

A Comprehensive Review on the Surgical Management of Femoral Neck Fractures: A Synthesis of Evidence for Internal Fixation Versus Joint Replacement

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Abstract: Current high-level evidence mandates a patient-stratified therapeutic strategy for femoral neck fractures, demonstrating that arthroplasty—particularly using cemented prostheses—significantly outperforms internal fixation (IF) regarding long-term functional outcomes and reoperation rates in elderly patients with displaced fractures. While Total Hip Arthroplasty (THA) yields superior functional results for active individuals or those with pre-existing arthritis, Hemiarthroplasty (HA) remains the optimal low-risk intervention for frail, low-demand patients. Conversely, IF is clinically indicated primarily for non-displaced fractures or physiologically young patients requiring femoral head preservation, despite a markedly higher risk of treatment failure secondary to nonunion and avascular necrosis. Consequently, surgical decision-making should be individualized based on physiological age, fracture displacement, and pre-injury functional demand to minimize complications and optimize quality of life.

1. Introduction and Overview of Treatment Landscape

Displaced femoral neck fractures in the elderly population present a formidable challenge to orthopedic surgery, demanding a treatment strategy that balances skeletal stability, functional restoration, and patient safety. For individuals who remain functionally active despite their advanced age, the therapeutic consensus has progressively shifted towards Joint Replacement as the optimal management approach. This preference is particularly pronounced with the adoption of contemporary cemented prostheses, which have been empirically demonstrated to produce superior functional outcomes and to significantly mitigate the need for subsequent reoperations when compared directly with internal fixation techniques. This prevailing clinical viewpoint is not based on anecdotal evidence but is instead underpinned by a robust body of high-quality research, including large-scale network meta-analyses and influential multicenter randomized controlled trials.

Nevertheless, it is crucial to recognize that internal fixation has not been rendered obsolete. This surgical approach maintains a well-defined and critical therapeutic role within carefully selected patient cohorts. Its application is most appropriate for physiologically young individuals,

where the biological potential for healing is greater, or for patients presenting with non-displaced fractures. In these specific clinical scenarios, the objective of preserving the native femoral head—thereby avoiding the long-term complications inherent to prosthetic joints—remains a clinically relevant and desirable goal. This review will synthesize the evidence guiding the selection between these divergent surgical philosophies.

2. Surgical Treatment Modalities and Approaches

The selection of a surgical intervention for a femoral neck fracture is a multifactorial decision, critically dependent on the specific characteristics of the fracture pattern and a host of patient-related factors. The available surgical options can be broadly categorized into two distinct philosophies: internal fixation, which aims to preserve the native bone, and Joint Replacement, which involves the replacement of the damaged joint.

Internal fixation encompasses a variety of techniques, including the use of multiple cannulated screws, pins, and dynamic hip screw (DHS) constructs. These methods are designed to stabilize the fracture fragments to facilitate biological healing. On the other hand, the spectrum of Joint Replacement options includes hemiJoint Replacement (HA), where only the femoral head is replaced, and total hip Joint Replacement (THA), where both the femoral head and the acetabular socket are replaced. HemiJoint Replacement itself presents further variations, such as unipolar versus bipolar designs and the choice between cemented and uncemented fixation. Similarly, total hip Joint Replacement has evolved to include advanced designs like single-articulation and dual-mobility components, which aim to enhance stability and longevity.

2.1. Internal Fixation

The primary methods employed for internal fixation of the femoral neck include the placement of multiple parallel cannulated screws, the application of a sliding hip screw (also known as a DHS), or the use of pins and supplementary screws. A significant advantage of these techniques, as consistently reported in clinical trials and meta-analyses, is that they are generally associated with a quicker surgical procedure and less intraoperative blood loss when compared to any form of Joint Replacement. This procedural efficiency can be particularly beneficial for patients with significant medical comorbidities who may be less able to tolerate prolonged anesthesia and extensive surgery. However, this benefit must be weighed against the biological risks of fixation failure [1] [2].

2.2. HemiJoint Replacement (HA)

HemiJoint Replacement is a joint replacement procedure that is frequently indicated for elderly patients who are frail or have a more limited life expectancy and ambulatory capacity. The primary goal in this cohort is often a reliable and expedient return to basic mobility with minimized surgical risk. The variants of hemiJoint Replacement include cemented versus uncemented stem fixation and unipolar versus bipolar articular designs. The selection among these is often guided by surgeon preference and institutional protocols. Notably, modern constructs utilizing cemented stems, whether unipolar or bipolar, have served as the principal comparator groups against other interventions in numerous large-scale clinical trials and comprehensive systematic reviews, establishing their role as a standard treatment option [2] [3].

2.3. Total Hip Joint Replacement (THA)

Total hip Joint Replacement is a more extensive procedure reserved for a distinct patient demographic. The primary indications for THA in the context of a femoral neck fracture include active older patients who have a high functional demand and a longer life expectancy [2].

Another key indication is the presence of coexisting, symptomatic hip arthritis, as THA addresses both the acute fracture and the underlying degenerative joint disease in a single intervention. The technological evolution of THA has led to various implant designs, including traditional single-articulation bearings and more recent dual-mobility components, the latter of which are engineered to reduce the risk of postoperative dislocation. The comparative effectiveness of these different designs has been a subject of evaluation in sophisticated network analyses [1] [2].

3. Principles of Patient Selection and Age-Related Considerations

The cornerstone of effective treatment for femoral neck fractures lies in meticulous patient selection. This process requires the surgeon to carefully balance a multitude of factors, including the patient's physiologic age (which may differ from their chronologic age), their level of mobility and independence before the fracture, their cognitive status, the degree of fracture displacement, and their overall life expectancy. The wealth of evidence from randomized clinical trials provides a strong basis for stratifying treatment recommendations across different patient populations[2][4].

A consistent finding from numerous trials and comprehensive meta-analyses is the superiority of Joint Replacement over internal fixation for displaced fractures in the older, active, and cognitively intact patient population. This strong recommendation is driven by the significantly lower rates of implant failure and subsequent reoperation, as well as by the more favorable functional outcomes observed in the medium term for patients receiving a joint replacement [2][4].

3.1. Nondisplaced Fractures in Older Patients (Age >65)

For the subgroup of older patients who sustain non-displaced or minimally displaced (valgus impacted) fractures, the treatment decision is more nuanced. However, a growing body of evidence derived from randomized trials and subsequent meta-analyses suggests that even in this group, hemiJoint Replacement (or Joint Replacement more broadly) can offer distinct advantages over internal fixation. Specifically, Joint Replacement has been shown to facilitate a more rapid early recovery, is associated with a lower incidence of implant-related complications (such as screw cut-out), and results in fewer reoperations being required down the line [5].

3.2. Displaced Fractures in Active Older Patients

In the context of active older adults with displaced fractures, the evidence is overwhelmingly in favor of Joint Replacement (either HA or THA) over internal fixation. Data from large-scale randomized controlled trials and comprehensive network meta-analyses consistently demonstrate that Joint Replacement yields superior functional recovery and a markedly lower rate of reoperations. Within the Joint Replacement category, there is compelling evidence to suggest that THA may be the preferred option for more active patients or for those who have pre-existing symptomatic osteoarthritis of the hip, as it provides a more durable and higher-performing joint replacement [2][6][1].

3.3. Patients Aged 55–70 with Low-Energy Displaced Fractures

A specific patient cohort that has been the focus of high-quality research is the "borderline" age group of 55 to 70 years old who sustain a low-energy displaced fracture. A landmark multicenter randomized controlled trial focusing on this demographic demonstrated decisively that THA resulted in better functional scores and a significantly lower number of major reoperations when compared to internal fixation [7]. This evidence strongly favors the use of THA for active and otherwise healthy patients who fall within this specific age bracket.

3.4. Young Patients (Age <55 or Clearly Biologically Young)

For younger patients, typically defined as those under the age of 55 or individuals who are biologically much younger than their chronological age, the treatment paradigm is less clear. The supplied body of literature does not contain robust, high-level randomized evidence to unequivocally support a single best surgical approach for this cohort. The desire to preserve the native femoral head is strong, given the patient's long life expectancy and the finite lifespan of a prosthetic joint. Consequently, specific treatment recommendations for this group are limited by the available data. Decision-making must be highly individualized, involving a detailed discussion with the patient about the risks and benefits of each option, and is currently based on insufficient evidence.

3.5. Clinical Selection Emphasis from High-Quality Syntheses

Synthesizing the highest quality evidence, a clear directive emerges: primary Joint Replacement should be strongly favored for displaced intracapsular fractures in patients who are fit, older, or have high functional demands. Internal fixation should only be considered in scenarios where the potential for biological healing and the clinical imperative of bone preservation are deemed to outweigh the well-documented and significantly higher risk of reoperation associated with this approach [2][1][4].

4. Comparative Analysis of Outcomes and Complications

This section provides a detailed summary and comparison of the key outcomes associated with the principal surgical approaches: internal fixation (using cannulated screws/pins or DHS), hemiJoint Replacement (HA), and total hip Joint Replacement (THA). The analysis covers operation-related metrics, postoperative function, reoperation rates, and common complications. The findings presented here are substantiated by an extensive body of evidence from randomized controlled trials and network meta-analyses that have rigorously evaluated these treatment strategies.

4.1. Comparative Outcomes Summary Table

A comparative analysis reveals a clear trade-off, where internal fixation offers shorter operative times and less blood loss, while Joint Replacement provides superior long-term function and lower reoperation rates. These key outcome comparisons are summarized in Table 1.

Table 1 Comparative Outcomes Summary

Outcome Domain	Internal Fixation (CS/pins/DHS)	HemiJoint Replacement (HA)	Total Hip Joint Replacement (THA)
Operation time	Shortest (fastest)	Intermediate	Longest on average
Intraoperative blood loss	Lowest	Higher than fixation	Highest
Early functional scores	Lower than Joint Replacement	Good	Best or modestly superior
Reoperation/failure risk	Highest	Lower than fixation	Lowest
Dislocation risk	Lowest	Lower	Higher (vs. HA)
Long-term pain/quality of life	Lower than Joint Replacement	Good	Often best

Note: Quantitative estimates and comparative rankings presented above are derived from randomized trial pools and network meta-analyses directly evaluating these four operative strategies [1][2][4].

4.2. Evidence Synthesis and Clinical Outcomes

A synthesis of high-certainty network meta-analyses and large-scale randomized controlled trials (RCTs) reveals a clear dichotomy between perioperative efficiency and long-term durability in hip fracture management [1,2,6].

4.3. Comparative Metrics and Failure Modes

Internal fixation (IF), particularly via percutaneous cannulated screws, minimizes surgical trauma and blood loss, offering a short-term advantage for medically fragile patients [1]. However, IF is associated with the highest reoperation rates—driven primarily by nonunion and avascular necrosis—and often results in inferior functional scores due to residual pain or limb shortening [1,4,8]. Conversely, arthroplasty (HA and THA) provides a more definitive solution. While THA achieves superior health-related quality of life (HRQoL) and functional metrics (HHS, WOMAC) compared to HA or IF, it carries a higher risk of early postoperative dislocation [1,2,6,7]. Notably, while arthroplasty reduces long-term complications, it does not demonstrate a clinically significant mortality benefit over fixation [2,6,9].

4.4. The Burden of Conversion and Secondary Intervention

A critical consideration in electing IF is the risk of conversion to total hip arthroplasty (cTHA) following failure. Data indicate that cTHA is technically more complex and associated with significantly higher rates of periprosthetic infection and intraoperative fracture compared to primary THA [10,11]. Therefore, IF should be avoided in patients with a high predicted risk of failure. Furthermore, while patients treated with arthroplasty achieve earlier functional recovery, the literature lacks standardized rehabilitation protocols, highlighting a need for future trials to integrate protocolized physiotherapy with surgical outcomes [2,6,7].

5. Integrated Clinical Recommendations

Recommendation 1: Arthroplasty as the Primary Modality for Displaced Fractures

For independent, cognitively intact older adults with displaced intracapsular fractures, arthroplasty (THA or HA) is strongly preferred over internal fixation [1,2,4].

Total Hip Arthroplasty (THA): Should be prioritized for active patients, those with a longer life expectancy, or those with pre-existing hip osteoarthritis, as it provides the highest functional ceiling and HRQoL [6,7].

Hemiarthroplasty (HA): A cemented HA is the treatment of choice for frail elderly patients with lower functional demands, offering a reliable return to mobility with reduced operative time and lower dislocation risk compared to THA [2].

Recommendation 2: Selective Joint Preservation and Risk Mitigation

Internal fixation should be reserved for non-displaced (Garden I–II) fractures or younger patients (<55 years) where preservation of the native femoral head is prioritized. Given the elevated risk of nonunion and the subsequent complexity of conversion surgery, these patients require rigorous radiographic surveillance and a transparent shared decision-making process regarding the potential for secondary arthroplasty [4,5,10,12].

Recommendation 3: Technical Optimization and Postoperative Care

To maximize implant longevity and patient safety, the following technical standards should be observed:

Fixation and Design: Modern cemented prosthetic designs are recommended for osteoporotic bone to ensure stable fixation and prevent periprosthetic failure [2].

Instability Prevention: In THA, surgeons should employ meticulous soft-tissue preservation and consider dual-mobility constructs for patients at high risk of dislocation [2,6].

Rehabilitation: Postoperative pathways must emphasize early weight-bearing and structured mobilization to capitalize on the stability provided by arthroplasty [6,7].

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