

Comparison of Clinical Outcomes between Cemented and Uncemented Total Hip Arthroplasty in Elderly Patients: A Prospective Study

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Received: 15-05-2026 / Revised: 20-06-2026 / Accepted: 21-06-2026

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Conflict of interest: Nil

Abstract

Background: Total hip arthroplasty (THA) is a reliable technique for pain relief and mobility restoration in elderly patients; however, the best fixation technique for the femur is still under debate, as cemented stems provide instant stability and uncemented stems minimize the risk of cement-related complication and the number of surgical steps. The aim of this study was to compare the perioperative, functional and radiological outcomes of cemented versus uncemented THA in elderly patients.

Methods: A prospective study comparing 80 patients aged 65 years or older with primary THA for advanced hip disease or displaced intracapsular femoral neck fracture was performed. The number of patients receiving cemented and uncemented fixation of the femur was 40 and 40 patients, respectively. The outcomes measured were at discharge, 6 weeks, 3 months, 6 months and 12 months. The primary outcome was Harris Hip Score (HHS) at 12 months. Secondary outcomes were operative time, blood loss, VAS pain, WOMAC score, walking capacity, radiological stability, thigh pain and complications.

Results: The groups were similar in terms of age, sex, BMI, comorbidity, indication and preoperative HHS. Cemented THA had longer operative time (101.8 +/- 14.6 vs 87.5 +/- 12.9 minutes; $p < 0.001$) and greater blood loss (482 +/- 92 vs 414 +/- 88 mL; $p = 0.002$). At 12 months, cemented THA showed higher HHS (86.7 +/- 7.4 vs 82.3 +/- 8.1; $p = 0.014$), lower VAS pain (1.3 +/- 0.8 vs 2.0 +/- 1.0; $p = 0.001$), and less thigh pain (7.5% vs 25.0%; $p = 0.034$). Periprosthetic fracture was found in one cemented and four uncemented cases ($p = 0.166$).

Conclusion: Cemented THA had better short term pain relief and functional recovery in the elderly population, whereas uncemented THA reduced the operating time and blood loss. Fixation should be individualized based on age, bone quality, and co-morbidity, as well as on intra-operative stability.

Keywords: Total hip arthroplasty; cemented fixation; uncemented fixation; elderly; Harris Hip Score; periprosthetic fracture.

DOI: 10.25258/ijcpr.18.6.169

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Introduction

Total hip arthroplasty is one of the most successful reconstructive operations in modern medicine due to its consistently high rates of relieving pain, increasing mobility and restoring independence in patients with significant hip disease [1]. In elderly patients, indications are advanced arthritis within the knee, osteonecrosis, inflammatory arthropathy, failed internal fixation, and displaced intracapsular fracture of the femoral neck in physiologically active patients. The elderly patient population with permanent hip replacement surgery continues to grow with the rising life expectancy.

Fixation in THA continues to be a key surgical decision. Cemented fixation is immediate

biomechanical stability because of the interdigitation of polymethylmethacrylate cement and cancellous bone and can be beneficial with osteoporotic femora. This method of fixation is uncemented, depending on the press fit stability and biological integration of the implant; it is successful when the bone quality and fit are favourable. Both techniques have proven to be long-lasting, but the benefits of one method over the other depend on the age of the patient, diagnosis, stem design, bone morphology, and surgeon experience [2].

Registry studies have given vital information on the population level. A Swedish Hip Arthroplasty

Register study of over 170,000 primary THA revealed that there were variations in revision outcomes between fixation techniques and there was some concern that uncemented implants were not uniformly better in older patients [3]. Similarly, data from the Nordic registries showed that the revision rate in patients 55 years or older was affected by fixation choice, but that patient selection and implant design were significant confounders [4].

Uncemented THA has been reported to decrease the operating time and prevent cement implantation syndrome, but may be associated with increased risk of early periprosthetic femur fracture, particularly in elderly female patients and those with osteoporosis [5, 6]. Cemented stems can also make the procedure longer, with greater blood loss and cardiopulmonary monitoring during the procedure, but may aid early pain relief and walking confidence due to the fact that they offer quick fixation.

Data from hip fracture arthroplasty also help with fixation considerations in the elderly. The periprosthetic fracture rate, pain score, or the incidence of prosthesis-related complications have been shown to be lower for cemented hemiarthroplasty in randomized studies of total hemiarthroplasty in comparison to the uncemented hemiarthroplasty group [7-10]. However, while there is no direct transferability of evidence from hemiarthroplasty to THA, it does emphasize the need for osteoporotic bone quality and early mechanical stability in older patients.

The risk of periprosthetic fracture has been found to be lower with cemented femoral fixation in recent registries of THA in patients ≥ 65 years of age, and other recent matched studies have shown that well-designed uncemented stems can offer similar survivorship in the same age group [11, 12]. This apparent conflict highlights the need for future clinical studies to assess the revision risk, as well as pain, function, radiological stability, and early complications.

The purpose of the present study was to compare the clinical results between cemented and uncemented THA in elderly patients at a tertiary care teaching hospital. The main aim was to compare 12 month Harris Hip Score. Secondary outcomes included comparison of perioperative parameters, pain, WOMAC score, walking ability, radiological findings, thigh pain, periprosthetic fracture, dislocation, infection and early revision.

Materials and Methods

This was a prospective comparative study conducted in the Department of Orthopaedics in a tertiary care teaching hospital for 24 months. All patients with THA were screened and included in

the study cohort for the consecutive elderly patients undergoing primary THA.

Sample size was determined assuming 12 month outcome as the primary endpoint (HHS). A difference of five points on the HHS was deemed clinically significant using previous comparative data. With a standard deviation of 7.5, 80% power, and a two-sided alpha of 0.05, a total of 36 patients was needed in each group. Patients were enrolled in either two groups, of 40 each, after allowing for attrition.

The patients who were included were those who underwent primary THA for end-stage osteoarthritis, end-stage osteonecrosis and collapse, inflammatory arthropathy, failed internal fixation, and displaced intracapsular femoral neck fracture, and were 65 years of age or older and independent in ambulation. Exclusion criteria included revision THA, pathological fracture secondary to malignancy, active infection, severe neuromuscular disease, non-ambulatory prior to illness, American Society of Anesthesiologists grade V, severe cognitive impairment inability to assess, and follow-up refusal.

The patient's demographic data, comorbidities, Charlson Comorbidity Index, body mass index, indication for surgery, baseline HHS, WOMAC score, VAS pain, and standard AP pelvis and lateral hip radiographs were evaluated preoperatively. The surgeon's evaluation of the bone quality, the morphology of the canal on the femur, the patient's physiology and the availability of the implant determined the choice of fixation. Patients underwent cemented stem implantation if they were thought to have poor metaphyseal bone and/or Dorr type C femora, but the final grouping resulted in comparable clinical groups.

All procedures were done by experienced arthroplasty surgeons either through a posterolateral or anterolateral approach, depending on their preference. Third generation cementing method was applied with canal lavage, distal plug, retrograde cement insertion and pressurization in cemented stems. Sequential broaching was used to insert uncemented stems to provide a press-fit stability in both axial and rotational directions. In most cases, a cementless hemispherical cup was used for acetabular fixation, and in some cases, screws were used. Highly crosslinked polyethylenes were used as liners for ceramic or metal heads, as available.

Post-operative treatment included antibiotic prophylaxis, thromboprophylaxis based on risk, hip precautions, early physiotherapy, walker-assisted walking and progressive strengthening. Patients were followed at 6 weeks, 3 months, 6 months and 12 months. Functional outcomes were HHS,

WOMAC, pain (VAS), walking aid use, and stair climbing. Radiological measurements comprised: stem alignment, subsidence, radiolucent lines, osteolysis, cup inclination, heterotopic ossification and loosening. Injuries were prospectively recorded.

Data were analyzed statistically with SPSS version 26. Continuous variables were reported as mean +/- SD and compared using independent t-test or Mann-Whitney U test.

The categorical variables were compared with chi-square or Fisher exact test. Embedded items were analyzed using repeated-measures ANOVA. P-values < 0.05 were deemed to be significant.

Results

Eighty patients completed 12-month follow-up. Cemented and uncemented groups had similar demographic and clinical characteristics at baseline. Mean age was 72.8 +/- 5.4 years in the cemented group and 71.9 +/- 5.7 years in the uncemented group.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Cemented THA (n=40)	Uncemented THA (n=40)	p-value
Age (years), mean +/- SD	72.8 +/- 5.4	71.9 +/- 5.7	0.471
Female sex, n (%)	23 (57.5)	21 (52.5)	0.653
BMI (kg/m ²)	24.8 +/- 3.6	25.2 +/- 3.8	0.630
Charlson Comorbidity Index	3.1 +/- 1.0	2.9 +/- 1.1	0.398
Diabetes mellitus, n (%)	13 (32.5)	11 (27.5)	0.625
Hypertension, n (%)	22 (55.0)	20 (50.0)	0.654
Femoral neck fracture indication, n (%)	17 (42.5)	15 (37.5)	0.648
Dorr type C femur, n (%)	14 (35.0)	11 (27.5)	0.468
Preoperative HHS	41.6 +/- 8.2	42.3 +/- 7.9	0.699
Preoperative WOMAC	72.4 +/- 9.6	70.8 +/- 10.2	0.472

The two groups were comparable with respect to demographic profile, comorbidity, indication for THA, femoral morphology, and preoperative functional status.

Table 2: Perioperative and Early Postoperative Outcomes

Outcome	Cemented THA (n=40)	Uncemented THA (n=40)	p-value
Operative time (minutes)	101.8 +/- 14.6	87.5 +/- 12.9	<0.001
Estimated blood loss (mL)	482 +/- 92	414 +/- 88	0.002
Transfusion required, n (%)	12 (30.0)	8 (20.0)	0.302
Hospital stay (days)	6.8 +/- 1.7	6.4 +/- 1.8	0.309
Ambulation by day 2, n (%)	32 (80.0)	29 (72.5)	0.432
Intraoperative fracture, n (%)	1 (2.5)	3 (7.5)	0.305
30-day cardiopulmonary event, n (%)	2 (5.0)	1 (2.5)	0.556
Superficial infection, n (%)	2 (5.0)	2 (5.0)	1.000

Cemented THA required significantly longer operative time and greater blood loss, whereas early ambulation, hospital stay, transfusion, and early medical events did not differ significantly.

Table 3: Functional, Radiological, and Complication Outcomes at 12 Months

Outcome	Cemented THA (n=40)	Uncemented THA (n=40)	p-value
HHS at 6 months	81.5 +/- 8.3	77.6 +/- 8.8	0.045
HHS at 12 months	86.7 +/- 7.4	82.3 +/- 8.1	0.014
WOMAC at 12 months	16.8 +/- 6.7	21.2 +/- 8.1	0.010
VAS pain at 12 months	1.3 +/- 0.8	2.0 +/- 1.0	0.001
Persistent thigh pain, n (%)	3 (7.5)	10 (25.0)	0.034
Independent outdoor walking, n (%)	31 (77.5)	26 (65.0)	0.216
Stem subsidence >2 mm, n (%)	1 (2.5)	5 (12.5)	0.091
Radiolucent lines/progressive loosening, n (%)	2 (5.0)	3 (7.5)	0.644
Periprosthetic fracture, n (%)	1 (2.5)	4 (10.0)	0.166
Dislocation, n (%)	1 (2.5)	2 (5.0)	0.556

At 12 months, cemented THA showed significantly better HHS, lower WOMAC and VAS pain, and

lower persistent thigh pain. Radiological complications were numerically higher in the

uncemented group but did not reach statistical significance.

Discussion

This prospective study proved that cemented THA had a better outcome with regards to functional and pain outcomes in elderly patients with a shorter operation time and less blood loss in uncemented THA. The 12-month HHS scores were significantly lower and the VAS pain and WOMAC scores significantly higher in the control group. This trend towards persisting thigh pain was also observed after uncemented fixation, which is directly related to the dependence of cementless stems on metaphyseal press-fit and osseointegration.

The results are consistent with the hypothesis that immediate fixation stability is crucial in older patients. Cemented femoral fixation may be able to overcome the osteoporotic cancellous bone and Dorr type C canal geometry by distributing the load in the cement mantle. Learmonth et al described THA as a “transformative operation,” but noted that the durability and function of THA will depend on implant fixation and material choice [1]. Hailer et al. and Makela et al. conducted studies that showed that fixation method influences the revision patterns and survivorship on a population level [3, 4].

This superior early functional recovery seen with cemented stems in this study is biologically reasonable. Cemented fixation will give immediate axial and rotational stability and can help to minimize the pain of micromotion and assist in confidence with early gait training. Randomized evidence from Abdulkarim et al. suggested that both cemented and uncemented fixation is successful but fixation choice must be based on the age of the patient and bone quality [5]. Cemented THR was also shown to offer functional benefits for elderly fracture patients in a heterogeneous manner, as reported by Raja et al. [6].

Peri-operative disadvantages of the cemented THA also proved to be apparent. Operative time and blood loss was significantly higher. The canal preparation, lavage, cement mixing, pressurisation and haemodynamic vigilance are the key steps in cement insertion. Although a difference in 30-day cardiopulmonary events was not observed in the elderly population with cardiopulmonary disease, cement implantation syndrome is still a concern. Due to the small sample size, the study might not have been able to identify rare medical complications.

Periprosthetic fracture was seen in one cemented and four uncemented cases, which was not statistically significant but clinically significant. This outcome is better assessed with larger registry studies. Kelly et al. found in the American Joint

Replacement Registry that periprosthetic femur fracture risk was decreased in patients over 65 years old with cemented femur fixation [11]. Another study by Lindberg-Larsen et al. reported a higher incidence of periprosthetic fracture in the early postoperative period and during surgery with uncemented femurs, especially in elderly and osteoporotic patients [13].

This is further supported by findings from the hemiarthroplasty trials. Fernandez et al. determined that older patients with intracapsular hip fracture had a greater quality of life and reduced risk of periprosthetic fracture with cemented hemiarthroplasty [7]. In elderly fracture patients, a cemented fixation was found to result in less pain or complications or improved mobility by Parker et al., Taylor et al., and Moerman et al. [8-10]. The principles of fixation of the femur are applicable to geriatric bone, although the reconstruction of the acetabulum and indications for hemiarthroplasty are different from THA.

The uncemented THA should not be underestimated. Modern cementless stems can function well provided there is sufficient metaphyseal bone, canal geometry and press-fit stability. In a selected group of patients 70 years old or older, Rocha et al. found similar survival with the two types of stems [12]. Radiological fixation was stable in most uncemented stems at 12-months, and there was a significant improvement in the functional scores from baseline. In selected elderly patients with good bone stock and low fracture risk, therefore, uncemented fixation is appropriate.

The one drawback of this study is that no randomization is used to select fixation; this may lead to surgeon preference and bone-quality bias. Baseline variables were similar, but there were differences in variables not measured that might affect results. There was a limited follow-up period of 12 months and it was not possible to evaluate the risk of aseptic loosening, polyethylene wear or revision. This single centre approach could also be limited in generalisability. However, the results of the prospective data collection, the standardisation of functional scores and the radiological follow-up, enhance the clinical relevance of the results.

Fixation should be individualised in practice. Cemented stems are seemingly beneficial in older patients with poor bone quality, large femoral canals, signs of fracture on X-rays and a high risk of early periprosthetic fracture. In older patients with good Dorr A or B morphology, good metaphyseal support, and lower cardiopulmonary risk, uncemented stems might be appropriate.

Regardless of fixation method, careful postoperative rehabilitation, shared decision

making and meticulous technique are still critical to success.

Conclusion

Cemented THA in older adults resulted in better 12-month pain relief and functional outcomes, and blood loss and thigh pain were not persistent, but took longer to operate. Uncemented THA was effective in selected patients and had a higher incidence of numerically higher stem subsidence and periprosthetic fracture. Bone and comorbidity factors, fracture risks, and intraoperative stability should all be considered when deciding upon femoral fixation.

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