International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/
Original Researcher Article *DOI: 10.61336/im/26-07-135*

Comparative Study of Cemented versus Uncemented Total Hip Arthroplasty in Terms of Functional Outcome and Complications.

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Received: 07-04-2026
Revised: 11-05-2026
Accepted: 10-06-2026
Published: 14-07-2026

Abstract
Background: Total hip arthroplasty (THA) is an established surgical procedure for relieving pain and restoring function in patients with end-stage hip disorders. Cemented and uncemented fixation techniques are widely used, each offering distinct biomechanical and clinical advantages. However, the optimal method of fixation remains a matter of debate. ***Aim:*** To compare the functional outcomes and postoperative complications between cemented and uncemented total hip arthroplasty. Objectives: To compare the functional outcome of cemented and uncemented THA using the Harris Hip Score. To compare the incidence of postoperative complications between cemented and uncemented THA. To evaluate radiological outcomes and implant stability following cemented and uncemented THA. ***Materials and Methods:*** A prospective comparative observational study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital. A total of 140 patients undergoing primary total hip arthroplasty were included, comprising 70 patients treated with cemented THA and 70 patients treated with uncemented THA. Demographic characteristics, operative details, Harris Hip Score, postoperative complications, and radiological outcomes were recorded using a structured case record form. Statistical analysis was performed using SPSS version 26.0. Continuous variables were analyzed using the independent Student's t-test, while categorical variables were compared using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant. ***Results:*** The cemented THA group had a significantly higher mean age than the uncemented group (62.8±8.7 vs. 56.9±10.4 years; $p<0.001$). Operative time (102.4±17.6 vs. 94.8±15.9 minutes; $p=0.008$) and hospital stay (8.9±2.7 vs. 7.6±2.4 days; $p=0.003$) were significantly longer in the cemented group. Preoperative Harris Hip Scores were comparable between groups ($p=0.652$). The uncemented THA group demonstrated significantly higher Harris Hip Scores at 6 weeks (67.8±8.4 vs. 64.7±8.9; $p=0.036$), 3 months (82.9±7.1 vs. 78.6±7.7; $p=0.001$), and 6 months (90.7±5.8 vs. 86.8±6.9; $p<0.001$). Improvement in Harris Hip Score, earlier independent walking, and lower pain scores also favored the uncemented group. Overall postoperative complications (24.3% vs. 31.4%; $p=0.346$) and radiological implant stability were comparable between both fixation methods. ***Conclusion:*** Both cemented and uncemented total hip arthroplasty achieved excellent functional recovery and satisfactory radiological outcomes with comparable complication rates. Uncemented THA demonstrated superior early functional recovery and earlier mobilization, whereas cemented THA remained an effective option for older patients with poorer bone quality. Appropriate patient selection and individualized fixation strategy remain essential for achieving optimal clinical outcomes.

Keywords: Total Hip Arthroplasty. Cemented Hip Prosthesis. Harris Hip Score.

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INTRODUCTION
Total hip arthroplasty (THA) is one of the most successful orthopedic procedures for relieving pain, restoring mobility, and improving the quality of life in patients with end-stage hip disorders. Since its introduction, THA has undergone remarkable advancements in implant design, bearing surfaces, fixation techniques, and surgical approaches, resulting in improved implant longevity and patient satisfaction. The common indications for THA include primary osteoarthritis, avascular necrosis of the femoral head, rheumatoid arthritis, fracture neck of femur, post-traumatic arthritis, developmental dysplasia of the hip, and inflammatory joint diseases. With increasing life expectancy and growing demand for mobility among elderly as well as younger active individuals, the number of THA procedures performed worldwide has increased substantially.[1]

One of the most important decisions during THA is the choice between cemented and uncemented fixation of the prosthetic components. Cemented total hip arthroplasty utilizes polymethylmethacrylate (PMMA) bone cement to secure the femoral and acetabular components, providing immediate implant stability and allowing early weight bearing. Cemented implants have traditionally demonstrated excellent long-term survival, particularly among elderly patients with poor bone quality or osteoporosis. However, concerns regarding cement implantation syndrome, longer operative time, and difficulty during revision surgery have prompted the development and widespread adoption of uncemented implants.[2]

Uncemented total hip arthroplasty relies on biological fixation through osseointegration between the implant surface and host bone. Modern porous-coated and hydroxyapatite-coated implants encourage bone ingrowth, resulting in durable fixation without the use of cement. These implants are generally preferred in younger patients with good bone stock because of their potential for long-term biological stability and easier revision. Nevertheless, uncemented fixation may be associated with complications such as intraoperative femoral fractures, postoperative thigh pain, delayed weight bearing in selected patients, and early implant migration if adequate primary stability is not achieved.[3]

Several randomized controlled trials, observational studies, and joint registry analyses have compared cemented and uncemented THA regarding functional outcomes, implant survival, complication rates, and revision surgery. Although both fixation methods have demonstrated excellent clinical results, evidence suggests that patient age, bone quality, activity level, surgeon experience, and implant selection significantly influence postoperative outcomes. Functional assessment using validated scoring systems such as the Harris Hip Score (HHS), Oxford Hip Score, and WOMAC score has become the standard for evaluating postoperative recovery. Similarly, monitoring complications including periprosthetic fracture, aseptic loosening, prosthetic joint infection, dislocation, thromboembolic events, and revision surgery is essential for determining the long-term success of THA.[4]

Despite numerous published studies, the optimal fixation method remains a subject of ongoing debate, particularly in developing countries where patient demographics, bone quality, implant availability, and economic considerations may differ from Western populations. Therefore, comparative evaluation of cemented and uncemented THA in the local population is necessary to generate evidence that may assist surgeons in selecting the most appropriate fixation technique. The present study was undertaken to compare cemented and uncemented total hip arthroplasty with respect to functional outcomes and postoperative complications, thereby contributing to evidence-based clinical decision-making and improving patient care.[5]

AIM

To compare the functional outcomes and postoperative complications between cemented and uncemented total hip arthroplasty.

OBJECTIVES

1) To compare the functional outcome of cemented and uncemented total hip arthroplasty using the Harris Hip Score.
2) To compare the incidence of postoperative complications between cemented and uncemented total hip arthroplasty.
3) To evaluate radiological outcomes and implant stability following cemented and uncemented total hip arthroplasty.

MATERIALS AND METHODS

Source of Data

The data were collected from patients undergoing primary total hip arthroplasty in the Department of Orthopaedics at the study hospital. Clinical details, radiological findings, operative records, and postoperative follow-up data were obtained from hospital records and direct patient assessment using a predesigned case record form.

Study Design

A hospital-based prospective comparative observational study was conducted.

Study Location

The study was conducted in the Department of Orthopaedics of a tertiary care teaching hospital.

Study Duration

The study was conducted over a period of 18 months, including patient recruitment, surgery, follow-up, data collection, analysis, and interpretation.

Sample Size

A total of 140 patients undergoing primary total hip arthroplasty were included in the study.

- Cemented THA: 70 patients

- Uncemented THA: 70 patients

Patients were enrolled consecutively after satisfying the eligibility criteria until the desired sample size was achieved.

Inclusion Criteria

Patients fulfilling all of the following criteria were included:

- Age ≥18 years.
- Patients undergoing primary total hip arthroplasty.
- Indications including osteoarthritis, avascular necrosis of femoral head, fracture neck of femur, rheumatoid arthritis, post-traumatic arthritis, and other degenerative hip disorders.
- Patients receiving either cemented or uncemented prosthesis.
- Patients willing to participate and provide written informed consent.
- Patients available for postoperative follow-up.

Exclusion Criteria

Patients with any of the following were excluded:

- Revision total hip arthroplasty.
- Active local or systemic infection.
- Pathological fractures due to malignancy.
- Severe neuromuscular disorders affecting gait.
- Polytrauma patients requiring multiple major surgeries.
- Previous ipsilateral hip arthroplasty.
- Patients with incomplete clinical records.
- Patients unwilling to participate or lost to follow-up.

Procedure and Methodology

Institutional Ethics Committee approval was obtained before commencement of the study. Eligible patients attending the Orthopaedic outpatient department or admitted for surgery were screened according to the inclusion and exclusion criteria. Written informed consent was obtained from all participants before enrollment.

A detailed history including age, sex, body mass index, presenting complaints, diagnosis, duration of symptoms, comorbidities, smoking status, alcohol intake, and indication for surgery was recorded. General physical examination and local examination of the affected hip were performed. Baseline laboratory investigations including complete blood count, renal function tests, liver function tests, blood sugar profile, coagulation profile, viral markers, electrocardiography, and chest radiography were carried out whenever indicated. Preoperative radiological assessment included anteroposterior pelvis radiograph with both hips and lateral view of the affected hip. Implant templating was performed before surgery.

Patients underwent either cemented or uncemented total hip arthroplasty according to the treating surgeon's preference, patient age, bone quality, and intraoperative assessment. Standard surgical techniques and perioperative antibiotic prophylaxis were followed. Appropriate postoperative rehabilitation protocols, thromboprophylaxis, physiotherapy, and early mobilization were instituted in both groups. Patients were evaluated clinically during the postoperative period and at scheduled follow-up visits. Functional outcome was assessed using the Harris Hip Score at follow-up. Radiographs were evaluated for implant position, alignment, radiolucent lines, loosening, subsidence, and evidence of osseointegration where applicable. Postoperative complications including superficial wound infection, deep infection, dislocation, periprosthetic fracture, deep vein thrombosis, pulmonary embolism, limb length discrepancy, aseptic loosening, implant failure, and revision surgery were recorded.

Sample Processing

Each participant was assigned a unique study identification number. Data collected from clinical examination, operative findings, radiological assessment, laboratory investigations, and follow-up evaluations were entered into a standardized case record form. Functional scores and complication details were verified before data entry. The completed forms were checked for completeness and accuracy before statistical analysis.

Statistical Methods

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0.

- Continuous variables were expressed as Mean ± Standard Deviation (SD).
- Categorical variables were expressed as frequency and percentage.
- Independent Student's t-test was used to compare continuous variables between the two groups.
- Chi-square test or Fisher's Exact test was used for categorical variables.

- Repeated measurements of functional scores, where applicable, were analyzed using repeated-measures ANOVA.
- Relative risk or odds ratio with 95% confidence intervals were calculated where appropriate.
- A p-value <0.05 was considered statistically significant.

Data Collection

Data were collected using a structured case record form designed specifically for the study. The following information was recorded:

- Demographic details (age, sex, BMI)
- Diagnosis and indication for THA
- Side of surgery
- Associated comorbidities
- Preoperative clinical findings
- Radiological findings
- Type of prosthesis (cemented or uncemented)
- Operative duration
- Intraoperative blood loss
- Length of hospital stay
- Time to mobilization
- Harris Hip Score (preoperative and postoperative follow-up)
- Radiological assessment of implant stability
- Early and late postoperative complications
- Requirement for revision surgery
- Final clinical and functional outcome.

RESULTS

Table 1: Overall functional and complication profile between cemented and uncemented THA

Variable	Cemented THA (n=70)	Uncemented THA (n=70)	Test	95% CI	p-value
Age, years, Mean±SD	62.8±8.7	56.9±10.4	t=3.64	2.69 to 9.11	<0.001*
Male	33 (47.1%)	41 (58.6%)	χ^2=1.83	-27.9% to 5.0%	0.176
Female	37 (52.9%)	29 (41.4%)	χ^2=1.83	-5.0% to 27.9%	0.176
BMI, kg/m², Mean±SD	25.7±3.8	24.9±3.6	t=1.28	-0.44 to 2.04	0.203
Operative time, min, Mean±SD	102.4±17.6	94.8±15.9	t=2.68	1.99 to 13.21	0.008*
Hospital stay, days, Mean±SD	8.9±2.7	7.6±2.4	t=3.01	0.45 to 2.15	0.003*
Good/Excellent functional outcome	58 (82.9%)	63 (90.0%)	χ^2=1.48	-18.3% to 4.0%	0.224
Any postoperative complication	22 (31.4%)	17 (24.3%)	χ^2=0.89	-7.7% to 21.9%	0.346

Table 1 compares the overall functional and complication profile between patients undergoing cemented and uncemented total hip arthroplasty (THA). The mean age was significantly higher in the cemented THA group (62.8±8.7 years) than in the uncemented THA group (56.9±10.4 years) (t=3.64, 95% CI: 2.69 to 9.11, p<0.001). The proportion of male patients was 47.1% in the cemented group and 58.6% in the uncemented group, while females constituted 52.9% and 41.4%, respectively; however, the gender distribution did not differ significantly (p=0.176).

The mean BMI was comparable between the two groups (25.7±3.8 vs. 24.9±3.6 kg/m²; p=0.203). The mean operative time was significantly longer in the cemented THA group (102.4±17.6 minutes) compared to the uncemented THA group (94.8±15.9 minutes) (t=2.68, 95% CI: 1.99 to 13.21, p=0.008). Similarly, the mean hospital stay was significantly longer in patients who underwent cemented THA (8.9±2.7 days) than in those receiving uncemented THA (7.6±2.4 days) (t=3.01, 95% CI: 0.45 to 2.15, p=0.003).

Good to excellent functional outcomes were observed in 82.9% of cemented THA patients and 90.0% of uncemented THA patients, although this difference was not statistically significant (p=0.224). Postoperative complications occurred in 31.4% of the cemented group and 24.3% of the uncemented group, with no significant difference between the groups (p=0.346).

Table 2: Comparison of Harris Hip Score between cemented and uncemented THA

Harris Hip Score parameter	Cemented THA (n=70)	Uncemented THA (n=70)	Test	95% CI	p-value
Preoperative HHS	41.8±7.6	42.4±8.1	t=0.45	-3.23 to 2.03	0.652
HHS at 6 weeks	64.7±8.9	67.8±8.4	t=2.12	-5.99 to -0.21	0.036*
HHS at 3 months	78.6±7.7	82.9±7.1	t=3.44	-6.78 to -1.82	0.001*
HHS at 6 months	86.8±6.9	90.7±5.8	t=3.62	-6.03 to -1.77	<0.001*
Improvement in HHS	45.1±8.4	48.3±8.2	t=2.28	-5.97 to -0.43	0.024*
Time to independent walking, days	9.4±2.8	8.1±2.5	t=2.90	0.41 to 2.19	0.004*
VAS pain score at 6 weeks	3.2±1.1	2.7±1.0	t=2.81	0.15 to 0.85	0.006*

Table 2 compares the Harris Hip Score (HHS) and functional recovery between the cemented and uncemented THA groups. The preoperative HHS was similar in both groups (41.8±7.6 vs. 42.4±8.1; p=0.652), indicating comparable baseline functional status. At 6 weeks, patients in the uncemented THA group achieved a significantly higher HHS than those in the cemented group (67.8±8.4 vs. 64.7±8.9; t=2.12, 95% CI: −5.99 to −0.21, p=0.036). This significant difference continued at 3 months (82.9±7.1 vs. 78.6±7.7; p=0.001) and at 6 months (90.7±5.8 vs. 86.8±6.9; p<0.001), demonstrating superior functional recovery in the uncemented THA group. The overall improvement in HHS was also significantly greater among patients undergoing uncemented THA (48.3±8.2) compared with cemented THA (45.1±8.4) (p=0.024). Furthermore, patients in the uncemented group achieved independent walking significantly earlier (8.1±2.5 vs. 9.4±2.8 days; p=0.004) and reported significantly lower pain scores at 6 weeks (VAS 2.7±1.0 vs. 3.2±1.1; p=0.006).

Table 3: Incidence of postoperative complications between cemented and uncemented THA

Complication	Cemented THA (n=70)	Uncemented THA (n=70)	Test	95% CI	p-value
Superficial wound infection	7 (10.0%)	3 (4.3%)	χ^2=1.72	-2.8% to 14.2%	0.189
Deep infection	3 (4.3%)	2 (2.9%)	Fisher's exact	-4.7% to 7.6%	1.000
Dislocation	4 (5.7%)	2 (2.9%)	Fisher's exact	-3.8% to 9.6%	0.681
Periprosthetic fracture	2 (2.9%)	7 (10.0%)	Fisher's exact	-15.2% to 0.9%	0.165
Deep vein thrombosis	4 (5.7%)	3 (4.3%)	Fisher's exact	-5.8% to 8.6%	1.000
Limb length discrepancy	8 (11.4%)	6 (8.6%)	χ^2=0.32	-7.1% to 12.8%	0.573
Aseptic loosening	4 (5.7%)	2 (2.9%)	Fisher's exact	-3.8% to 9.6%	0.681
Revision surgery	3 (4.3%)	2 (2.9%)	Fisher's exact	-4.7% to 7.6%	1.000
Any complication	22 (31.4%)	17 (24.3%)	χ^2=0.89	-7.7% to 21.9%	0.346

Table 3 compares the postoperative complications observed in the cemented and uncemented THA groups. Superficial wound infection occurred in 10.0% of patients in the cemented group and 4.3% in the uncemented group, although the difference was not statistically significant (p=0.189). Deep infection was uncommon in both groups, occurring in 4.3% and 2.9% of patients, respectively (p=1.000). Dislocation occurred in 5.7% of cemented THA patients and 2.9% of uncemented THA patients (p=0.681). Periprosthetic fracture was observed more frequently in the uncemented group (10.0%) compared with the cemented group (2.9%), but this difference did not reach statistical significance (p=0.165). Deep vein thrombosis was reported in 5.7% of cemented THA patients and 4.3% of uncemented THA patients (p=1.000). Limb length discrepancy occurred in 11.4% and 8.6% of patients in the cemented and uncemented groups, respectively (p=0.573). Aseptic loosening was identified in 5.7% of cemented THA patients and 2.9% of uncemented THA patients (p=0.681),

while revision surgery was required in 4.3% and 2.9% of patients, respectively (p=1.000). Overall postoperative complications were observed in 31.4% of the cemented group and 24.3% of the uncemented group, with no statistically significant difference between the two groups (χ^2=0.89, p=0.346).

Table 4: Radiological outcomes and implant stability following cemented and uncemented THA

Radiological parameter	Cemented THA (n=70)	Uncemented THA (n=70)	Test	95% CI	p-value
Cup inclination angle, degrees	42.7±5.4	41.9±4.9	t=0.92	-0.92 to 2.52	0.360
Neutral cup position	57 (81.4%)	61 (87.1%)	χ^2=0.86	-17.7% to 6.3%	0.353
Stem alignment deviation, degrees	1.8±1.2	1.5±1.1	t=1.54	-0.08 to 0.68	0.125
Radiolucent line present	8 (11.4%)	4 (5.7%)	Fisher's exact	-3.5% to 14.9%	0.366
Stem subsidence >2 mm	4 (5.7%)	9 (12.9%)	Fisher's exact	-16.7% to 2.4%	0.243
Limb length discrepancy, mm	6.3±3.1	5.7±2.8	t=1.20	-0.39 to 1.59	0.232
Stable implant at follow-up	63 (90.0%)	61 (87.1%)	χ^2=0.29	-7.8% to 13.5%	0.592
Evidence of osseointegration	Not applicable	63 (90.0%)			

*Statistically significant at p<0.05.

Table 4 compares the radiological outcomes and implant stability between cemented and uncemented THA. The mean cup inclination angle was comparable between the cemented and uncemented groups (42.7±5.4° vs. 41.9±4.9°; p=0.360). Neutral cup positioning was achieved in 81.4% of cemented THA patients and 87.1% of uncemented THA patients, with no significant difference (p=0.353). The mean stem alignment deviation was similar in both groups (1.8±1.2° vs. 1.5±1.1°; p=0.125). Radiolucent lines were observed in 11.4% of cemented THA patients and 5.7% of uncemented THA patients (p=0.366). Stem subsidence greater than 2 mm occurred more frequently in the uncemented group (12.9%) than in the cemented group (5.7%), although this difference was not statistically significant (p=0.243). The mean postoperative limb length discrepancy was comparable between the groups (6.3±3.1 mm vs. 5.7±2.8 mm; p=0.232). Stable implant fixation at follow-up was achieved in 90.0% of patients undergoing cemented THA and 87.1% of those undergoing uncemented THA, with no statistically significant difference (p=0.592). Evidence of successful osseointegration was observed in 90.0% of patients with uncemented implants, while this parameter was not applicable to the cemented fixation group.

DISCUSSION

In the present study, the cemented THA group had a significantly higher mean age than the uncemented group, indicating that cemented fixation was more commonly preferred in relatively older patients, probably because of poorer bone quality and need for immediate stable fixation. Similar observations were reported by Goyal et al. (2018)[1] and Taanam et al. (2025)[2], who noted that cemented fixation was frequently used in elderly patients, whereas uncemented fixation was preferred in younger and more active patients with better bone stock. In the present study, operative time and hospital stay were significantly higher in the cemented group. This was comparable with Moore et al. (2024)[3], who reported higher perioperative burden in cemented THA, although fixation choice was strongly influenced by patient factors. However, the overall good/excellent functional outcome was comparable between cemented and uncemented THA, which agrees with Sapienza et al. (2024)[4] and Ahmed et al. (2025)[5], who concluded that both fixation techniques provide satisfactory functional improvement when appropriately selected.

In the present study, preoperative Harris Hip Score was comparable between both groups, suggesting similar baseline disability. Postoperatively, HHS at 6 weeks, 3 months, and 6 months was significantly better in the uncemented THA group. The improvement in HHS was also significantly higher in the uncemented group, along with earlier independent walking and lower VAS pain score at 6 weeks. These findings indicate better early functional recovery in the uncemented group. Taanam et al. (2025)[2] similarly reported slightly better functional outcomes in uncemented THA, although differences were not statistically significant in their study. In contrast, Goyal et al. (2018)[1] and Ahmed et al. (2025)[5] observed better early functional scores in cemented THA, especially during the early postoperative period. This variation may be explained by differences in patient age, diagnosis, bone quality, rehabilitation protocol, implant design, and duration of follow-up. Marahatta et al. (2020)[6] also reported that THA produced marked improvement in pain and function when assessed by Harris Hip Score, supporting the usefulness of HHS as a functional outcome measure after THA.

Regarding complications, the present study showed no statistically significant difference in overall postoperative complications between cemented and uncemented THA. Superficial wound infection, deep infection, dislocation, DVT, limb length discrepancy, aseptic loosening, and revision surgery were comparable between groups. Periprosthetic fracture was numerically higher in the uncemented group, although not statistically significant. Similar findings were reported by Roitzsch et al. (2025)[7], who observed that fixation method influenced revision risk, particularly in fracture-related THA. Moore et al. (2024)[3] reported higher infection, aseptic loosening, and revision rates in cemented fixation in a large database study, while other registry-based studies have suggested that cemented fixation may reduce early periprosthetic fracture risk in elderly patients. Thus, complication patterns appear to depend on patient selection, age, bone quality, surgical technique, and implant design. The present finding of comparable overall complications supports the view that both cemented and uncemented THA are safe when used in appropriately selected patients.

Radiological outcomes in the present study were also comparable between the two groups. Cup inclination angle, neutral cup position, stem alignment deviation, radiolucent lines, stem subsidence, limb length discrepancy, and implant stability did not show statistically significant differences. Stable implant fixation was observed in 90.0% of cemented and 87.1% of uncemented THA cases. Evidence of osseointegration was present in 90.0% of uncemented implants. These findings are consistent with Abushal et al. (2025)[8] and Siddiqi et al. (2025)[9], who emphasized that cementless fixation depends on initial mechanical stability followed by biological osseointegration. Lim et al. (2025)[10] also noted that stem subsidence after cementless THA may be influenced by bone mineral density, femoral morphology, and canal fill ratio. In the present study, although stem subsidence was numerically higher in the uncemented group, the difference was not statistically significant, suggesting acceptable early implant stability.

CONCLUSION

provided excellent clinical and functional outcomes with acceptable complication rates. Patients undergoing uncemented THA showed significantly better early postoperative functional recovery, as evidenced by higher Harris Hip Scores at 6 weeks, 3 months, and 6 months, greater overall improvement in functional score, earlier achievement of independent ambulation, and lower postoperative pain scores. Conversely, cemented THA was more frequently performed in older patients and was associated with significantly longer operative time and hospital stay. Despite these differences, the incidence of postoperative complications, including infection, dislocation, deep vein thrombosis, aseptic loosening, revision surgery, and overall complication rate, was comparable between the two groups. Radiological assessment also demonstrated similar implant positioning, alignment, and stability, while satisfactory osseointegration was achieved in the majority of uncemented implants. Therefore, both fixation techniques are safe and effective options for primary total hip arthroplasty. The choice between cemented and uncemented fixation should be individualized according to patient age, bone quality, functional demand, implant characteristics, and surgeon expertise rather than relying on a single fixation strategy for all patients.

LIMITATIONS OF THE STUDY

1) The sample size of 140 patients, although adequate for comparison, may not detect differences in rare complications.
2) The follow-up duration was relatively short and did not permit assessment of long-term implant survival or late aseptic loosening.
3) Implant selection and fixation method were influenced by surgeon preference and patient characteristics, introducing potential selection bias.
4) Multiple implant designs and manufacturers were not analyzed separately, which may have influenced functional and radiological outcomes.
5) Functional assessment was primarily based on the Harris Hip Score without inclusion of other patient-reported outcome measures.
6) Bone mineral density and objective assessment of bone quality were not evaluated for all patients.
7) The study did not include cost-effectiveness analysis or quality-of-life assessment.
8) Long-term revision rates and implant survivorship could not be determined.
9) Multicentre randomized studies with larger sample sizes and longer follow-up are required to validate these findings.

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