

Review Article

Cemented Versus Uncemented Hemiarthroplasty for Displaced Femoral Neck Fractures in the Elderly

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Abstract

Background: Displaced femoral neck fractures in the elderly are increasingly treated with hemiarthroplasty, but whether the femoral stem should be cemented or uncemented remains debated because of concerns about bone cement implantation syndrome versus periprosthetic fracture.

Objective: To synthesise randomized trial, registry, and meta-analytic evidence comparing cemented and uncemented hemiarthroplasty.

Methods: Narrative review of randomized trials, arthroplasty registries, meta-analyses, and guideline statements.

Findings: The largest trial (1,125 patients) found cemented fixation reduced periprosthetic fracture (0.5% vs 2.1%) and improved quality of life at four months, with a non-significant mortality trend favouring cemented fixation (23.9% vs 27.8% at one year). Meta-analyses corroborate fewer periprosthetic complications and better function with cemented stems, at the cost of longer operative time and a small risk of bone cement implantation syndrome.

Conclusions: Cemented hemiarthroplasty is now favoured by most guidelines and registries for elderly patients with displaced femoral neck fractures.

Keywords: Hemiarthroplasty; Femoral neck fracture; Bone cements; Hip fractures; Bone cement implantation syndrome

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Keywords: hemiarthroplasty; femoral neck fracture; bone cements; hip fractures; bone cement implantation syndrome; periprosthetic fracture

Introduction

Fragility fractures of the femoral neck are among the most common injuries in orthopaedic trauma practice, and their incidence continues to rise as populations age. For displaced intracapsular fractures in older, lower-demand patients, hemiarthroplasty remains the dominant surgical treatment, offering a shorter operation than total hip arthroplasty while restoring mobility better than internal fixation. A persistent question is whether the femoral component should be fixed with polymethylmethacrylate bone cement or implanted uncemented, relying on

press-fit or bioactive coating for osseointegration. This choice matters clinically: cementation carries a small but real risk of bone cement implantation syndrome (BCIS) — hypoxia, hypotension, and occasionally cardiac arrest at cement pressurisation and stem insertion — whereas uncemented fixation avoids this physiological insult but carries a materially higher risk of intraoperative and early postoperative periprosthetic fracture, particularly in osteoporotic bone.

Historically, uncemented fixation was often preferred in frail patients to avoid the perceived cardiopulmonary risk of cementation, a rationale reinforced by early reports of intraoperative cardiac arrest during cementing [1]; the trade-off between fixation stability and cementing-related cardiopulmonary events was already noted in comparative work from the mid-1980s [2]. However, registry data and adequately powered randomized trials accumulated over the past decade have substantially clarified this balance, generally favouring cemented fixation while confirming that severe, clinically consequential BCIS is uncommon with modern cementing technique. This review synthesises randomized trial evidence, national registry data, meta-analyses, and guideline recommendations regarding cemented versus uncemented hemiarthroplasty, addressing intraoperative complications, mortality, functional outcomes, reoperation, and cost.

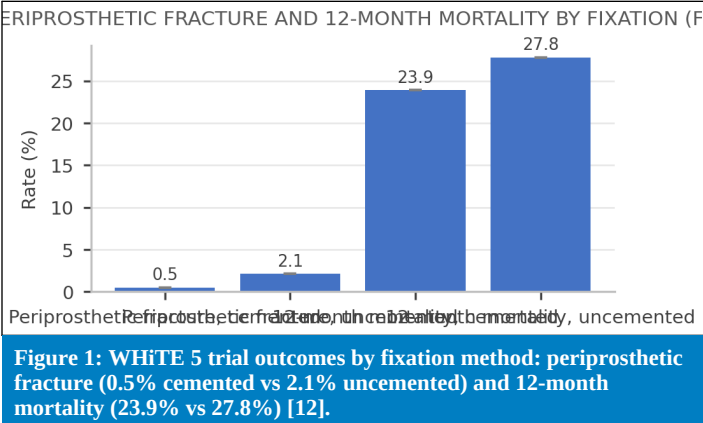
Randomized Controlled Trial Evidence

The earliest adequately designed randomized trial directly comparing cemented and uncemented hemiarthroplasty for displaced femoral neck fractures was conducted by Figved and colleagues, who randomized 220 patients aged 70 years or older to a cemented or uncemented Charnley-Hastings prosthesis and found better hip function and quality of life with cemented fixation at four months, without a mortality difference (Table 1) [3].

Five-year follow-up confirmed durability of the functional advantage, with no excess of late cement-attributable complications [4]. Contemporaneous trials by DeAngelis and colleagues (100 patients) and Khan and colleagues (400 patients) similarly found no mortality disadvantage with cementing while raising concern about intraoperative fracture with uncemented stems [5,6]. Parker and colleagues' earlier 400-patient trial found a higher femoral shaft fracture rate with the uncemented Austin-Moore-type implant and recommended cemented fixation for routine use, a conclusion strengthened by the same group's more recent 400-patient trial [7,8]. Smaller trials from Iran, India, and Slovenia reported broadly concordant findings, with comparable mortality and a trend toward fewer mechanical complications after cementing [9,10,11].

Table 1: Major randomized controlled trials comparing cemented and uncemented hemiarthroplasty for displaced femoral neck fractures reviewed here [3,4,5,6,7,8,11,12].				
Study	Year	N	Follow-up	Key finding
Khan et al.	2002	400	Perioperative	Higher intraoperative fracture rate with uncemented implant
Figved et al.	2009	220	4 months	Better function and quality of life with cemented fixation
Parker et al.	2010	400	Perioperative-2 years	Higher femoral shaft fracture rate with uncemented implant
DeAngelis et al.	2012	100	1 year	No mortality difference; concern for uncemented fracture
Langslet et al.	2014	220	5 years	Functional advantage of cemented fixation sustained
Movrin	2020	78	2 years	Comparable mortality; fewer mechanical complications with cement

Study	Year	N	Follow-up	Key finding
Fernandez et al. (WHiTE 5)	2022	1,125	12 months	Better QoL, fewer periprosthetic fractures with cemented fixation
Parker et al.	2023	400	2 years	Cemented fixation favoured on function and complications



The definitive modern trial is WHiTE 5, a pragmatic, multicentre trial embedded within the World Hip Trauma Evaluation platform, which randomized 1,125 patients aged 60 years or older with an intracapsular hip fracture to cemented (n=610) or modern hydroxyapatite-coated uncemented (n=615) hemiarthroplasty (Table 1) [12]. The primary outcome, EQ-5D-derived quality of life at four months, favoured cemented fixation (mean 0.371 vs 0.315; adjusted difference 0.055, 95% CI 0.009–0.101, P=0.02). Periprosthetic fracture occurred in 0.5% of the cemented group versus 2.1% of the uncemented group (odds ratio 4.37, 95% CI 1.19–24.00) (Figure 1). Twelve-month mortality was numerically lower with cemented fixation (23.9% vs 27.8%; odds ratio 0.80, 95% CI 0.62–1.05), a non-significant difference directionally consistent with fewer periprosthetic complications and better early function. A planned economic evaluation alongside WHiTE 5 found cemented hemiarthroplasty both less costly and more effective than hydroxyapatite-coated uncemented hemiarthroplasty, driven by fewer

reoperations in the cemented arm [13].

Registry and Observational Evidence

Randomized trials, even pooled, are typically underpowered to detect differences in rarer outcomes such as perioperative mortality or reoperation, making national arthroplasty registries an important complementary evidence source. Data from the Norwegian Hip Fracture Register demonstrated that uncemented stems were associated with a higher revision risk, driven substantially by periprosthetic fracture, though overall mortality did not differ materially by fixation method after adjustment [14]. This registry-level signal has directly influenced practice: a Norwegian quality-improvement initiative that increased cemented-stem use from 27% to 91% was followed by a reoperation-rate reduction from 5.9% to 3.3%, an adjusted hazard rate ratio of 0.6 (95% CI 0.4–0.8) [15]. Complementary implant-registry analyses have similarly identified uncemented fixation, older age, and female sex as independent risk factors for periprosthetic fracture, indicating the excess risk is a generalisable pattern rather than an artefact of trial-specific technique [16]. A recent United States registry analysis confirms that cemented fixation use is rising in step with this evidence, though practice variation between institutions remains considerable [17].

Intraoperative Complications: Bone Cement Implantation Syndrome and Periprosthetic Fracture

Bone cement implantation syndrome remains the principal argument against routine cementation in this frail population. In a cohort of 1,016 patients undergoing cemented hemiarthroplasty, Olsen and colleagues found any-grade BCIS occurred in roughly one in four patients (grade 1, 21%; grade 2, 5.1%; grade 3, 1.7%), but clinically severe (grade 2–3) BCIS, affecting under 7% of patients, was associated with markedly increased early mortality:

5.2% with no BCIS, rising to 35% with grade 2 and 88% with grade 3, an approximately sixteen-fold increase with severe BCIS [1] (Figure 2). A German cohort confirmed BCIS remains a "persistent risk" in contemporary practice despite modern technique, underscoring the importance of anaesthetic vigilance and pre-emptive haemodynamic optimisation rather than abandoning cementation altogether [18]. Conversely, the periprosthetic fracture risk with uncemented stems is not a rare edge case: pooled data place the odds ratio for periprosthetic complications at approximately 0.15 favouring cemented stems [19]. The two intraoperative risks are thus asymmetric: BCIS mortality concentrates in a minority with severe physiological derangement that experienced anaesthetic teams can often anticipate, whereas periprosthetic fracture is a mechanical complication frequently necessitating further surgery in an already vulnerable population.

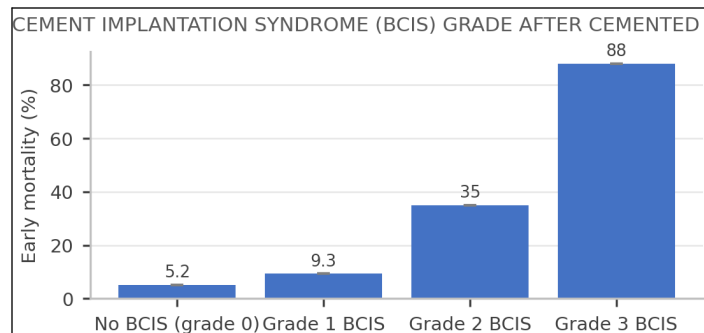


Figure 2: Early mortality by bone cement implantation syndrome (BCIS) grade after cemented hemiarthroplasty: 5.2% (no BCIS), 9.3% (grade 1), 35% (grade 2), 88% (grade 3) [1].

Mortality Outcomes

Perioperative and 30-day mortality after hemiarthroplasty is driven predominantly by frailty, comorbidity, and time-to-surgery rather than fixation method, and most individual trials are underpowered to detect a mortality difference. Nonetheless, directionality across the evidence base is consistent: WHiTE 5 found a non-significant trend toward lower one-year mortality with cemented fixation

(23.9% vs 27.8%) [12], while a meta-analysis of seven trials (1,125 patients) found no significant perioperative mortality difference (odds ratio 1.11, 95% CI 0.67–1.83) [19]. A larger meta-analysis of nine trials totalling 3,177 patients reported improved one-year mortality with cemented hemiarthroplasty alongside reduced periprosthetic fracture [20]. An earlier meta-analysis of twelve studies (1,805 patients) found no significant mortality difference (odds ratio 1.08, 95% CI 0.88–1.34), reflecting heterogeneity in pooled estimates by trial generation and cementing technique [21]. Overall, the evidence does not support a net mortality disadvantage from cementation once modern technique and haemodynamic vigilance are employed.

Functional Outcomes and Reoperation

Functional recovery, residual pain, and reoperation are arguably more clinically meaningful than mortality alone, given most patients survive the perioperative period. Multiple trials and meta-analyses converge on a modest but consistent functional advantage for cemented fixation (Table 2): Li and colleagues found significantly better hip function at one year (odds ratio 0.48, 95% CI 0.31–0.76) and less residual thigh pain (odds ratio 0.43, 95% CI 0.29–0.64) with cemented stems, alongside markedly fewer periprosthetic complications, at the cost of a modestly longer operative time (weighted mean difference 7.43 minutes) [19]. A systematic review of pooled outcomes similarly found cemented fixation associated with lower implant-related reoperation, though methodological heterogeneity limited precision [22]. A 2019 PRISMA-compliant meta-analysis and a 2020 meta-analysis, both in Medicine, reached concordant conclusions favouring cemented fixation, while noting uncemented implants may still suit patients with excessively narrow femoral canals [23,24].

Cost Considerations

Beyond clinical outcomes, cost further favours cemented

fixation. The WHiTE 5 economic evaluation found cemented hemiarthroplasty dominated hydroxyapatite-coated uncemented hemiarthroplasty in cost-utility analysis, being both cheaper and more effective, principally because of higher revision burden and implant costs in the uncemented arm [13]. A United States-based Markov cost analysis modelling patients over 60 years old similarly found substantial projected savings with routine cemented hemiarthroplasty, driven by downstream costs of managing periprosthetic fracture and revision [25]. These economic findings strengthen the case for cemented fixation as the more resource-efficient default in health systems managing large hip-fracture volumes.

Table 2: Meta-analyses of cemented versus uncemented hemiarthroplasty for femoral neck fracture reviewed here [19,21,23,24,22,20].		
Meta-analysis	Studies (N patients)	Key pooled finding
Ahn et al. 2008	Systematic review	Lower implant-related reoperation with cemented fixation
Li et al. 2013	7 RCTs (1,125)	Better function, less pain, fewer periprosthetic complications with cement
Ning et al. 2014	12 studies (1,805)	No significant mortality difference (OR 1.08)
Lin et al. 2019	PRISMA meta-analysis	Composite outcomes favour cemented fixation
Li et al. 2020	Meta-analysis	Concordant with favouring cemented fixation
Hurley et al. 2024	9 RCTs (3,177)	Improved 1-year mortality and less periprosthetic fracture with cement

Guideline Recommendations

Clinical practice guidelines have increasingly converged on cemented fixation as the preferred approach. The UK National Institute for Health and Care Excellence guideline on hip fracture management (NICE CG124), reaffirmed on surveillance review, recommends a cemented implant for hemiarthroplasty, based on trial and registry evidence of fewer periprosthetic fractures and

better function without mortality penalty [26]. The American Academy of Orthopaedic Surgeons' evidence-based guideline on managing hip fractures in older adults likewise addresses implant fixation, reflecting accumulated randomized and registry evidence, while acknowledging that surgeon experience and individual bone quality remain relevant intraoperatively [27]. Registry-driven quality-improvement programmes in Scandinavia have operationalised these recommendations directly, with measurable reoperation reductions following deliberate shifts toward cemented fixation [15].

Discussion

Considered together, this evidence supports cemented fixation as the preferred default for hemiarthroplasty in elderly patients with displaced femoral neck fractures. The principal counterargument, BCIS, is real and can be severe, but modern technique combined with anaesthetic vigilance mitigates much of this risk, and severe BCIS incidence remains low relative to the consistently higher periprosthetic fracture risk with uncemented stems. Uncemented fixation is not without a role: it may remain preferable for patients with excessive anaesthetic risk from cementation itself, unfavourable femoral canal anatomy, or settings with limited cementing expertise. Modern hydroxyapatite-coated uncemented designs, as tested in WHiTE 5, have narrowed but not eliminated the outcome gap, and individualised decision-making incorporating frailty, bone quality, and local expertise remains appropriate.

Conclusion

Randomized trials, national registries, and meta-analyses converge on cemented fixation providing better quality of life, fewer periprosthetic fractures, lower reoperation rates, and probable cost savings compared with uncemented hemiarthroplasty for displaced femoral neck fractures in elderly patients, without an associated

mortality penalty once modern cementing technique is used. Bone cement implantation syndrome remains a recognised but generally manageable intraoperative risk. Current guidelines increasingly recommend cemented fixation as the default approach, reserving uncemented implants for selected patients in whom cementation itself poses excessive anaesthetic risk or in whom femoral anatomy precludes reliable cemented stem fixation.

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