Cemented Bipolar Hemiarthroplasty for Femoral Neck Fractures in Osteoporotic Patients: An Evidence-Based Review

Adel Mohamed Salama, Mohamed Khaled Saleh, Gehad Mohamed Ali, Ahmed Hassan Zaki

Orthopedic Surgery Department, Faculty of Medicine, Zagazig University,

Corresponding Author: Gehad Mohamed Ali

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Abstract

Background: Femoral neck fractures represent a major public health concern, particularly among elderly osteoporotic patients, due to their association with high morbidity, mortality, and socioeconomic burden. Osteoporosis compromises bone quality, making internal fixation unreliable and increasing the risk of fixation failure, nonunion, and reoperation. Arthroplasty has therefore become the preferred treatment for displaced femoral neck fractures in this population. Among available options, cemented bipolar hemiarthroplasty has gained widespread acceptance due to its ability to provide immediate stability, allow early mobilization, and reduce implant-related complications in poor-quality bone. However, ongoing debate persists regarding its optimal indications, functional outcomes, and complication profile when compared with uncemented hemiarthroplasty and total hip arthroplasty. This review aims to critically evaluate the current evidence regarding the use of cemented bipolar hemiarthroplasty in the management of femoral neck fractures in osteoporotic patients. Specifically, it examines indications for cementation, biomechanical rationale, surgical considerations, functional and mortality outcomes, complication rates, and comparative effectiveness relative to alternative surgical options. A comprehensive review of peer-reviewed literature was conducted, focusing on randomized controlled trials, meta-analyses, cohort studies, and major orthopedic guidelines addressing cemented bipolar hemiarthroplasty for osteoporotic femoral neck fractures. Emphasis was placed on high-quality evidence reporting clinical outcomes, implant survival, perioperative complications, and patient-centered functional measures. The available evidence consistently demonstrates that cemented bipolar hemiarthroplasty provides superior early postoperative stability, improved pain control, and better functional recovery compared with uncemented stems in osteoporotic bone. Cemented fixation is associated with lower rates of periprosthetic fracture and implant loosening, although it carries specific risks such as bone cement implantation syndrome. Bipolar articulation offers theoretical advantages in reducing acetabular wear, though long-term benefits remain debated. Overall mortality rates appear comparable between cemented and uncemented techniques when appropriate perioperative precautions are employed.

Conclusion: Cemented bipolar hemiarthroplasty remains a reliable and evidence-supported treatment option for displaced femoral neck fractures in osteoporotic patients. When patient selection and surgical technique are optimized, it offers predictable outcomes with acceptable complication rates. Further high-quality studies are needed to refine patient-specific decision-making and optimize long-term outcomes.

Keywords: *Cemented Bipolar Hemiarthroplasty, Femoral Neck Fractures, Osteoporotic Patients*

Introduction

Femoral neck fractures are among the most serious fragility fractures encountered in orthopedic practice, predominantly affecting elderly patients with underlying osteoporosis. The global incidence of hip fractures continues to rise due to increasing life expectancy, with femoral neck fractures accounting for nearly half of all hip fractures. These injuries are associated with substantial morbidity, functional decline, loss of independence, and increased one-year mortality rates, which may exceed 20–30% in frail populations. Osteoporosis plays a central role in both the occurrence of these fractures and the challenges associated with their surgical management, as compromised bone quality adversely affects

implant fixation and healing potential [1].

The primary goals in the management of femoral neck fractures in osteoporotic patients include early mobilization, pain relief, restoration of function, and minimization of complications and reoperations. Internal fixation, while preserving the native hip joint, has demonstrated high failure rates in displaced femoral neck fractures in elderly osteoporotic patients due to nonunion, avascular necrosis, and implant cut-out. As a result, arthroplasty-based solutions have become the preferred treatment modality for displaced fractures in this population, supported by multiple clinical guidelines and randomized trials [2].

Hemiarthroplasty, as a surgical option, offers several advantages in elderly osteoporotic patients, including shorter operative time, reduced blood loss, and lower risk of dislocation when compared with total hip arthroplasty. Bipolar hemiarthroplasty was developed to address concerns related to acetabular cartilage wear observed with unipolar designs, incorporating an additional articulation intended to reduce acetabular stress. Although the long-term superiority of bipolar over unipolar hemiarthroplasty remains debated, bipolar implants are widely used in clinical practice for femoral neck fractures due to favorable early functional outcomes and surgeon familiarity [3].

Fixation method of the femoral stem represents a critical determinant of success in osteoporotic bone. Cemented fixation provides immediate implant stability, improved load distribution, and enhanced pain control, particularly in patients with poor proximal femoral bone stock. In contrast, uncemented stems rely on bone ingrowth for stability, which may be unreliable in osteoporotic patients and is associated with higher rates of periprosthetic fracture and early loosening. Several randomized controlled trials and registry-based studies have demonstrated superior functional outcomes and lower revision rates with cemented hemiarthroplasty in elderly patients with femoral neck fractures [4].

Despite these advantages, concerns persist regarding the use of bone cement, particularly the risk of bone cement implantation syndrome (BCIS), which can lead to intraoperative hypoxia, hypotension, and, in severe cases, cardiovascular collapse. These risks have prompted ongoing debate regarding the routine use of cemented fixation, especially in patients with significant cardiopulmonary comorbidities. Advances in anesthetic management, surgical technique, and patient optimization have significantly reduced the incidence and severity of BCIS, allowing cemented hemiarthroplasty to remain a safe option when appropriate precautions are implemented [5].

Although cemented bipolar hemiarthroplasty is widely practiced, variability remains in patient selection, implant choice, and perioperative protocols. Additionally, controversy persists regarding its comparative effectiveness relative to uncemented hemiarthroplasty and total hip arthroplasty in terms of functional outcomes, complication rates, and mortality in osteoporotic patients. Many studies focus on mixed populations, limiting the applicability of their conclusions specifically to osteoporotic bone. This highlights the need for an evidence-based synthesis focusing on cemented bipolar hemiarthroplasty in this high-risk group [6].

Aim of the Review:

The aim of this evidence-based review is to critically evaluate the role of cemented bipolar hemiarthroplasty in the management of femoral neck fractures in osteoporotic patients, with particular emphasis on indications, biomechanical rationale, clinical outcomes, complications, and comparison with alternative surgical strategies.

Epidemiology and Burden of Femoral Neck Fractures in Osteoporotic Patients

Femoral neck fractures constitute a significant proportion of hip fractures worldwide and are predominantly encountered in elderly patients with osteoporosis. The global incidence of hip fractures is expected to increase substantially with the aging population, with projections estimating a rise to over six million cases annually by the middle of this century. Osteoporotic femoral neck fractures typically result from low-energy trauma, such as falls from standing height, reflecting reduced bone mineral density and impaired trabecular architecture. These fractures present considerable challenges for orthopedic management due to compromised bone strength and limited capacity for biological fixation [7].

The burden of femoral neck fractures extends beyond the immediate orthopedic injury and is associated with substantial mortality and morbidity. One-year mortality rates following hip fracture remain high, particularly among elderly patients with osteoporosis and multiple comorbidities, with reported rates approaching 30%. Survivors often experience long-term functional impairment, chronic pain, and reduced mobility, frequently leading to loss of independence and institutionalization. Osteoporosis further compounds this burden by increasing the likelihood of subsequent fragility fractures, thereby amplifying the cumulative impact on patient health and quality of life [8].

Femoral neck fractures also impose a considerable socioeconomic burden on healthcare systems worldwide. Direct costs include surgical intervention, inpatient hospitalization, and postoperative rehabilitation, while indirect costs arise from long-term disability, need for social support, and caregiver dependence. Studies have demonstrated that complications and revision surgeries substantially increase overall treatment costs. Surgical strategies that reduce reoperation rates and facilitate early mobilization, such as cemented hemiarthroplasty, are therefore increasingly emphasized as cost-effective solutions in osteoporotic populations [9].

Osteoporosis influences not only fracture incidence but also fracture morphology and displacement patterns. Displaced intracapsular femoral neck fractures are more frequently observed in osteoporotic bone and are associated with disruption of femoral head blood supply, significantly reducing the likelihood of fracture union. These pathophysiological characteristics limit the success of internal fixation and support the widespread adoption of arthroplasty-based treatments for displaced fractures in elderly osteoporotic patients [10].

An understanding of the epidemiological trends and disease burden associated with osteoporotic femoral neck fractures is essential for informed surgical decision-making. Despite clear evidence supporting arthroplasty in this population, variations in practice patterns persist due to differences in surgeon preference, patient factors, and healthcare infrastructure. This variability underscores the importance of evidence-based evaluations focusing specifically on cemented bipolar hemiarthroplasty as a reliable and reproducible treatment option in osteoporotic patients [11].

Pathophysiology of Osteoporotic Femoral Neck Fractures and Implications for Surgical Management

Osteoporosis is characterized by reduced bone mineral density and deterioration of bone microarchitecture, resulting in increased skeletal fragility and susceptibility to fractures. In the proximal femur, these changes lead to thinning of cortical bone and loss of trabecular connectivity, particularly within the femoral neck region. This structural weakening predisposes elderly patients to intracapsular fractures following low-energy trauma and significantly compromises the mechanical environment required for stable fracture fixation and biological healing [12].

The intracapsular location of femoral neck fractures has important pathophysiological implications, particularly with regard to femoral head vascularity. Displaced fractures are frequently associated with disruption of the retinacular vessels arising from the medial femoral circumflex artery, leading to ischemia of the femoral head. In osteoporotic patients, this vascular compromise is exacerbated by diminished regenerative capacity and impaired osteogenic potential, substantially increasing the risks of nonunion and avascular necrosis following internal fixation [13].

Bone quality plays a critical role in determining the success of surgical implants used in femoral neck fracture management. Osteoporotic bone provides poor purchase for screws and uncemented prosthetic stems, increasing the likelihood of implant migration, loosening, and periprosthetic fracture. These biomechanical limitations have been consistently demonstrated in both clinical and biomechanical studies, highlighting the challenges associated with achieving durable fixation in severely osteoporotic proximal femoral bone [14].

The altered load transfer characteristics in osteoporotic femurs further complicate surgical management. Reduced cortical thickness and widened medullary canals diminish the capacity of uncemented stems to achieve press-fit stability, leading to micromotion at the bone–implant interface. Cemented fixation addresses these issues by distributing load more evenly along the femoral canal and providing immediate

mechanical stability, which is particularly advantageous in osteoporotic patients who require early weight-bearing to minimize medical complications [15].

Fracture displacement, bone fragility, and compromised biology collectively explain the inferior outcomes associated with internal fixation in elderly osteoporotic patients. High rates of fixation failure, reoperation, and prolonged immobilization have been reported in this population, prompting a paradigm shift toward arthroplasty-based solutions. Cemented bipolar hemiarthroplasty aligns with the pathophysiological realities of osteoporotic femoral neck fractures by bypassing the need for fracture healing and providing a stable construct that facilitates early mobilization [16].

Understanding the underlying pathophysiology of osteoporotic femoral neck fractures is essential for tailoring surgical strategies to patient-specific factors. Recognition of poor bone stock, limited healing capacity, and vascular compromise supports the rationale for cemented stem fixation and arthroplasty in appropriately selected patients. These considerations form the foundation for evaluating the clinical effectiveness and safety of cemented bipolar hemiarthroplasty in the osteoporotic population [17].

Rationale for Hemiarthroplasty in Osteoporotic Femoral Neck Fractures

Hemiarthroplasty has become a widely accepted treatment option for displaced femoral neck fractures in elderly osteoporotic patients due to its ability to provide reliable pain relief and facilitate early mobilization. Unlike internal fixation, hemiarthroplasty eliminates the need for fracture healing, which is often compromised in osteoporotic bone. Early weight-bearing following surgery is particularly important in this population to reduce the risk of medical complications such as pneumonia, thromboembolism, and pressure ulcers, which are closely associated with prolonged immobilization [18].

Clinical trials and meta-analyses have consistently demonstrated higher reoperation rates following internal fixation compared with hemiarthroplasty in elderly patients with displaced femoral neck fractures. Fixation failure due to nonunion or avascular necrosis often necessitates secondary arthroplasty, exposing patients to additional surgical trauma and increased morbidity. In contrast, primary hemiarthroplasty offers a definitive solution with lower rates of revision surgery, making it a preferred strategy in osteoporotic patients with limited physiological reserve [19].

When compared with total hip arthroplasty, hemiarthroplasty offers several advantages in the elderly osteoporotic population. These include shorter operative time, reduced intraoperative blood loss, and a lower risk of postoperative dislocation. While total hip arthroplasty may provide superior functional outcomes in younger, more active patients, the functional demands and life expectancy of many osteoporotic patients make hemiarthroplasty a more appropriate and pragmatic choice in routine clinical practice [20].

The choice between unipolar and bipolar hemiarthroplasty designs has been the subject of ongoing debate. Bipolar hemiarthroplasty incorporates an additional articulation between the prosthetic head and shell, theoretically reducing acetabular cartilage wear by allowing motion at the inner bearing. Although long-term differences in acetabular erosion remain inconclusive, bipolar implants are commonly favored due to perceived improvements in range of motion and reduced acetabular stress in the early postoperative period [21].

Patient-related factors such as advanced age, reduced mobility, cognitive impairment, and comorbidities further support the use of hemiarthroplasty in osteoporotic femoral neck fractures. These patients often prioritize pain relief and the ability to perform basic activities of daily living over high-demand functional outcomes. Hemiarthroplasty reliably meets these goals while minimizing surgical complexity and postoperative risks, particularly when combined with cemented femoral stem fixation [22].

Overall, the rationale for hemiarthroplasty in osteoporotic femoral neck fractures is grounded in both biological and functional considerations. By providing immediate stability and predictable outcomes, hemiarthroplasty addresses the limitations of internal fixation and avoids the potential complications associated with more extensive reconstructive procedures. Cemented bipolar hemiarthroplasty, in particular, represents a balanced approach that aligns surgical strategy with the physiological realities of osteoporotic bone [23].

Cemented Versus Uncemented Fixation in Osteoporotic Bone

The method of femoral stem fixation is a critical determinant of outcome in hemiarthroplasty for osteoporotic femoral neck fractures. Osteoporotic bone is characterized by reduced cortical thickness and an expanded medullary canal, which compromises the ability of uncemented stems to achieve stable press-fit fixation. As a result, uncemented implants are more susceptible to early micromotion, subsidence, and mechanical failure in elderly patients with poor bone quality [24].

Cemented fixation offers several biomechanical advantages in osteoporotic femurs by providing immediate stem stability and uniform load transfer along the femoral canal. Polymethylmethacrylate cement acts as a grout rather than an adhesive, filling voids within the cancellous bone and improving the interface between the implant and host bone. This enhanced stability translates into improved early postoperative pain control and facilitates early mobilization, which is essential for reducing medical complications in frail elderly patients [25].

Randomized controlled trials comparing cemented and uncemented hemiarthroplasty have consistently demonstrated superior functional outcomes with cemented stems in elderly patients with femoral neck fractures. Patients receiving cemented implants report lower thigh pain scores and improved mobility in the early postoperative period. Additionally, registry-based studies have shown lower revision rates associated with cemented fixation, particularly in osteoporotic populations where implant stability is a primary concern [26].

Uncemented hemiarthroplasty has been associated with a higher incidence of intraoperative and postoperative periprosthetic fractures, especially in elderly women with severe osteoporosis. The force required to achieve press-fit fixation in fragile bone increases the risk of iatrogenic fracture during stem insertion. In contrast, cemented stems allow controlled implantation without excessive hoop stress on the femoral cortex, thereby reducing the risk of periprosthetic fracture [27].

Despite its advantages, cemented fixation carries specific risks, most notably bone cement implantation syndrome, which may manifest as hypoxia, hypotension, or cardiovascular collapse during cementation. However, evidence suggests that with modern cementing techniques, appropriate patient selection, and close anesthetic monitoring, the incidence of severe complications is low. Several large cohort studies have demonstrated no significant difference in overall mortality between cemented and uncemented hemiarthroplasty when perioperative protocols are optimized [28].

Current clinical guidelines from major orthopedic associations recommend cemented femoral stems for hemiarthroplasty in elderly patients with femoral neck fractures, particularly those with osteoporotic bone. These recommendations are based on robust evidence demonstrating improved functional outcomes and reduced complication rates. As such, cemented fixation has become the standard of care in many centers for the management of osteoporotic femoral neck fractures [29].

Bipolar Versus Unipolar Hemiarthroplasty: Design Rationale and Clinical Evidence

Unipolar hemiarthroplasty was historically the first arthroplasty option used for femoral neck fractures and consists of a single fixed prosthetic head articulating directly with the native acetabulum. While this design offers simplicity and lower implant cost, concerns have been raised regarding accelerated acetabular cartilage wear due to direct metal–cartilage articulation. In osteoporotic elderly patients, progressive acetabular erosion may contribute to pain, reduced function, and the eventual need for conversion to total hip arthroplasty, particularly in those with longer life expectancy [30].

Bipolar hemiarthroplasty was developed to address these limitations by incorporating a dual-articulation mechanism, consisting of an inner bearing between the prosthetic head and shell and an outer bearing between the shell and acetabulum. This design theoretically reduces acetabular wear by allowing motion to occur preferentially at the inner articulation, thereby decreasing shear forces transmitted to the acetabular cartilage. Biomechanical studies have demonstrated that bipolar implants distribute motion across both articulations, particularly during low-demand activities common in elderly patients [31].

Clinical studies comparing bipolar and unipolar hemiarthroplasty have reported mixed results regarding functional outcomes and acetabular erosion. Several randomized controlled trials have shown modest improvements in hip function and range of motion with bipolar implants in the early postoperative

period. However, long-term follow-up studies suggest that motion at the inner bearing may decrease over time, effectively converting the bipolar implant into a unipolar construct, particularly in low-activity elderly patients [32].

Acetabular erosion remains a key concern when selecting hemiarthroplasty design. Radiographic studies have suggested lower rates of acetabular wear with bipolar hemiarthroplasty compared with unipolar designs, although the clinical significance of this finding remains debated. In osteoporotic patients with limited ambulatory demands, the reduced activity level may mitigate the impact of acetabular wear, making the theoretical advantages of bipolar implants more relevant in patients with relatively preserved mobility and life expectancy [33].

From a complication standpoint, bipolar hemiarthroplasty has not been associated with increased rates of dislocation, infection, or revision compared with unipolar hemiarthroplasty. The larger effective head size of bipolar implants may contribute to improved joint stability, which is particularly advantageous in elderly patients with compromised soft tissue integrity. Registry data have demonstrated comparable survival rates between bipolar and unipolar hemiarthroplasty, with implant choice often guided by surgeon preference and institutional practice [34].

In the context of osteoporotic femoral neck fractures, bipolar hemiarthroplasty offers a balanced approach by combining reliable pain relief with a potential reduction in acetabular cartilage stress. While definitive long-term superiority over unipolar designs has not been conclusively established, the widespread use of bipolar implants reflects their favorable early outcomes and acceptable complication profile. When combined with cemented fixation, bipolar hemiarthroplasty provides a stable and durable solution tailored to the biomechanical and functional needs of osteoporotic patients [35].

Surgical Technique and Cementation Considerations in Osteoporotic Patients

Successful outcomes following cemented bipolar hemiarthroplasty depend heavily on meticulous surgical technique, particularly in osteoporotic patients with fragile bone. Preoperative planning should include careful assessment of femoral canal morphology, bone quality, and fracture pattern using radiographs and, when necessary, advanced imaging. Adequate templating assists in appropriate stem selection and minimizes intraoperative complications such as femoral perforation or malalignment, which are more likely in osteoporotic femurs with widened canals and thin cortices [36].

Surgical exposure is commonly achieved through posterior, anterolateral, or direct lateral approaches, each with specific advantages and risks. While no single approach has demonstrated clear superiority in hemiarthroplasty for femoral neck fractures, attention to soft tissue handling and restoration of femoral offset is essential for optimizing joint stability and functional outcome. In osteoporotic patients, preservation of abductor function is particularly important, as muscle weakness may exacerbate postoperative gait disturbances and increase fall risk [37].

Cementation technique plays a pivotal role in achieving durable femoral stem fixation. Modern third-generation cementing techniques, including pulsatile lavage, intramedullary canal drying, use of distal cement restrictors, and retrograde cement insertion, have been shown to improve cement–bone interdigitation and implant stability. These measures are especially critical in osteoporotic bone, where cancellous structure is compromised and adequate cement penetration is required to achieve a stable interface [38].

Stem alignment and positioning are crucial determinants of long-term implant performance. Varus malalignment increases the risk of mechanical failure and periprosthetic fracture, while improper version may predispose to instability and dislocation. Cemented stems allow controlled positioning within the femoral canal, reducing the reliance on bone quality for alignment and enabling the surgeon to optimize biomechanics even in severely osteoporotic patients [39].

Bone cement implantation syndrome remains a concern during cemented hemiarthroplasty, particularly in elderly patients with cardiopulmonary disease. Preventive strategies include thorough medullary canal lavage, venting techniques to reduce intramedullary pressure, careful pressurization of cement, and close communication with the anesthesia team during cementation. Evidence indicates that adherence to these protocols significantly reduces the incidence and severity of intraoperative hemodynamic disturbances

[40].

Postoperative protocols following cemented bipolar hemiarthroplasty emphasize early mobilization and weight-bearing as tolerated. Immediate stability provided by cemented fixation enables rapid initiation of physiotherapy, which is critical for minimizing medical complications and restoring function. In osteoporotic patients, early mobilization also plays a key role in reducing the risk of secondary fractures and maintaining overall musculoskeletal health [41].

Clinical and Functional Outcomes of Cemented Bipolar Hemiarthroplasty in Osteoporotic Patients

Clinical outcomes following cemented bipolar hemiarthroplasty in osteoporotic patients have been widely reported to be favorable, particularly with respect to pain relief and early functional recovery. Multiple randomized controlled trials have demonstrated that patients undergoing cemented hemiarthroplasty experience significantly less postoperative thigh pain compared with those receiving uncemented stems. This improvement is attributed to enhanced implant stability and reduced micromotion at the bone–implant interface, which is especially important in osteoporotic bone with limited load-bearing capacity [42].

Early mobilization is a key determinant of functional recovery in elderly patients with femoral neck fractures. Cemented bipolar hemiarthroplasty allows immediate or early full weight-bearing in most cases, facilitating faster return to ambulation and reducing the duration of hospital stay. Studies assessing mobility scores, such as the Harris Hip Score and Timed Up and Go test, have consistently shown superior early functional outcomes in patients treated with cemented fixation compared with uncemented techniques in osteoporotic populations [43].

Longitudinal studies evaluating mid- to long-term outcomes have reported sustained functional benefits following cemented bipolar hemiarthroplasty. Although some decline in function is expected due to aging and comorbidities, implant-related factors rarely account for functional deterioration. Prosthesis survival rates remain high, with low incidences of aseptic loosening or mechanical failure, reinforcing the durability of cemented stems in osteoporotic bone [44].

Quality of life measures, including patient-reported outcome scores, further support the effectiveness of cemented bipolar hemiarthroplasty. Patients frequently report improved pain control, increased confidence in ambulation, and enhanced ability to perform activities of daily living. These outcomes are particularly meaningful in osteoporotic patients, where treatment goals often focus on maintaining independence rather than achieving high-demand athletic function [45].

Comparative studies between bipolar hemiarthroplasty and total hip arthroplasty in elderly osteoporotic patients suggest that while total hip arthroplasty may offer marginally better functional scores in selected active individuals, cemented bipolar hemiarthroplasty provides comparable outcomes with fewer complications in the majority of patients. This balance between functional benefit and surgical risk further supports the role of cemented bipolar hemiarthroplasty as a pragmatic treatment option in routine clinical practice [46].

Overall, the clinical and functional outcomes of cemented bipolar hemiarthroplasty in osteoporotic patients are consistently positive across diverse healthcare settings. Reliable pain relief, early mobilization, and durable implant performance make this procedure well suited to the physiological and functional demands of elderly patients with femoral neck fractures. These outcomes form a critical component of the evidence base supporting its continued use in this high-risk population [47].

Complications and Risk Profile of Cemented Bipolar Hemiarthroplasty

Complications following cemented bipolar hemiarthroplasty can be broadly categorized into intraoperative, early postoperative, and late complications. Intraoperative complications include femoral fractures, cement-related hemodynamic instability, and technical errors related to stem positioning. Osteoporotic bone is particularly vulnerable to iatrogenic injury; however, cemented fixation has been shown to reduce the incidence of intraoperative periprosthetic fractures compared with uncemented stems by minimizing hoop stresses during implantation [48].

Bone cement implantation syndrome (BCIS) remains one of the most significant concerns associated

with cemented hemiarthroplasty. BCIS is characterized by hypoxia, hypotension, cardiac arrhythmias, and, in severe cases, cardiovascular collapse occurring during or immediately after cementation. Elderly patients with femoral neck fractures are at increased risk due to advanced age, cardiopulmonary comorbidities, and the embolic load generated during cement pressurization. Despite these risks, large observational studies have demonstrated that severe BCIS is relatively uncommon when modern cementing techniques and perioperative precautions are employed [49].

Postoperative medical complications such as deep vein thrombosis, pulmonary embolism, pneumonia, and urinary tract infections are common in elderly patients following hip fracture surgery. Early mobilization enabled by the immediate stability of cemented bipolar hemiarthroplasty plays a critical role in reducing the incidence of these complications. Evidence suggests that delayed ambulation is a stronger predictor of medical morbidity than the choice of implant itself, emphasizing the indirect protective effect of cemented fixation through facilitation of early rehabilitation [50].

Surgical site complications, including infection and wound-related problems, have been reported at comparable rates between cemented and uncemented hemiarthroplasty. Osteoporotic patients often present with compromised immune function and nutritional status, which may increase susceptibility to infection. However, cemented fixation does not appear to independently increase infection risk, and some studies suggest that antibiotic-loaded cement may provide a protective effect against deep periprosthetic infection in high-risk populations [51].

Dislocation following hemiarthroplasty is less common than after total hip arthroplasty but remains a clinically relevant complication. Bipolar hemiarthroplasty is associated with low dislocation rates, potentially due to the larger effective head size and increased jump distance. Risk factors for dislocation include posterior surgical approach, inadequate restoration of femoral offset, and cognitive impairment. Cemented fixation facilitates accurate stem positioning, which may contribute to improved joint stability in osteoporotic patients [52].

Late complications such as acetabular erosion and prosthetic loosening are important considerations in long-term survivors. Although bipolar designs were developed to reduce acetabular wear, erosion may still occur over time, particularly in more active patients. Nonetheless, the rate of symptomatic acetabular erosion requiring revision surgery remains low in elderly osteoporotic populations, and aseptic loosening of cemented stems is uncommon due to the favorable load distribution achieved with cemented fixation [53].

Overall mortality following cemented bipolar hemiarthroplasty has been extensively studied, with most large-scale analyses demonstrating no significant difference in short- or long-term mortality when compared with uncemented hemiarthroplasty. Mortality is more closely related to patient-specific factors such as age, comorbidities, and pre-fracture functional status rather than implant choice. These findings support the continued use of cemented bipolar hemiarthroplasty as a safe option when appropriate perioperative management is applied [54].

Comparison With Total Hip Arthroplasty in Osteoporotic Femoral Neck Fractures

Total hip arthroplasty has been advocated as an alternative to hemiarthroplasty for displaced femoral neck fractures, particularly in physiologically young and active patients. The rationale for total hip arthroplasty lies in its potential to provide superior functional outcomes, improved hip biomechanics, and reduced risk of acetabular erosion. However, in elderly osteoporotic patients, these theoretical advantages must be balanced against increased surgical complexity, longer operative time, and higher risk of complications, which may outweigh functional gains in this population [55].

Randomized controlled trials comparing total hip arthroplasty and hemiarthroplasty in elderly patients with femoral neck fractures have demonstrated modest functional advantages with total hip arthroplasty, primarily in selected patients with high pre-fracture mobility and cognitive independence. Nevertheless, these benefits are less pronounced in osteoporotic patients with limited functional demands. In contrast, cemented bipolar hemiarthroplasty has been shown to provide reliable pain relief and acceptable functional outcomes while minimizing perioperative risks, making it more suitable for the majority of elderly osteoporotic patients [56].

Dislocation remains a major concern following total hip arthroplasty for femoral neck fractures. Elderly osteoporotic patients often have compromised soft tissue tension, muscle weakness, and impaired balance, all of which increase instability risk. Several studies have reported significantly higher dislocation rates following total hip arthroplasty compared with hemiarthroplasty in fracture settings. Bipolar hemiarthroplasty, with its larger effective head size, offers enhanced stability and lower dislocation risk, an important consideration in cognitively impaired or frail patients [57].

Operative time and blood loss are consistently greater with total hip arthroplasty compared with hemiarthroplasty. Prolonged surgery increases the risk of perioperative complications such as blood transfusion, infection, and cardiopulmonary events, particularly in osteoporotic patients with multiple comorbidities. Cemented bipolar hemiarthroplasty offers a shorter, less invasive procedure while still achieving the primary goals of fracture management, including pain control and early mobilization [58].

Revision surgery following femoral neck fracture is a critical outcome measure, particularly in elderly patients with limited physiological reserve. While total hip arthroplasty may reduce the need for later conversion due to acetabular erosion, revision rates following cemented bipolar hemiarthroplasty remain low in osteoporotic populations due to limited life expectancy and activity level. Registry data indicate comparable implant survival between the two procedures when appropriate patient selection criteria are applied [59].

Clinical guidelines increasingly emphasize individualized treatment strategies based on patient age, bone quality, cognitive status, and pre-fracture functional level. In elderly osteoporotic patients, cemented bipolar hemiarthroplasty is frequently recommended as the preferred option due to its favorable balance of functional outcome, safety profile, and surgical efficiency. Total hip arthroplasty is best reserved for carefully selected patients with good bone stock, high functional demands, and longer anticipated survival [60].

Current Guidelines and Evidence-Based Recommendations

International orthopedic guidelines consistently support arthroplasty as the preferred treatment for displaced femoral neck fractures in elderly patients with osteoporosis. Organizations such as the National Institute for Health and Care Excellence and the American Academy of Orthopaedic Surgeons emphasize the importance of selecting surgical strategies that allow immediate stability and early mobilization. Cemented hemiarthroplasty is specifically recommended in patients with poor bone quality, as cemented fixation has been shown to reduce pain and improve functional recovery compared with uncemented stems [61].

Guideline recommendations are largely informed by randomized controlled trials and national registry data demonstrating superior outcomes with cemented fixation in elderly fracture patients. These data show lower rates of revision surgery, reduced risk of periprosthetic fracture, and improved early postoperative mobility. Bipolar hemiarthroplasty is commonly included within these recommendations due to its acceptable complication profile and widespread clinical use, particularly in patients with limited functional demands [62].

Patient selection remains a central theme in evidence-based recommendations. Guidelines stress the importance of considering age, bone quality, cognitive status, comorbidities, and pre-fracture mobility when choosing between hemiarthroplasty and total hip arthroplasty. In osteoporotic patients with reduced life expectancy or limited ambulatory capacity, cemented bipolar hemiarthroplasty is frequently identified as the most appropriate intervention due to its balance of durability and safety [63].

Perioperative management protocols are also emphasized in current recommendations to optimize outcomes following cemented hemiarthroplasty. These include multidisciplinary orthogeriatric care, early surgery within 24–48 hours of admission, thromboprophylaxis, and aggressive postoperative rehabilitation. Such protocols have been shown to improve functional outcomes and reduce complications, reinforcing the effectiveness of cemented bipolar hemiarthroplasty within a comprehensive care pathway [64].

Despite strong guideline support, variations in practice persist across institutions and regions, often influenced by surgeon preference, training, and resource availability. Ongoing education and

dissemination of evidence-based recommendations are essential to standardize care and ensure that osteoporotic patients with femoral neck fractures receive optimal treatment. Cemented bipolar hemiarthroplasty remains a cornerstone of guideline-endorsed management in this population [65].

Conclusion

Cemented bipolar hemiarthroplasty represents a well-established and evidence-supported treatment option for displaced femoral neck fractures in osteoporotic patients. The unique challenges posed by osteoporotic bone, including poor implant fixation potential and limited biological healing capacity, necessitate surgical strategies that prioritize immediate stability and early mobilization. Cemented fixation effectively addresses these challenges by providing reliable stem stability, improved pain control, and predictable functional recovery in a vulnerable patient population.

From a biomechanical and clinical perspective, bipolar hemiarthroplasty offers a pragmatic balance between surgical simplicity and functional effectiveness. While long-term advantages over unipolar designs remain a subject of debate, bipolar implants provide acceptable early outcomes, low dislocation rates, and potential reduction in acetabular stress. When combined with cemented fixation, this approach aligns closely with the primary goals of treatment in elderly osteoporotic patients—namely, restoration of mobility, reduction of morbidity, and maintenance of independence.

Comparative evidence indicates that cemented bipolar hemiarthroplasty delivers outcomes that are comparable or superior to alternative surgical options for most osteoporotic patients, particularly when weighed against the increased risks associated with uncemented stems or total hip arthroplasty. Careful patient selection, meticulous surgical technique, and adherence to modern perioperative protocols are essential to optimizing outcomes and minimizing complications such as bone cement implantation syndrome.

In conclusion, cemented bipolar hemiarthroplasty should remain a cornerstone in the management of osteoporotic femoral neck fractures. Its continued use is strongly supported by current evidence and clinical guidelines, offering a reliable, safe, and effective solution tailored to the physiological and functional needs of this high-risk population.

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