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Comparative Evaluation of Functional Outcomes and Postoperative Complications Following Cemented Versus Uncemented Total Hip Arthroplasty.

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Abstract

Background: Cemented and uncemented total hip arthroplasty are widely used for advanced hip disease. Their relative performance varies with patient characteristics, bone quality, and implant design. ***Aim:*** To compare functional outcomes and complications following cemented and uncemented total hip arthroplasty. ***Materials and Methods:*** This study framework described a prospective comparative observational study of primary elective THA. Sample-size planning required 64 evaluable participants per group, with a proposed recruitment target of 144 after allowing for attrition. Harris Hip Scores were assessed before surgery and at 6 weeks, 3 months, 6 months, and 12 months. Perioperative parameters and complications were compared using Welch's t-test, chi-square test, or Fisher's exact test, as appropriate. ***Results:*** In the dataset of 128 participants, Harris Hip Scores were higher after cemented THA at 6 weeks and 3 months. At 12 months, scores were 91.2 (5.4) versus 90.3 (5.8), with a mean difference of 0.90 points (95% CI -1.06 to 2.86; p=0.365). Cemented procedures had longer operative duration by 11.70 minutes and greater blood loss by 46.80 mL. Any listed complication occurred in 10.9% versus 21.9% (p=0.151). ***Conclusion:*** The analysis showed an early functional advantage with cemented THA but no significant difference in the primary 12-month functional endpoint. Complication differences remained uncertain. These simulated results require replacement with actual study observations before clinical or publication use.

Keywords: Total hip arthroplasty; Cemented fixation; Cementless fixation.

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INTRODUCTION

Total hip arthroplasty (THA) is an established surgical treatment for advanced hip disease associated with persistent pain, restricted mobility, and functional disability. Successful THA depends on appropriate patient selection, restoration of hip biomechanics, implant positioning, and durable fixation of the femoral and acetabular components. Cemented implants achieve fixation through polymethylmethacrylate bone cement, whereas uncemented implants depend on initial mechanical stability followed by biological integration. Although both methods are widely used, their relative advantages vary according to patient characteristics and implant design. Dale et al. (2020)[1], analysing 66,995 primary THAs, reported a higher revision risk with all-uncemented fixation, particularly among older women, highlighting the importance of age and sex in fixation selection.

Bone quality is particularly relevant to femoral fixation. Press-fit insertion of an uncemented stem may increase fracture risk in patients with weak proximal femoral bone. Lindberg-Larsen et al. (2017)[2] identified uncemented stems, osteoporosis, female sex, and increasing age as factors associated with intraoperative and early postoperative periprosthetic femoral fractures. Yang et al. (2019)[3] reported more favourable outcomes with cemented femoral fixation in an elderly osteoporotic population. These findings suggest that the benefits of biological fixation must be considered alongside the mechanical demands of implantation and the quality of available bone.

Complications following THA include periprosthetic fracture, dislocation, infection, venous thromboembolism, persistent pain, and implant loosening. Kelly et al. (2023)[4], using American Joint Replacement Registry data, found that cementless femoral fixation was associated with a higher risk of periprosthetic femoral fracture in patients aged 65 years or older. Nevertheless, fixation selection cannot be based on fracture risk alone. Perioperative physiological risk, functional

recovery, and longer-term implant performance also require consideration. Pedersen et al. (2021)[5] found similar adjusted early mortality after cemented and cementless THA for primary osteoarthritis, illustrating the importance of accounting for differences in patient health when interpreting observational comparisons.

AIM

To compare functional outcomes and complications following cemented and uncemented total hip arthroplasty.

OBJECTIVES

1. To compare Harris Hip Scores between cemented and uncemented THA before surgery and at 6 weeks, 3 months, 6 months, and 12 months postoperatively.
2. To compare operative duration, intraoperative blood loss, hospital stay, and postoperative pain between the two groups.
3. To compare the frequency of postoperative complications and revision procedures during 12 months of follow-up.

MATERIALS AND METHODS

Source of data

Data were obtained from patients undergoing primary elective THA in the Department of Orthopaedics. Information was collected from clinical interviews, examination findings, inpatient records, operative notes, anaesthesia charts, radiographs, and scheduled follow-up assessments.

Study design

The study was designed as a prospective comparative observational study with two groups:

- **Cemented group:** Both femoral and acetabular components were fixed using bone cement.
- **Uncemented group:** Both components were implanted without cement.

Hybrid and reverse-hybrid constructs were excluded. Fixation was selected by the treating surgeon according to clinical assessment, bone quality, proximal femoral morphology, and implant suitability. Treatment was not randomly allocated.

Study location

The study was conducted in the Department of Orthopaedics.

Study duration

The assumed study duration was 30 months: 18 months for recruitment and a further 12 months to complete follow-up of the last recruited participant. Actual commencement and completion dates were recorded.

Sample size

The sample size was calculated for comparing two independent mean Harris Hip Scores at 12 months. At least 63 evaluable patients were required per group. This was rounded to 64 per group, giving 128 evaluable participants.

The proposed recruitment target was therefore 144 patients, with an intended evaluable sample of at least 128.

The SD and target difference are planning assumptions, not estimates taken from a supplied pilot study. The five-point difference should not automatically be described as a validated minimum clinically important difference. This calculation primarily addresses functional outcome and does not ensure adequate power for uncommon complications.

Inclusion criteria

1. Patients aged 50-80 years undergoing primary unilateral elective THA.
2. Patients with advanced primary osteoarthritis or osteonecrosis with secondary degenerative changes.
3. Persistent pain and functional limitation despite appropriate conservative treatment.
4. Patients medically suitable for THA.
5. Patients who consented to participation and follow-up.

Exclusion criteria

1. THA performed for an acute hip fracture.
2. Revision THA, previous ipsilateral arthroplasty, or simultaneous bilateral THA.
3. Hybrid or reverse-hybrid fixation.
4. Active local or systemic infection.
5. Pathological fractures or malignancy involving the operative hip.
6. Major neurological disease substantially affecting walking or functional assessment.
7. Severe acetabular deficiency requiring complex reconstruction.
8. Medical contraindications to surgery or inability to provide informed consent.

Procedure and methodology

Eligible patients were screened consecutively. Baseline assessment included age, sex, body mass index, diagnosis, symptom duration, comorbidities, smoking status, previous treatment, and American Society of Anesthesiologists physical status. Hip examination included gait, limb-length assessment, deformity, range of movement, and Harris Hip Score.

Anteroposterior pelvic and appropriate lateral hip radiographs were reviewed for diagnosis, templating, proximal femoral morphology, and bone quality. Bone-density results were recorded when available. The reason for choosing cemented or uncemented fixation was documented to assess potential selection bias.

Surgery was performed by experienced arthroplasty surgeons using the departmental approach and perioperative pathway. Surgical approach, surgeon, implant manufacturer and model, head size, bearing surface, and component fixation were recorded. Cemented components were implanted using the institutional cementing technique, while uncemented components were inserted to achieve satisfactory initial stability.

Operative duration was measured from skin incision to completion of wound closure. Blood loss was estimated using suction volume after correction for irrigation and the departmental swab-assessment method. Intraoperative fractures, haemodynamic disturbances, and other adverse events were recorded.

Postoperative care included antibiotic prophylaxis, risk-based thromboprophylaxis, multimodal analgesia, and supervised physiotherapy according to institutional policy. Weight-bearing instructions were documented individually, particularly when intraoperative fracture or inadequate fixation required restrictions.

Patients were assessed at 6 weeks, 3 months, 6 months, and 12 months. Functional status was evaluated using the Harris Hip Score, and pain was measured on a 0-10 visual analogue scale. Clinical and radiographic assessment documented fracture, dislocation, infection, implant migration or loosening, persistent thigh pain, and revision surgery.

Outcome definitions

The **primary outcome** was Harris Hip Score at 12 months.

Secondary outcomes included serial postoperative Harris Hip Scores, operative duration, blood loss, hospital stay, pain score, and complications.

Periprosthetic fractures included intraoperative and postoperative fractures involving the operated femur. Dislocation required clinical or radiographic confirmation. Infection was classified according to the institutional diagnostic criteria, with superficial wound infection distinguished from periprosthetic joint infection. Venous thromboembolism required objective confirmation.

Persistent thigh pain was recorded at or beyond 3 months after excluding another evident cause. Revision was defined as removal, exchange, or addition of an implant component. Patients with multiple complications were counted once in the "any complication" category.

Sample processing

No research-specific biological specimen processing was required. Routine preoperative blood investigations were processed in the hospital laboratory according to standard procedures. Specimens obtained because of suspected infection were processed through the clinical microbiology service.

For data processing, each participant received a unique study identifier. Clinical and radiographic findings were entered into a structured database and checked against source records. Missing values, inconsistent dates, duplicate records, and implausible measurements were reviewed before analysis.

Data collection

A structured case-record form captured baseline characteristics, preoperative function, operative details, rehabilitation instructions, follow-up scores, radiographic findings, and complications. Dates and reasons for missed visits were recorded. Patient identifiers were stored separately from the analytical dataset.

Statistical methods

Continuous variables were summarised as mean and standard deviation or median and interquartile range, as appropriate. Categorical variables were expressed as frequency and percentage.

For the **tables**, continuous outcomes were compared using Welch's independent-samples t-test. Baseline categorical variables were compared using Pearson's chi-square test. Sparse complication counts were compared using two-sided Fisher's exact test.

Mean differences and their 95% confidence intervals were calculated for continuous outcomes. Absolute risk differences, expressed in percentage points, were presented with Newcombe-Wilson 95% confidence intervals for categorical outcomes. All differences were calculated as **cemented minus uncemented**.

For an actual observational study, the primary analysis should adjust 12-month Harris Hip Score for baseline score and prespecified confounders, including age, sex, diagnosis, bone quality, and comorbidity. A repeated-measures mixed model would be appropriate for longitudinal scores. Such adjusted results cannot be calculated from the summary statistics alone.

A two-sided p value below 0.05 was considered statistically significant for the primary endpoint. Secondary comparisons were treated as exploratory because multiple outcomes and time points were examined.

Ethical considerations

The final manuscript should state the actual ethics committee approval number, approval date, and consent procedure. These details have not been supplied and must not be represented as already obtained.

RESULTS

Table 1: Comparison of baseline demographic and clinical characteristics

Characteristic	Cemented (n=64)	Uncemented (n=64)	Difference, C-U (95% CI)	Test statistic	p value
Age, years, mean (SD)	63.4 (7.8)	62.1 (8.2)	1.30 (-1.50 to 4.10)	t=0.919	0.360
Male sex, n (%)	34 (53.1)	36 (56.3)	-3.13 pp (-19.75 to 13.75)	χ^2=0.126	0.723
BMI, kg/m², mean (SD)	26.3 (3.7)	25.8 (3.9)	0.50 (-0.83 to 1.83)	t=0.744	0.458
Primary osteoarthritis, n (%)	45 (70.3)	43 (67.2)	3.13 pp (-12.71 to 18.75)	χ^2=0.145	0.703
ASA class III, n (%)	12 (18.8)	10 (15.6)	3.13 pp (-10.13 to 16.31)	χ^2=0.220	0.639
Preoperative Harris Hip Score, mean (SD)	43.8 (8.6)	44.6 (8.2)	-0.80 (-3.74 to 2.14)	t=-0.539	0.591

In the sample, mean age was 63.4 years in the cemented group and 62.1 years in the uncemented group. Male participants constituted 53.1% and 56.3%, respectively. Mean BMI, diagnostic distribution, ASA class III frequency, and preoperative Harris Hip Score showed no statistically significant between-group differences. However, nonsignificant baseline tests do not demonstrate equivalence or exclude confounding, particularly from unmeasured differences in bone quality and implant selection.

Table 2: Comparison of postoperative functional outcomes

Assessment	Cemented (n=64), mean (SD)	Uncemented (n=64), mean (SD)	Mean difference, C-U (95% CI)	Welch's t	p value
Harris Hip Score at 6 weeks	71.8 (7.2)	67.6 (7.8)	4.20 (1.57 to 6.83)	3.165	0.002
Harris Hip Score at 3 months	81.6 (6.8)	78.4 (7.1)	3.20 (0.77 to 5.63)	2.604	0.010
Harris Hip Score at 6 months	87.9 (5.9)	86.8 (6.2)	1.10 (-1.02 to 3.22)	1.028	0.306
Harris Hip Score at 12 months—primary endpoint	**91.2 (5.4)**	**90.3 (5.8)**	**0.90 (-1.06 to 2.86)**	**0.909**	**0.365**

Mean Harris Hip Scores increased across successive visits in both groups. Cemented THA had higher scores at 6 weeks and 3 months, with mean differences of 4.20 points and 3.20 points, respectively. The differences narrowed at 6 months and 12 months. At the primary endpoint, the mean difference was 0.90 points (95% CI -1.06 to 2.86; p=0.365), providing no statistically significant evidence of a difference. Formal within-patient improvement tests were not calculated because paired observations and their covariance were unavailable.

Table 3: Comparison of perioperative parameters and postoperative pain

Parameter	Cemented (n=64), mean (SD)	Uncemented (n=64), mean (SD)	Mean difference, C-U (95% CI)	Welch's t	p value
Operative duration, minutes	96.4 (14.8)	84.7 (13.6)	11.70 (6.73 to 16.67)	4.657	<0.001
Intraoperative blood loss, mL	368.5 (92.4)	321.7 (86.8)	46.80 (15.44 to 78.16)	2.953	0.004
Hospital stay, days	5.8 (1.6)	6.2 (1.9)	-0.40 (-1.01 to 0.21)	-1.288	0.200
Pain VAS at 12 months, 0-10	1.3 (0.8)	1.4 (0.9)	-0.10 (-0.40 to 0.20)	-0.664	0.508

Operative duration was longer with cemented THA by 11.70 minutes (p<0.001). Estimated blood loss was also higher by 46.80 mL (p=0.004), although the clinical importance of this difference would depend on haemoglobin change, transfusion requirements, and patient health. Hospital stay and pain scores at 12 months did not differ significantly between groups.

Table 4: Comparison of complications during 12 months of follow-up

Complication	Cemented (n=64), n (%)	Uncemented (n=64), n (%)	Risk difference, C-U, pp (95% CI)	Test	p value
Periprosthetic femoral fracture	1 (1.6)	4 (6.3)	-4.69 (-13.53 to 3.07)	Fisher's exact	0.365
Dislocation	2 (3.1)	3 (4.7)	-1.56 (-10.08 to 6.61)	Fisher's exact	1.000
Periprosthetic joint infection	1 (1.6)	1 (1.6)	0.00 (-6.89 to 6.89)	Fisher's exact	1.000
Symptomatic venous thromboembolism	1 (1.6)	2 (3.1)	-1.56 (-9.24 to 5.58)	Fisher's exact	1.000
Persistent thigh pain	2 (3.1)	8 (12.5)	-9.38 (-19.90 to 0.30)	Fisher's exact	0.096
Revision surgery	1 (1.6)	2 (3.1)	-1.56 (-9.24 to 5.58)	Fisher's exact	1.000
Patients with any listed complication	**7 (10.9)**	**14 (21.9)**	**-10.94 (-23.75 to 2.08)**	**Fisher's exact**	**0.151**

In the dataset, periprosthetic fractures occurred in 1.6% of cemented cases and 6.3% of uncemented cases, but this difference was not statistically significant. Persistent thigh pain was numerically less frequent after cemented THA, although Fisher's exact testing remained nonsignificant (p=0.096). Any listed complication occurred in 10.9% versus 21.9%, corresponding to a risk difference of -10.94 percentage points (95% CI -23.75 to 2.08; p=0.151). These findings do not establish either superior safety or equivalent complication risks.

DISCUSSION

Baseline characteristics and selection of fixation

The groups had similar measured baseline characteristics, including age, sex, BMI, diagnosis, and preoperative function. Nevertheless, fixation selection in an observational study remains susceptible to confounding. Dale et al. (2020)[1] demonstrated that the relationship between fixation and revision varied with age and sex. Lindberg-Larsen et al. (2017)[2] additionally identified osteoporosis as a fracture risk factor, while Yang et al. (2019)[3] specifically examined an elderly osteoporotic population. These studies indicate that apparent demographic similarity alone is insufficient: bone quality, femoral morphology, and the clinical reason for fixation choice should also be recorded and considered in analysis.

The population was younger than several registry cohorts focused on older adults. Consequently, results from patients aged over 75 or 80 years should not be transferred directly to this sample. Orce Rodríguez et al. (2024)[7] compared specific commonly used collared cementless and polished cemented stems in patients aged at least 75 years. Their design illustrates why comparisons should account for the actual implant rather than treating all cemented or uncemented stems as interchangeable. Bloemheuvel et al. (2022)[8], studying 43,053 THAs in patients aged at least 80 years, found a higher adjusted revision risk with uncemented fixation but no mortality difference between fixation methods.

Functional recovery

The functional results showed an early advantage for cemented THA that diminished by 12 months. Immediate mechanical fixation is a plausible explanation for an early difference, but the tables cannot establish that mechanism. Rehabilitation restrictions, baseline muscle strength, surgical approach, and complications could also influence recovery.

Yang et al. (2019)[3] reported favourable results for cemented femoral fixation in elderly patients with osteoporosis, whereas Rocha et al. (2025)[21] found no significant difference in Harris Hip Score improvement between cemented and cementless cohorts aged 70 years or older. The latter finding is consistent with the absence of a significant 12-month difference, although population, implant, and follow-up differences limit direct comparison.

Clement et al. (2021)[15] reported a higher complication rate with uncemented THA in a small randomised trial involving displaced intracapsular fractures. Axenhus et al. (2025)[16] provided longer-term follow-up of another randomised comparison in elderly fracture patients. These studies are relevant to fixation safety but represent a different indication from elective THA for degenerative disease. Their findings should therefore be discussed as supporting context rather than direct confirmation of the functional pattern.

The early mean differences of 4.20 and 3.20 points were statistically significant in unadjusted comparisons, but their clinical importance remains uncertain. Conversely, p=0.365 at 12 months does not demonstrate formal equivalence. An equivalence conclusion would require a prespecified margin and an appropriate study design.

Operative duration, blood loss, and hospital stay

The cemented procedures took approximately 12 minutes longer. Haider et al. (2024)[19] similarly reported longer operative duration for cemented THA across age groups in a propensity-matched study. Additional preparation and cement handling provide a plausible explanation, although surgeon experience and implant system also affect surgical time. Haider et al.

found shorter hospital stays among some older cemented cohorts; the present difference in hospital stay was smaller and nonsignificant.

The blood-loss difference was statistically significant but modest in absolute terms. It should not be interpreted as a clinically important disadvantage without accompanying transfusion and haemoglobin data. Moore et al. (2024)[6] reported higher rates of several adverse outcomes in their cemented cohort, demonstrating that published comparisons do not uniformly favour cemented fixation. Chen et al. (2023)[10] also observed differing complication profiles between fixation groups; after adjustment, cemented fixation was associated with lower odds of periprosthetic fracture. Differences in case selection and analytical methods are important when reconciling these findings.

Periprosthetic fracture and other complications

The fracture rate was numerically lower with cemented THA, but the confidence interval was wide. Kelly et al. (2023)[4] reported an increased fracture hazard with cementless stems in patients aged at least 65 years. This supports careful attention to fixation in older patients, but the registry estimate cannot be applied directly to a small local cohort.

Alagha et al. (2025)[20], analysing matched Swedish registry patients, reported higher revision and femoral periprosthetic fracture risks with cementless fixation. Gjertsen et al. (2024)[17] found that an initiative promoting cemented fixation in selected elderly populations was associated with reduced revision or reoperation rates. These findings support patient-specific selection, while their observational designs leave scope for residual confounding and changes in practice over time.

Cemented fixation does not eliminate fracture risk. Lamb et al. (2020)[18] identified patient and implant characteristics associated with revision for fracture around polished taper-slip cemented stems. This reinforces the importance of component design, implantation technique, and patient anatomy within each fixation category.

The differences in infection, dislocation, venous thromboembolism, and revision were nonsignificant. With only a few events per category, however, these estimates were imprecise. The absence of significance should not be used to claim equal safety. Likewise, the numerical difference in persistent thigh pain requires confirmation using a larger sample and a consistent pain definition.

Cement-related physiological risk and mortality

Rassir et al. (2021)[11] examined bone cement implantation syndrome across arthroplasty procedures, highlighting the importance of perioperative physiological monitoring. A study assessing cemented fixation should record cement-associated hypoxia and hypotension explicitly rather than relying only on postoperative surgical complications.

Mortality comparisons require particular caution. Garland et al. (2017)[12] identified an early mortality signal after cemented THA relative to matched population controls. In contrast, Ekman et al. (2019)[13] found similar adjusted early mortality between fixation groups in Finnish national data. Dale et al. (2020)[14] reported similar adjusted mortality across fixation methods in Norwegian registry data, and Pedersen et al. (2021)[5] found no meaningful adjusted 90-day mortality difference in the Nordic cohort. Together, these studies emphasise the influence of comorbidity, comparator selection, and observation period. The tables contain no mortality analysis and cannot address this outcome.

Implant survival and interpretation

Babazadeh et al. (2022)[9] reported lower revision rates for cemented polished tapered stems than commonly used cementless implants over extended follow-up. This demonstrates the importance of assessing durability beyond the first postoperative year. A 12-month study can describe early recovery and complications but cannot establish long-term superiority.

Roitzsch et al. (2025)[22] compared acetabular fixation in fracture-related THA and reported lower revision rates with cemented cups. That study addressed cup fixation in a fracture population, whereas many other cited reports primarily compared femoral stems. This distinction matters because a comparison of fully cemented and fully uncemented THA changes both components simultaneously; any observed difference cannot automatically be attributed to the femoral stem alone.

Overall, the findings show how an early functional difference can coexist with a nonsignificant primary endpoint and uncertain complication differences. They support cautious interpretation rather than a universal preference for either fixation method.

CONCLUSION

Cemented THA showed higher early Harris Hip Scores but longer operative duration and greater estimated blood loss. At 12 months, functional outcome and pain did not differ significantly between groups. Complications were numerically less frequent with cemented fixation, but the differences were imprecise and statistically nonsignificant. These example results do not establish superiority or equivalence. Actual conclusions should be based on verified patient data, with adjustment for relevant differences in patient selection and bone quality.

LIMITATIONS OF THE STUDY

1. The presented results are ; they provide no empirical evidence about actual patients.

2. A single-centre observational design would be vulnerable to selection bias and confounding by indication.
3. A sample planned for functional outcome would have limited power for uncommon complications.
4. Twelve-month follow-up would be insufficient to assess long-term loosening, wear, and implant survival.
5. Differences in bone quality, implant design, approach, surgeon experience, and rehabilitation could influence outcomes.
6. The displayed comparisons are unadjusted; patient-level data would be required for adjusted and longitudinal analyses.
7. Multiple secondary comparisons increase the possibility of chance findings.
8. Excluding acute fracture cases and limiting the age range would restrict generalisability.
9. Loss to follow-up could bias results if related to complications or poor recovery.
10. Comparing fully cemented with fully uncemented constructs would not isolate the effects of femoral and acetabular fixation.

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