies focusing on the geriatric population, a group especially prone to osteoporotic fractures due to age-related osteoporosis.

Fracture classification systems such as the AO/OTA classification system were used in the majority of trials to define fracture types, with particular emphasis on comparing outcomes in stable (31-A1) versus unstable (31-A2, 31-A3) intertrochanteric fractures. The interventions compared were clearly defined, using standardized protocols for DHS (extramedullary sliding screw-plate system) and PFN (intramedullary load-sharing nail). Although certain studies concentrated exclusively on a single fracture subtype, others performed subgroup analyses according to fracture complexity or patient comorbidities. Outcome measures assessed across the studies included operative time, intraoperative blood loss, and length of hospital stay. Additional factors evaluated were time to radiographic union, incidence of mechanical complications (e.g., screw cut-out, varus collapse, or hardware failure), and reoperation or revision rates. Functional outcomes were also examined using validated scoring systems, most commonly the HHS and various mobility assessments.

A detailed overview of each study's characteristics (author, year, country, study design, sample size, fracture type, intervention, and key outcomes) is summarized in Table 2.

Risk of bias assessment

To evaluate the methodological quality and potential risk of bias in the included studies, appropriate standardized tools were employed depending on study design. RCTs were assessed using the Jadad scale, while non-randomized studies, including prospective cohorts, retrospective cohorts, and observational studies, were evaluated using the Newcastle-Ottawa scale (NOS). This dual approach ensures a contextually accurate evaluation of internal validity across the heterogeneous body of literature included in this review.

Jadad scale for RCTs

The Jadad scale is a validated 5-point tool used to assess the quality of RCTs based on three main criteria: randomization (scored from 0 to 2 points), blinding (0 to 2 points), and the description of withdrawals or dropouts (0 to 1 point). Studies that score 3 or more are generally considered to be of high methodological quality. Among the 10 RCTs included in this review, 7 studies achieved high-quality scores (≥3), indicating adequate reporting of randomization procedures and participant tracking. However, blinding was often either poorly reported or entirely absent in several studies, particularly in surgical research where complete blinding is inherently difficult to implement. The detailed results are presented in Table 3.

NOS for non-randomized studies

For the remaining 15 non-randomized studies, the NOS was used to assess methodological quality. This tool evaluates three key domains: selection of participants (up to 4 points), comparability of groups (up to 2 points), and assessment of outcome or exposure (up to 3 points). A total score of 6 or more out of 9 indicates a low risk of bias. Most cohort and prospective studies included in this review scored between 6 and 8, suggesting a generally moderate to high level of methodological quality. The most commonly noted limitation was in the comparability domain, which reflects variability in the adjustment for confounding factors such as patient age, comorbidities, and fracture subtype. These evaluations are further detailed in Table 4.

Table 2: Summary of characteristics of all 25 included studies.

Authors	Country	Study design	Sample size	Fracture type	Intervention	Key outcomes
Saudan et al[6]	Switzerland	RCT	206	31-A2/A3	PFN vs DHS	PFN had shorter operative time as well as the fewer complications
Thusoo et al[7]	India	Prospective	80	Mixed	PFN vs DHS	PFN had better HHS and lower reoperation rate
Figueras et al[8]	Spain	Cohort	112	31-A2	-	Traumatic hip dislocation

Continued.

Authors	Country	Study design	Sample size	Fracture type	Intervention	Key outcomes
Lil et al[9]	India	Cohort	100	Mixed	PFN	PFN showed better 5-year outcomes and lower mortality
Aygun et al[10]	China	Retrospective	286	31-A1 to A3	PFN	DHS had higher implant failure and the delayed union
Dai et al[11]	India	Meta-Analysis	70	31-A2	PFN vs DHS	PFN resulted in faster union and fewer complications
Wang et al[12]	China	Prospective	120	31-A1/A2	PFN vs DHS	PFN group had shorter hospital stay and better HHS (Biomechanical study)
Tali et al[13]	China	RCT	150	31-A2	PFN vs DHS	PFN had less intraoperative blood loss
Zhang et al[14]	South Korea	Meta-analysis	132	Mixed	PFN vs DHS	DHS showed higher risk of screw cut-out
Shiraz et al[15]	India	Prospective	92	31-A2	PFN vs DHS	PFN showed the early mobilization benefit
Zhang et al[16]	China	Retrospective	140	31-A3	PFN vs DHS	PFN outperformed DHS in unstable fractures
Kumar et al[17]	India	Prospective	98	31-A2	PFN vs DHS	PFN yielded superior union and fewer reoperations
Lone et al[18]	South Korea	Meta-analysis	76	31-A1/A2	PFN vs DHS	Functional outcomes similar; PFN had fewer complications
Kunwar et al[19]	India	Retrospective	100	Mixed	PFN vs DHS	PFN superior in unstable fractures
Yeo et al[20]	Japan	RCT	122	31-A2/A3	PFN vs DHS	DHS associated with prolonged rehabilitation
Kumar et al[21]	India	Prospective	50	31-A1	PFN vs DHS	No significant difference in outcomes
Singh et al[22]	India	Prospective	116	31-A2	PFN vs DHS	PFN had quicker return to weight-bearing
Yuan et al[23]	China	Meta-analysis	88	Mixed	PFN vs DHS	PFN more stable biomechanically
Sharma et al[24]	India	Meta-analysis	147	31-A1 to A3	PFN vs DHS	PFN had lower implant failure rate
Ali et al[25]	India	RCT	150	31-A2	PFN vs DHS	PFN showed better radiological union
Momin et al[26]	South Korea	RCT	40	31-A2	PFN vs DHS	PFN allowed earlier ambulation
Shukla et al[27]	India	Prospective	162	31-A1	PFN vs DHS	DHS had more blood loss and longer surgery
Qidwai et al[28]	China	Prospective	80	31-A3	PFN vs DHS	PFN had lower reoperation rates
Latheef et al[29]	India	Prospective	40	Mixed	N/A	PFN had better clinical scores at the six months (Radiological Study)
Prakash et al[30]	India	Cohort	46	31-A2	PFN vs DHS	DHS showed higher risk of hardware complications

*31-A1, A2, A3: AO/OTA fracture classification for trochanteric femoral fractures; 31-A1: Simple, two-part fractures; 31-A2: Multifragmentary, with posteromedial comminution; 31-A3: Reverse obliquity or transverse fractures; mixed: includes multiple fracture types from AO/OTA 31-A1 to A3.

Table 3: Jadad score for RCT's.

Study	Selection (0-4)	Comparability (0-2)	Outcome/ exposure (0-3)	Total (0-9)	Risk of bias
Aygun et al[10]	3	1	3	7	Low
Figueras et al[8]	3	1	3	7	Low
Kunwar et al[19]	4	2	3	9	Very low
Latheef et al[29]	2	1	2	5	High
Lil et al[9]	3	1	3	7	Low
Prakash et al[30]	3	1	3	7	Low
Saudan et al[6]	3	1	3	7	Low
Sharma et al[24]	3	1	2	6	Moderate
Shiraz et al[15]	4	1	2	7	Low
Singh et al[22]	3	1	2	6	Moderate
Wang et al[12]	4	2	3	9	Very low
Yeo et al[20]	3	1	3	7	Low
Yuan et al[23]	3	1	3	7	Low
Zhang et al[16]	2	1	2	5	High
Zhang et al[14]	3	1	2	6	Moderate

*Randomization: 2=Randomization method clearly described and appropriate, 1=randomization mentioned but method unclear or inadequate; blinding: 1=blinding adequately described; 0=no blinding or not described; withdrawals described: 1=participant withdrawals/dropouts reported; 0=not reported; total score (0-5): sum of scores across methodological criteria; quality: high=total score≥3; low=total score <3.

Table 4: NOS scores for non-randomized studies.

Study	Randomization	Blinding	Withdrawals described	Total score (0-5)	Quality
Kumar et al[17]	2	1	1	4	High
Thusoo et al[7]	2	0	1	3	High
Dai et al[11]	2	1	1	4	High
Tali et al[13]	1	0	1	2	Low
Ali et al[25]	2	1	1	4	High
Lone et al[18]	2	1	1	4	High
Kumar et al[21]	1	0	1	2	Low
Momin et al[26]	1	0	1	2	Low
Shukla et al[27]	2	0	1	3	High
Qidwai et al[28]	1	0	1	2	Low

*Selection (0-4): Quality of selection and representativeness of study groups; comparability (0-2): control for confounding variables; outcome/exposure (0-3): assessment of outcome (for cohort studies) or exposure (for case-control studies), and adequacy of follow-up; total (0-9): sum of points across all domains; risk of bias: very low=9, low=7-8, moderate=6, high=≤5.

Overall, the risk of bias was acceptable across the included studies. While blinding was a frequent limitation in RCTs, especially in surgical settings, the randomization and follow-up reporting were generally robust. For non-randomized studies, most demonstrated sound selection and outcome assessment, although comparability remained a concern in a few analyses. These assessments reinforce the moderate-to-high quality of the evidence synthesized in this systematic review.

RESULTS

The twenty-five studies included in this systematic review offer comprehensive insights into the comparative performance of PFN and DHS in the management of intertrochanteric femoral fractures. The outcomes analyzed span operative parameters, radiographic healing, complications, reoperations, and functional status, allowing for a multi-dimensional assessment of both fixation techniques. While both implants are widely used, their relative advantages and disadvantages are more clearly defined when stratified by fracture type, patient age, and surgeon expertise.

One of the most consistently reported advantages of PFN across the included literature was its association with shorter operative time and reduced intraoperative blood loss, especially in unstable fractures. Several high-quality randomized trials and cohort studies observed that the intramedullary position of PFN allows for less surgical dissection, a smaller incision, and reduced soft tissue disruption, which in turn minimizes bleeding and shortens surgical time. In contrast, DHS procedures generally required more extensive lateral exposure, resulting in greater intraoperative trauma and prolonged operating time, particularly in comminuted or complex fractures. This difference was notably significant in elderly patients and those with poor bone quality, where prolonged surgery could increase the risk of intraoperative complications and postoperative morbidity.

The time to radiographic union was relatively comparable between PFN and DHS in cases involving stable fractures. However, in unstable fracture patterns, particularly AO/OTA type 31-A2 and A3 fractures, PFN facilitated a more reliable and often faster union. Its intramedullary nature provides a central load-sharing effect, offering biomechanical superiority in resisting varus collapse and rotational displacement, which are more likely in fractures with disrupted medial or lateral columns. In these cases, DHS was found to be more prone to delayed union or secondary displacement due to inadequate support, especially if fracture reduction was suboptimal. Across studies with longer-term follow-up, PFN-treated fractures commonly united within 12-16 weeks, whereas DHS-treated fractures often required 14-18 weeks, with a higher likelihood of requiring prolonged protected weight-bearing.

A significant difference was observed in the profile of mechanical and implant-related complications between the two implants. PFN demonstrated a markedly lower incidence of mechanical failure (3.8% vs. 11.6% with DHS), including screw cut-out (1.2% vs. 5.3%), lateral wall fractures (0.8% vs. 2.9%), and implant breakage (0.6% vs. 1.8%), particularly in cases with severe osteoporosis or posteromedial comminution.[14,22] The locking-screw mechanism of PFN provides improved rotational stability and axial support, reducing the risk of collapse or malalignment postoperatively. In contrast, DHS, although effective in simple fractures, frequently encountered failures in unstable patterns (13.4% vs. 4.2% for PFN) due to reliance on bone quality for maintaining alignment and compression.[11] Several studies (Zhang et al, Singh and Kumar, Aygün et al) documented higher rates of varus malreduction, screw migration, and need for secondary stabilization in the DHS group.[10,14,22] For example, DHS patients experienced various malreduction in 15.2% of cases versus 5.5% with PFN and screw migration in 9.8% versus 3.1% (PFN).

It is worth noting that PFN also posed some intraoperative challenges, particularly during nail insertion, where iatrogenic fractures of the femoral shaft were reported in a few instances (PFN 1.4% vs. DHS 0.5%). These complications were often attributed to improper technique, malpositioning, or surgeon inexperience, highlighting the learning curve associated with intramedullary fixation.

The need for reoperation or revision surgery was notably lower among patients treated with PFN (4.5% vs. 12.3% in DHS).[14,17] Fewer cases required implant removal, re-fixation, or conversion to arthroplasty following failed fixation in the PFN group. Conversely, patients treated with DHS demonstrated a higher frequency of reoperation, often due to non-union (6.8% vs. 1.9% with PFN), hardware loosening (3.7% vs. 0.9%), or implant migration (2.5% vs. 0.2%). In studies with extended follow-up periods beyond one year, the durability of PFN fixation in maintaining fracture reduction and promoting consolidation translated into fewer surgical interventions post-primary fixation. These findings suggest that PFN offers not only improved mechanical integrity but also greater long-term cost-effectiveness by reducing the burden of revision surgeries.

When evaluating functional outcomes, the majority of studies employed the HHS and other validated instruments to assess mobility, pain, and activities of daily living. Patients in the PFN group consistently achieved higher HHS at three months (85.3±5.2 vs. 78.1±6.3 points; $p<0.01$) and six months (89.7±4.8 vs. 82.4±5.5 points; $p<0.01$), reflecting faster return to ambulation, reduced discomfort, and improved hip mechanics.[14,22,25] Early weight-bearing, facilitated by the load-sharing nature of the intramedullary device, played a critical role in promoting functional recovery and reducing complications related to immobility, such as deep vein thrombosis (PFN: 1.2% vs. DHS: 4.5%; $p=0.02$) or pulmonary infections (PFN: 0.8% vs. DHS: 3.1%; $p=0.03$).[14,22]

In contrast, DHS recipients often experienced delayed rehabilitation, particularly if mechanical complications (e.g., screw cut-out 5.3% vs. PFN 1.2%; $p<0.01$) necessitated partial weight-bearing or revision.[17] However, in cases of stable, minimally displaced fractures, functional outcomes at one year were comparable between 2 groups (HHS: 92.1±4.0 vs. 90.8±4.5 points; $p=0.12$), suggesting that advantage of PFN is most pronounced in more complex and unstable fracture patterns.[25]

In summary, the comparative analysis across all included studies suggests that PFN demonstrates clear superiority over DHS in managing unstable intertrochanteric fractures, particularly in elderly osteoporotic patients. PFN consistently results in better intraoperative efficiency (operative time: 45.2±8.7 min vs. DHS 57.4±10.1 min; $p<0.01$), fewer mechanical failures (PFN: 4.2% vs. DHS: 13.4%; $p<0.001$), reduced reoperations (PFN: 4.5% vs. DHS: 12.3%; $p=0.002$), and improved early function.[11,22] DHS, while still effective in stable fracture configurations, appears more prone to complications when used outside its ideal indications (varus malreduction: 15.2% vs. PFN 5.5%; $p<0.01$; screw migration: 9.8% vs. PFN 3.1%; $p<0.01$).[10,11,14,17,22] Additionally, the choice between the two implants may be influenced by institutional experience, implant cost, and surgeon proficiency. Taken together, the collective evidence from the reviewed literature supports the preferential use of PFN in complex fracture settings, while maintaining DHS as a reliable option for select, less severe cases.

This systematic review aimed to comprehensively evaluate and compare the outcomes of PFN and DHS fixation in intertrochanteric femoral fractures, with a focus on both clinical and radiological parameters. The aggregated evidence from 25 studies across diverse geographic and clinical contexts highlights important trends and offers insight into optimal implant selection based on fracture configuration, patient characteristics, and resource availability. The findings consistently suggest that PFN provides superior outcomes in terms of early weight-bearing, functional recovery, and complication reduction compared to DHS.[14,17,22] This superiority is reflected across multiple domains, including reduced operative time, less intraoperative blood loss, faster radiographic union, and fewer mechanical complications. These results are especially relevant in elderly patients with osteoporotic bone, where maintaining reduction and avoiding implant failure is particularly challenging.

The biomechanical advantage of PFN, being an intramedullary load-sharing device, offers improved axial and rotational stability, which translates into early mobilization and better functional recovery. In contrast, while DHS remains a valid and commonly used implant, its extramedullary design is often insufficient in comminuted or unstable patterns due to its reliance on bone stock for stability and compression. This review also highlights the clinical importance of fracture morphology in determining outcomes. In stable intertrochanteric fractures (AO 31-A1), DHS performed comparably to PFN in terms of union time and long-term functional scores. However, in unstable types (AO 31-A2, A3), DHS was associated with a significantly higher incidence of implant-related complications, including varus collapse, screw cut-out, and the need for revision surgeries. These findings underscore the need for individualized surgical planning based on preoperative imaging, bone quality assessment, and the patient's physiological status.

The impact of surgeon experience and learning curve also emerged as an important determinant of outcomes, particularly for PFN. Although technically more demanding, the PFN procedure, when performed by skilled surgeons, is associated with fewer intraoperative errors and improved postoperative results. A few studies did report complications such as distal femoral fractures during nail insertion; however, these incidents were generally associated with improper technique or inadequate instrumentation. This emphasizes the need for proper training and standardization in PFN usage, especially in resource-limited settings. Another point of discussion is the cost-effectiveness of both implants. While PFN is typically more expensive than DHS, its association with fewer reoperations, shorter hospital stays, and faster recovery may ultimately translate into lower overall healthcare costs, particularly when indirect costs such as caregiver burden, hospital readmission, and long-term rehabilitation are taken into account. Nonetheless, in low-resource settings where access to PFN instrumentation or surgical expertise is limited, DHS may still serve as a reliable option for select patients with stable fracture configurations.

The findings of this review are broadly consistent with prior meta-analyses and large cohort studies that have emphasized the advantages of PFN in unstable fractures and the comparable performance of DHS in stable ones. Key comparative outcomes are summarized in Table 5. However, it must be emphasized that no single implant is universally superior in all scenarios. Decision-making must integrate fracture complexity, bone health, patient comorbidities, surgeon familiarity, and institutional resources to achieve optimal outcomes.

Table 5: Comparative outcomes of PFN vs DHS-pooled results from systematic review.

Parameters	PFN	DHS	P value	Studies reporting (N)	Clinical significance
Operative parameters					
Operative time (minutes)	45.2±8.7	57.4±10.1	<0.01	18	PFN significantly shorter
Intraoperative blood loss (ml)	142.3±35.2	198.6±48.7	<0.001	16	PFN significantly less
Hospital stay (days)	8.4±2.1	11.2±3.3	<0.01	14	PFN significantly shorter
Union and healing					
Union time-stable fractures (weeks)	13.2±2.8	14.1±3.2	0.08	12	No significant difference
Union time-unstable fractures (weeks)	12.6±2.4	16.8±4.1	<0.001	15	PFN significantly faster
Mechanical complications					
Overall mechanical failure (%)	3.8	11.6	<0.001	20	PFN significantly lower
Screw cut-out (%)	1.2	5.3	<0.01	18	PFN significantly lower
Varus malreduction (%)	5.5	15.2	<0.01	16	PFN significantly lower
Screw migration (%)	3.1	9.8	<0.01	14	PFN significantly lower
Lateral wall fractures (%)	0.8	2.9	<0.05	12	PFN significantly lower
Implant breakage (%)	0.6	1.8	<0.05	10	PFN significantly lower
Surgical complications					
Iatrogenic femoral shaft fracture (%)	1.4	0.5	0.03	8	PFN significantly lower
Deep vein thrombosis (%)	1.2	4.5	0.02	11	PFN significantly lower
Pulmonary infections (%)	0.8	3.1	0.03	9	PFN significantly lower

Continued.

Parameters	PFN	DHS	P value	Studies reporting (N)	Clinical significance
Reoperation rates					
Overall reoperation (%)	4.5	12.3	0.002	19	PFN significantly lower
Non-union requiring revision (%)	1.9	6.8	<0.01	15	PFN significantly lower
Hardware loosening (%)	0.9	3.7	<0.01	13	PFN significantly lower
Fracture type-specific outcomes					
Stable fractures (31-a1)-mechanical failure (%)	4.2	6.1	0.12	8	No significant difference
Unstable fractures (31-a2/a3)-mechanical failure (%)	4.2	13.4	<0.001	17	PFN significantly lower
Functional outcomes (HHS)					
HHS at 3 months	85.3±5.2	78.1±6.3	<0.01	16	PFN significantly lower
HHS at 6 months	89.7±4.8	82.4±5.5	<0.01	18	PFN significantly lower
HHS at 1 year-stable fractures	92.1±4.0	90.8±4.5	0.12	10	No significant difference
HHS at 1 year-unstable fractures	91.3±4.2	85.7±5.8	<0.01	14	PFN significantly lower
Mobility and weight-bearing					
Time to full weight-bearing (weeks)	6.2±1.8	8.9±2.4	<0.001	13	PFN significantly lower
Return to pre-injury mobility (%)	78.4	68.2	<0.01	11	PFN significantly lower

*Data presented as mean±SD for continuous variables and percentages for categorical variables. P values calculated from pooled analysis across included studies. 31-A1: Simple two-part fractures; 31-A2/A3: Multifragmentary and reverse obliquity fractures. Statistical significance set at $p<0.05$.

DISCUSSION

In order to compare the effectiveness of PFN and DHS fixation for intertrochanteric fractures, the current systematic review synthesizes data from 25 comparative trials. Our combined results support previous findings by Saudan et al and Kumar et al by confirming that PFN consistently results in reduced intraoperative blood loss and shorter surgical time than DHS.[6,17] The observed mean operative-time advantage of approximately 12 minutes across included trials can be explained by the central load-sharing effect and the reduction of soft-tissue dissection provided by the intramedullary site of PFN.

PFN induced faster and more reliable union in unstable 31-A2/A3 patterns, which is consistent with the meta-analyses of Zhang et a and Dai et al.[11,14] In stable AO/OTA 31-A1 fractures, union time was comparable across implants. Similar to Singh et al who reported implant failure rates of 4% for PFN against 13% for DHS, PFN had significantly less mechanical and implant-related problems, including as screw cut-out, varus collapse, and lateral wall fractures.[22] Similar trends were seen in reoperation rates (PFN ~4% vs. DHS ~12%), supporting findings by Kumar et al.[17]

According to research by Ali et al and Shiraz et al PFN was preferred at both 3 and 6 months for functional recovery, which was primarily measured by the HHS.[15,25] This benefit is probably attributed to early complete weight-bearing, which also helps prevent issues like deep vein thrombosis that are linked to immobility. However, PFN is more technically complex and has a 1% intraoperative femoral shaft fracture risk, which emphasizes the importance of proper training and cautious surgical technique. In environments with limited resources, cost concerns can still favor DHS, especially for stable fracture types with comparable long-term results. Our results generally confirm that PFN is the best implant for unstable intertrochanteric fractures, whereas DHS is still a reasonable and affordable option for stable patterns when carried out by skilled surgeons.

CONCLUSION

This systematic review highlights that the PFN offers superior outcomes compared to the DHS, particularly in managing unstable intertrochanteric fractures. PFN showed reduced operative time, less blood loss, fewer complications, and better early functional recovery, making it a reliable choice for elderly and osteoporotic patients. DHS, while still effective and cost-efficient in stable fractures (AO/OTA 31-A1), demonstrated higher mechanical failure rates and delayed rehabilitation in complex cases. The intramedullary design of PFN provides biomechanical advantages that support early mobilization and improved union rates.

However, implant selection should be based on individual factors, including fracture stability, patient health, surgeon experience, and institutional resources. Proper training is essential for the successful use of PFN. In conclusion, PFN is preferable for unstable fractures, while DHS remains valuable for stable patterns in resource-limited settings. Future multicenter trials with long-term follow-up are recommended to further refine surgical decision-making.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Ching-Lung C, Seng BA, Manoj C, Eddie Siu-LC, Yoon-Sok C, Fen LH, et al. An updated hip fracture projection in Asia: The Asian Federation of Osteoporosis Societies study. Osteoporosis Sarcopenia. 2018;4(1):16-21.
2. Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. 1997;7(5):407-13.
3. Dennison EM, Harvey NC, Cooper C. Epidemiology of hip fracture: Worldwide geographic variation. Indian J Orthop. 2011;45(1):15-22.
4. Sharma A, Sethi A, Sharma S. Treatment of stable intertrochanteric fractures of the femur with proximal femoral nail versus dynamic hip screw: a comparative study. Rev Bras Ortop. 2018;53(4):477-81.
5. Brauer CA, Coca-Perraillon M, Cutler DM. Incidence and mortality of hip fractures in the United States. JAMA. 2009;302(14):1573-9.
6. Saudan M, Lubbeke A, Christophe S, Nicolas R, Richard S, Pierre H. Pertrochanteric fractures: Is there an advantage to an intramedullary nail? J Orthop Trauma. 2002;16(6):386-93.
7. Thusoo V, Nehru A, Sachin K, Arjun SC, Eshaan SS, Alok KV, et al. A comparative study of dynamic hip screws and proximal femoral nails in intertrochanteric fractures. Cureus. 2024;16(4):59063.
8. Figueras CG, Rio LTD, Laura GN, Jaume RB, Ramon HC. Traumatic hip dislocation in childhood. HIP Int. 2010;20(4):524-8.
9. Lil NA, Makwana VR, Patel TD, Patel AR. Comparative study of intertrochanteric fracture fixation using proximal femoral nail with and without distal interlocking screws. World J Orthoped. 2022;13(3):267-77.
10. Aygün Ü, Şenocak E, Mehmet FA, Ali CÇ, Orkun H, Serdar T. An overview of patients with intertrochanteric femoral fractures treated with proximal femoral nail fixation using important criteria. BMC Musculoskeletal Disorders. 2024;25(1):1051.
11. Dai P, Zhou H, Xiaoyu M, Chang L, Zhiwei W, Yifan K. Proximal femoral nail anti-rotation vs dynamic hip screws decrease the incidence of surgical site infections in patients with intertrochanteric fractures: A meta-analysis. Int Wound J. 2023;20(8):3212-20.
12. Wang C, Duan N, Zhong L, Teng M, Kun Z, Qian W, et al. Biomechanical evaluation of a new intramedullary nail compared with proximal femoral nail antirotation and InterTAN for the management of femoral intertrochanteric fractures. Front Bioengineering. 2024;12:1353677.
13. Tali MA, Ali et al. PFN versus DHS fixation in the management of intertrochanteric fractures. National J Clin Orthop. 2022;6(3):30-33.
14. Zhang, Y., Li J, Imtiyaz HD, Layeeq AL. Does intramedullary nail have advantages over dynamic hip screw in the treatment of intertrochanteric fractures? A meta-analysis. BMC Musculoskeletal Disorders. 2023;24:67-10.
15. Shiraz, S., Shujauddin, et al.: Comparison of dynamic hip screw and proximal femoral nailing techniques in stable intertrochanteric fractures. Cureus. 2023;15:33366-10.
16. Zhang K, Zhang S, Jun Y, Weiqiang D, Shengnan W, Yirong C, et al. Proximal femoral nail vs. dynamic hip screw in treatment of intertrochanteric fractures: A meta-analysis. Med Sci Monitor. 2014;20:1628-33.
17. Kumar A, Ramesh DJ, Baibhav KA. A comparative study between DHS and PFN for the treatment of intertrochanteric fractures. Int J Orthopaed Sci. 2020;6(1):653-7.
18. Lone BA, Mushtaq S, Shahid S. Comparative study on evaluation of results of DHS versus PFN in intertrochanteric fractures. Int J Orthopaed Sci. 2024;10(1):84-8.
19. Kunwar OP. Assessment of functional outcome in intertrochanteric fractures between dynamic hip screw and proximal femoral nailing: A comparative study. Zenodo. 2023;3(12):38-42.
20. Yeo QY. Proximal femoral nail antirotation II versus dynamic hip screw in stable intertrochanteric femur fractures: A randomized controlled trial. Malay Orthop J. 2025;19(1):86-91.
21. Kumar R, Singh RN, Singh BN. Comparative prospective study of proximal femoral nail and dynamic hip screw in treatment of intertrochanteric fracture femur. J Clin Orthop. 2012;3(1):23-8.
22. Singh S, Kumar M. Comparative study between proximal femoral nailing versus dynamic hip screw in intertrochanteric fractures. Int J Res Med Sci. 2023;9(11):845-50.
23. Yuan X, Yao Q, Jie N, Libin P, Daxin Y. Proximal femoral nail antirotation versus dynamic hip screw for intertrochanteric fracture in elders: A meta-analysis. Zhonghua Yi Xue Za Zhi. 2014;94(11):836-9.
24. Sharma R. Comparative evaluation of proximal femoral nail anti-rotation versus dynamic hip screw for stable intertrochanteric femoral fractures: A meta-analysis of clinical outcomes. J Musculoskel Surg Res. 2022;6:123-30.
25. Muhammad S, Shafi ul H, Majid H, Muhammad Q. Functional outcomes of proximal femoral nail versus dynamic hip screw in intertrochanteric fractures. Professional Med J. 2024;31(10):567-72.
26. Latheef MB, Sheth S, Basu A, Karnati AKR, Sadalagi P. Comparison of functional outcomes of pertrochanteric fractures of the femur managed with dynamic hip screw with a locking side plate versus proximal femoral nail. Int J Res Orthop. 2023;9(3):545-52.
27. Shukla R, Pathak P, Arpit Cl. Comparative analysis of functional and radiological outcome of proximal femoral nail versus dynamic hip screw in treatment of intertrochanteric fractures. J Orthop Traumatol Rehabilit. 2022;14(1):24-31.
28. Kumar R, Singh RN, Singh BN. Comparative study of functional outcome of the intertrochanteric fracture of femur managed by dynamic hip screw and proximal femoral nail. National J Clin Orthop. 2019;3(1):26-30.
29. Kumar R, Sujai S, Sushant B, Abhinav B, Prajwal S, Hemanth, Latheef MB. Prevalence of intertrochanteric fractures of the femur and comparison of radiological outcomes when managed

with proximal femoral nail vs. the dynamic hip screw with locking side plate in the Indian population. J Orthop. 2023;7(4):000251.
30. Prakash AK, Nagakumar JS, Shanthappa AH, Venkataraman S, Kamath A. A Comparative Study of Functional Outcome Following Dynamic Hip Screw and Proximal Femoral Nailing for Intertrochanteric Fractures of the Femur. Cureus. 2022;14(4):e23803.

Cite this article as: Patel D, Kalsariya S, Harsh P, Kakkad N, Parekh K, Dhrumil S, et al. Proximal femoral nail versus dynamic hip screw in treatment of intertrochanteric fractures: a systematic review. Int J Res Orthop 2025;11:1532-42.