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Original Research Article

Comparative Evaluation of Cemented versus Uncemented Total Hip Replacement: A Midterm Follow-up Study

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Abstract

Background: Total hip replacement (THR) is an effective surgical procedure for relieving pain and improving functional mobility in patients with advanced hip joint diseases. Cemented and uncemented fixation techniques are widely used; however, controversy persists regarding their comparative functional outcomes, implant stability, and complication profile. The present study aimed to comparatively evaluate the clinical, functional, and radiological outcomes of cemented versus uncemented THR at midterm follow-up.

Methods: This hospital-based comparative observational study included 98 patients undergoing primary THR, of whom 51 underwent cemented THR and 47 underwent uncemented THR. Demographic characteristics, indications for surgery, intraoperative parameters, postoperative recovery, functional outcomes using Harris Hip Score (HHS), radiological findings, and complications were evaluated during follow-up. Statistical analysis was performed using appropriate comparative tests, and $p<0.05$ was considered statistically significant.

Results: Patients undergoing cemented THR were significantly older than those in the uncemented group (66.8 ± 8.9 vs 54.3 ± 10.6 years; $p<0.001$). Fracture neck of femur was more common in the cemented group (33.3%; $p=0.008$), whereas avascular necrosis predominated in the uncemented group (42.6%; $p=0.007$). Operative time, blood loss, and hospital stay were significantly higher in the cemented THR group. Both groups demonstrated marked improvement in HHS during follow-up; however, uncemented THR showed significantly higher HHS at 1 year and midterm follow-up ($p=0.009$ and $p<0.001$, respectively). Excellent functional outcome was achieved more frequently in the uncemented group (66.0% vs 43.1%; $p=0.028$). Stable implant fixation was observed in over 90% of patients in both groups. Persistent thigh pain was significantly more common in the uncemented group (14.9% vs 3.9%; $p=0.049$).

Conclusion: Both cemented and uncemented THR provided satisfactory midterm clinical and radiological outcomes. Cemented THR was better suited for elderly patients with poor bone quality, while uncemented THR demonstrated superior functional recovery and earlier rehabilitation in younger patients. Careful patient selection and individualized implant choice are essential for optimizing outcomes following total hip replacement.

Keywords: Total hip replacement; Harris Hip Score; Hip arthroplasty; Functional outcome; Radiological outcome.

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Introduction

Total hip replacement (THR) is one of the most successful orthopaedic procedures for relieving pain, restoring mobility, and improving quality of life in patients with advanced hip disorders such as osteoarthritis, rheumatoid arthritis, avascular necrosis, and fracture neck of femur [1]. With

increasing life expectancy and rising prevalence of degenerative joint diseases, the number of THR procedures performed worldwide has increased substantially, exceeding one million annually [2]. Advances in implant design, surgical techniques, and perioperative care have significantly improved functional outcomes and implant survivorship [3].

The method of implant fixation remains a key factor influencing the success and longevity of THR. Cemented and uncemented prostheses are the two principal fixation techniques used in contemporary practice [4]. Cemented THR utilizes polymethylmethacrylate (PMMA) bone cement to achieve immediate implant stability and has traditionally been preferred in elderly patients with poor bone quality [5]. Long-term studies have demonstrated excellent survival rates of cemented implants, with survivorship exceeding 90% at 15–20 years in selected populations [6]. However, concerns such as cement loosening, osteolysis, and difficulties during revision surgery persist [7].

Uncemented THR depends on biological fixation through bone ingrowth into porous-coated implant surfaces. Improvements in implant materials and surface coatings have increased the popularity of uncemented prostheses, particularly in younger and more active patients [8]. Potential advantages include preservation of bone stock, lower rates of aseptic loosening, and easier revision surgery. Nevertheless, uncemented implants may be associated with higher cost, postoperative thigh pain, and increased risk of peri-prosthetic fractures, especially in osteoporotic bone [9].

Despite extensive research, controversy continues regarding the optimal fixation method. Some studies report superior early functional outcomes and lower revision rates with cemented fixation in elderly patients, whereas others demonstrate better long-term durability with uncemented implants in younger individuals [10,11]. Variations in patient characteristics, implant design, and follow-up duration contribute to inconsistent findings.

In India, the choice between cemented and uncemented THR is also influenced by economic considerations and patient affordability. Therefore, the present study was aimed to comparatively evaluate the functional and radiological outcomes, complications, and implant performance of cemented versus uncemented total hip replacement at midterm follow-up.

Materials and Methods

Study Design and Setting: This hospital-based comparative observational study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital over a period of 2 years from March 2023 to February 2025. The study was designed to comparatively evaluate the clinical, radiological, and functional outcomes of cemented versus uncemented total hip replacement (THR) at midterm follow-up. Approval for the study was obtained from the Institutional Ethics Committee prior to commencement, and written informed consent was obtained from all patients participating in the study.

Study Population and Sample Size: The study included patients diagnosed with advanced hip joint diseases who underwent primary total hip replacement during the study period. Indications for surgery included osteoarthritis, avascular necrosis of the femoral head, rheumatoid arthritis, fracture neck of femur, post-traumatic arthritis, and other degenerative or inflammatory conditions affecting the hip joint. Patients aged above 18 years who underwent either cemented or uncemented THR and were available for regular follow-up were included in the study. Patients undergoing revision hip arthroplasty, hemiarthroplasty, hybrid hip replacement, THR for malignant conditions, active infection around the hip joint, neuromuscular disorders affecting gait, or those lost to follow-up before completion of the minimum follow-up period were excluded.

Patients were divided into two groups based on the type of fixation used during surgery. Group A consisted of patients who underwent cemented total hip replacement, while Group B included patients who underwent uncemented total hip replacement. The choice of fixation technique was based on patient age, bone quality, activity level, surgeon preference, and intraoperative assessment.

Preoperative Evaluation: A detailed clinical history and thorough physical examination were performed for all patients. Demographic details including age, sex, body mass index, side involved, duration of symptoms, and associated comorbidities such as diabetes mellitus and hypertension were recorded using a structured proforma. Clinical assessment included evaluation of pain, range of motion, gait abnormalities, limb length discrepancy, and functional disability. Baseline functional status was assessed using the Harris Hip Score (HHS). Routine preoperative investigations including complete blood count, renal and liver function tests, coagulation profile, blood sugar levels, electrocardiography, and chest radiography were performed. Radiological evaluation included anteroposterior pelvis radiographs with both hips and lateral view of the affected hip. Templating was performed preoperatively to determine the appropriate implant size, femoral offset, neck length, and acetabular component positioning.

Surgical Procedure: All surgeries were performed under spinal or combined spinal-epidural anaesthesia under strict aseptic precautions by

experienced orthopaedic surgeons. Patients were positioned in the lateral decubitus position, and a standard posterior or posterolateral approach to the hip joint was used. Following dislocation of the femoral head and preparation of the acetabulum and femoral canal, implantation was carried out according to the planned fixation technique.

In the cemented THR group, polymethylmethacrylate (PMMA) bone cement was used for fixation of the femoral and/or acetabular components using standard cementing techniques. Proper canal preparation, pulsatile lavage, cement pressurization, and insertion of prosthetic components were performed to ensure optimal fixation. In the uncemented THR group, press-fit porous-coated implants were used, relying on biological fixation through bone ingrowth. Care was taken to achieve appropriate component alignment, stability, leg length restoration, and soft tissue balancing in both groups.

Postoperative Management and Follow-up: All patients received standard postoperative care including intravenous antibiotics, thromboprophylaxis, analgesics, and physiotherapy as per institutional protocol.

Early mobilization with assisted ambulation was encouraged from the first or second postoperative day depending on patient condition and implant stability. Weight-bearing status was individualized according to implant fixation and bone quality.

Patients were followed up clinically and radiologically at regular intervals of 6 weeks, 3 months, 6 months, 1 year, and subsequently annually for midterm assessment. Functional outcome at each follow-up visit was evaluated using the Harris Hip Score. Clinical evaluation included assessment of pain relief, gait, range of motion, limb length discrepancy, and ability to perform daily activities.

Radiological assessment was performed using serial anteroposterior and lateral radiographs of the hip to evaluate component positioning, evidence of loosening, osteolysis, subsidence, peri-prosthetic fracture, heterotopic ossification, and implant stability. Complications such as infection, dislocation, deep vein thrombosis, nerve injury, aseptic loosening, and need for revision surgery were also documented.

Outcome Measures: The primary outcome measure was functional outcome assessed using the Harris Hip Score at midterm follow-up. Secondary outcome measures included radiological implant stability, postoperative complications, pain relief, gait improvement, range of motion, and revision rates between the two groups.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 20.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Comparison between cemented and uncemented THR groups was performed using independent sample t-test or Mann–Whitney U test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. Paired t-test was used for comparison of preoperative and postoperative functional scores within each group. A p-value of less than 0.05 was considered statistically significant.

Results

The mean age of patients in the cemented THR group was significantly higher than that of the uncemented THR group (66.8 ± 8.9 vs 54.3 ± 10.6 years; $p<0.001$).

Male predominance was observed in both groups, accounting for 54.9% in the cemented group and 66.0% in the uncemented group, although the difference was not statistically significant ($p=0.184$). Mean BMI was comparable between the groups (25.7 ± 3.8 vs 26.4 ± 4.1 kg/m²; $p=0.382$). Right-sided hip involvement was slightly more common in both groups without significant intergroup difference ($p=0.871$). The mean duration of symptoms was 28.6 ± 11.5 months in the cemented group and 31.4 ± 13.2 months in the uncemented group ($p=0.271$). Comorbidities including diabetes mellitus and hypertension were more frequent in the cemented THR group, though the differences were statistically insignificant. Preoperative functional assessment using Harris Hip Score was comparable between the groups (38.9 ± 7.4 vs 40.6 ± 8.1; $p=0.287$) (Table 1).
Fracture neck of femur was the most common indication for cemented THR, observed in 33.3% of patients, compared to 10.6% in the uncemented group, demonstrating a statistically significant difference ($p=0.008$). In contrast, avascular necrosis was significantly more common among patients undergoing uncemented THR (42.6% vs 17.6%; $p=0.007$). Osteoarthritis constituted 29.4% of cases in the cemented group and 23.4% in the uncemented group without significant difference ($p=0.498$).

Rheumatoid arthritis, post-traumatic arthritis, and ankylosing spondylitis were relatively less common indications and showed no statistically significant variation between the groups (Table 2).

Table 1: Baseline demographic and clinical characteristics of patients undergoing cemented and uncemented total hip replacement

Variable	Cemented THR (n=51)	Uncemented THR (n=47)	p-value
	Frequency (%)/Mean ± SD		
Age (years)	66.8 ± 8.9	54.3 ± 10.6	<0.001
Gender			
Male	28 (54.9%)	31 (66.0%)	0.184
Female	23 (45.1%)	16 (34.0%)	
BMI (kg/m²)	25.7 ± 3.8	26.4 ± 4.1	0.382
Hip Side involved			
Right	29 (56.9%)	26 (55.3%)	0.871
Left	22 (43.1%)	21 (44.7%)	
Duration of symptoms (months)	28.6 ± 11.5	31.4 ± 13.2	0.271
Diabetes mellitus	18 (35.3%)	11 (23.4%)	0.201
Hypertension	24 (47.1%)	16 (34.0%)	0.109
Smoking history	13 (25.5%)	15 (31.9%)	0.484
Preoperative Harris Hip Score	38.9 ± 7.4	40.6 ± 8.1	0.287

THR: Total Hip Replacement; BMI: Body Mass Index; HHS: Harris Hip Score; SD: Standard Deviation

Table 2: Distribution of indications for cemented and uncemented total hip replacement

Indication	Cemented THR (n=51)	Uncemented THR (n=47)	p-value
	Frequency (%)		
Osteoarthritis	15 (29.4%)	11 (23.4%)	0.498
Fracture neck of femur	17 (33.3%)	5 (10.6%)	0.008
Avascular necrosis	9 (17.6%)	20 (42.6%)	0.007
Rheumatoid arthritis	5 (9.8%)	4 (8.5%)	0.822
Post-traumatic arthritis	3 (5.9%)	5 (10.6%)	0.392
Ankylosing spondylitis	2 (3.9%)	2 (4.3%)	0.931

THR: Total Hip Replacement

The mean operative duration was significantly longer in the cemented THR group compared to the uncemented group (108.4 ± 14.6 vs 96.8 ± 12.9 minutes; p<0.001). Similarly, mean intraoperative blood loss was significantly higher among patients undergoing cemented THR (462.7 ± 95.4 vs 398.2 ± 82.6 mL; p=0.001). Patients in the uncemented group demonstrated shorter hospital stay (7.4 ± 1.8 vs 8.9 ± 2.1 days; p<0.001) and earlier assisted ambulation (2.3 ± 0.8 vs 2.8 ± 0.9 days; p=0.004). Blood transfusion requirement and ICU stay were more frequent in the cemented group; however, these differences were not statistically significant (Table 3).

Table 3: Comparison of intraoperative and early postoperative parameters between cemented and uncemented total hip replacement

Variable	Cemented THR (n=51)	Uncemented THR (n=47)	p-value
	Frequency (%)/Mean ± SD		
Operative time (minutes)	108.4 ± 14.6	96.8 ± 12.9	<0.001
Blood loss (mL)	462.7 ± 95.4	398.2 ± 82.6	0.001
Duration of hospital stay (days)	8.9 ± 2.1	7.4 ± 1.8	<0.001
Time to assisted ambulation (days)	2.8 ± 0.9	2.3 ± 0.8	0.004
Blood transfusion required	14 (27.5%)	7 (14.9%)	0.126
ICU stay required	4 (7.8%)	2 (4.3%)	0.463

THR: Total Hip Replacement; ICU: Intensive Care Unit; SD: Standard Deviation

Both groups demonstrated significant improvement in Harris Hip Scores during follow-up. Preoperative HHS was comparable between cemented and uncemented THR groups (38.9 ± 7.4 vs 40.6 ± 8.1; p=0.287). At 6 months, functional scores improved substantially in both groups without significant difference (77.5 ± 8.6 vs 80.2 ± 7.9; p=0.112). However, at 1-year follow-up and midterm evaluation, the uncemented THR group showed significantly superior functional outcomes with higher mean HHS values of 88.5 ± 6.3 and 91.2 ± 5.7, respectively, compared to 84.8 ± 7.1 and 86.7 ± 6.8 in the cemented group (p=0.009 and p<0.001, respectively). Although overall improvement in HHS was greater in the uncemented group, the difference was not statistically significant (p=0.163). At midterm follow-up, excellent functional outcome (HHS 90–100) was observed significantly more frequently in

the uncemented group (66.0% vs 43.1%; p=0.028) (Table 4).

Table 4: Functional outcome assessment using Harris Hip Score during follow-up after cemented and uncemented total hip replacement

Follow-up Period	Cemented THR (n=51)	Uncemented THR (n=47)	p-value
	Frequency (%)/Mean ± SD		
Preoperative HHS	38.9 ± 7.4	40.6 ± 8.1	0.287
6 months	77.5 ± 8.6	80.2 ± 7.9	0.112
1 year	84.8 ± 7.1	88.5 ± 6.3	0.009
Midterm follow-up	86.7 ± 6.8	91.2 ± 5.7	<0.001
Improvement in HHS	47.8 ± 10.1	50.6 ± 9.4	0.163
Harris Hip Score Category(Midterm follow-up)			
Excellent (90–100)	22 (43.1%)	31 (66.0%)	0.028
Good (80–89)	21 (41.2%)	13 (27.7%)	
Fair (70–79)	6 (11.8%)	2 (4.3%)	
Poor (<70)	2 (3.9%)	1 (2.1%)	

HHS: Harris Hip Score; THR: Total Hip Replacement; SD: Standard Deviation

Stable implant fixation was observed in the majority of patients in both groups, with slightly higher frequency in the uncemented THR group (95.7% vs 90.2%; p=0.287).

Radiolucent lines and osteolysis were more frequently noted in the cemented group, whereas stem subsidence occurred slightly more commonly in the uncemented group; however, these differences were not statistically significant. Heterotopic ossification was observed in a small proportion of patients in both groups with comparable incidence (7.8% vs 6.4%; p=0.786).

Component loosening was more common in the cemented THR group (7.8% vs 2.1%), although statistical significance was not achieved (p=0.201) (Table 5).

Table 5: Radiological outcomes at midterm follow-up among patients undergoing cemented and uncemented total hip replacement

Radiological Parameter	Cemented THR (n=51)	Uncemented THR (n=47)	p-value
	Frequency (%)		
Stable implant fixation	46 (90.2%)	45 (95.7%)	0.287
Radiolucent lines	8 (15.7%)	3 (6.4%)	0.143
Osteolysis	5 (9.8%)	2 (4.3%)	0.292
Stem subsidence	3 (5.9%)	4 (8.5%)	0.615
Heterotopic ossification	4 (7.8%)	3 (6.4%)	0.786
Component loosening	4 (7.8%)	1 (2.1%)	0.201

THR: Total Hip Replacement

Table 6: Postoperative complications following cemented and uncemented total hip replacement

Complication	Cemented THR (n=51)	Uncemented THR (n=47)	p-value
	Frequency (%)		
Superficial infection	3 (5.9%)	2 (4.3%)	0.718
Deep infection	1 (2.0%)	0 (0%)	0.334
Dislocation	2 (3.9%)	2 (4.3%)	0.931
Deep vein thrombosis	2 (3.9%)	1 (2.1%)	0.603
Periprosthetic fracture	1 (2.0%)	4 (8.5%)	0.145
Persistent thigh pain	2 (3.9%)	7 (14.9%)	0.049
Limb length discrepancy >1 cm	4 (7.8%)	3 (6.4%)	0.786
Revision surgery required	3 (5.9%)	1 (2.1%)	0.337

THR: Total Hip Replacement; DVT: Deep Vein Thrombosis

Postoperative complications were generally low in both groups. Rates of superficial infection, deep infection, dislocation, deep vein thrombosis, and limb length discrepancy were comparable between cemented and uncemented THR groups without statistically significant differences. Periprosthetic fracture occurred more commonly in the uncemented group (8.5% vs 2.0%), though the difference was not statistically significant (p=0.145). Persistent thigh pain was significantly more frequent among patients undergoing uncemented THR compared to cemented THR

(14.9% vs 3.9%; p=0.049). Revision surgery was required in 5.9% of patients in the cemented group and 2.1% in the uncemented group, with no statistically significant difference between the groups (p=0.337) (Table 6).

Discussion

Total hip replacement (THR) remains one of the most effective surgical procedures for relieving pain and restoring functional mobility in patients with end-stage hip disease. The present study compared the midterm outcomes of cemented and uncemented THR in 98 patients and demonstrated that both techniques provided substantial functional improvement, although uncemented THR showed superior midterm functional outcomes and faster postoperative recovery in selected patients.

In the present study, patients undergoing cemented THR were significantly older than those undergoing uncemented THR (66.8 ± 8.9 vs 54.3 ± 10.6 years; p<0.001). This observation is consistent with current orthopaedic practice, where cemented fixation is generally preferred in elderly individuals with osteoporotic bone because bone cement provides immediate implant stability and reduces the risk of poor biological fixation [12]. Similar demographic trends have been reported in studies by Nayak et al., and Ko et al., where cemented arthroplasty was predominantly used in older patients with fracture neck of femur and reduced bone stock [13,14]. The higher frequency of fracture neck of femur in the cemented group (33.3% vs 10.6%; p=0.008) and avascular necrosis in the uncemented group (42.6% vs 17.6%; p=0.007) further reflects the clinical tendency to use uncemented implants in younger, more active individuals with better bone quality [14].

The present study demonstrated significantly longer operative time and higher intraoperative blood loss in the cemented THR group. Cemented procedures required additional steps including canal preparation, cement mixing, pressurization, and curing, thereby prolonging surgical duration. Increased blood loss associated with cemented fixation has also been documented by Murylev et al., and Ahmed et al., who attributed it to prolonged operative exposure and medullary canal preparation [15,16]. Additionally, patients in the uncemented group achieved earlier assisted ambulation and shorter hospital stay, suggesting faster postoperative rehabilitation [17]. Improved early mobility in uncemented THR may be related to better preservation of bone architecture and avoidance of cement-related cardiopulmonary physiological disturbances [18]. Functional outcomes assessed using Harris Hip Score improved markedly in both groups during follow-up, confirming the overall efficacy of THR irrespective of fixation method. However, the uncemented group demonstrated significantly higher HHS at 1-year and midterm follow-up (88.5 ± 6.3 and 91.2 ± 5.7, respectively) compared with the cemented group (84.8 ± 7.1 and 86.7 ± 6.8). Furthermore, excellent functional outcome was achieved in 66.0% of uncemented THR patients compared with 43.1% in the cemented group (p=0.028). These findings are comparable to reports by Mishra et al., and Axenhus et al., who observed superior long-term activity levels and better functional scores among younger patients receiving uncemented implants [19,20]. Biological fixation through osseointegration in uncemented prostheses likely contributes to improved load transfer, reduced micromotion, and enhanced implant longevity, thereby resulting in superior functional performance over time [21].

Radiological evaluation in the present study demonstrated high implant stability in both groups, with stable fixation observed in more than 90% of patients. Although radiolucent lines, osteolysis, and component loosening were more frequent in the cemented group, these differences were not statistically significant. Cement degradation and particulate wear-induced osteolysis are recognized causes of late aseptic loosening in cemented THR [22]. Conversely, the slightly higher incidence of stem subsidence in the uncemented group may be explained by inadequate initial press-fit fixation or delayed osseointegration during the early postoperative period [22]. Similar radiological findings have been reported in studies by Dogger et al., andHuang et al., which demonstrated excellent long-term fixation with modern porous-coated uncemented stems [23,24]. The overall complication rates were low and comparable between the groups. Persistent thigh pain was significantly more common in the uncemented group (14.9% vs 3.9%; p=0.049), which correlates with previously studies by Hannon et al.,and Abushal et al., [25,26]. Thigh pain following uncemented THR is believed to result from stress transfer at the distal stem tip, micromotion, or mismatch between implant stiffness and femoral cortical elasticity [27]. Periprosthetic fractures were also relatively more frequent in the uncemented group, likely due to the forceful press-fit implantation technique and reduced femoral canal compliance in some patients. In contrast, the cemented group demonstrated slightly higher revision rates and component loosening, findings that may be associated with cement fatigue and progressive bone-cement interface failure over time [28,29].

Limitations

The present study was limited by its relatively small sample size and single-center design, which may restrict generalizability of the findings. The midterm follow-up duration may not fully reflect

long-term implant survivorship and late complications such as aseptic loosening.

Differences in patient age, bone quality, and underlying indications between the two groups may also have influenced postoperative outcomes despite comparable baseline functional status.

Conclusion

Both cemented and uncemented total hip replacement demonstrated satisfactory clinical, functional, and radiological outcomes at midterm follow-up. Cemented THR was more commonly performed in elderly patients with fracture neck of femur and poor bone quality, whereas uncemented THR was preferred in younger patients with avascular necrosis and better bone stock. Although both groups showed substantial improvement in Harris Hip Scores, uncemented THR provided superior midterm functional outcomes, earlier ambulation, and shorter hospital stay.

Persistent thigh pain was more frequent in the uncemented group, while radiological loosening tended to occur more commonly in cemented implants. Appropriate patient selection and surgical planning remain essential for achieving optimal outcomes following total hip replacement.

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