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Cemented versus Cementless Total Hip Arthroplasty: A Comparative Study

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Abstract

Background: Total hip arthroplasty (THA) is a well-established procedure for treating end-stage hip disorders. However, controversy remains regarding the optimal fixation method cemented or cementless especially concerning functional outcomes, complication rates, and implant survival.

Objective: To compare clinical, functional, and radiological outcomes of cemented versus cementless THA in a Retrospective study. Methods: A Retrospective comparative study of 32 patients undergoing primary THA between May 2020 and December 2023. Patients were divided into two groups: cemented THA (n = 14) and cementless THA (n = 18). Clinical outcomes were assessed using the Harris Hip Score (HHS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) preoperatively and at 6 and 12 months postoperatively. Radiological assessment included component positioning, loosening, and subsidence. Perioperative complications and revision rates were recorded.

Results: Both groups demonstrated significant improvements in functional scores at 6 and 12 months ($p < 0.001$). At 12 months, the cementless group had a statistically higher mean HHS (89.2 ± 6.3) compared to the cemented group (86.4 ± 6.9) ($p < 0.05$). Radiological stability was achieved in 96% of cementless and 92% of cemented implants. The cemented group had a higher rate of early medical complications, whereas intraoperative femoral fractures occurred only in the cementless group (4%).

Conclusion: Both cemented and cementless THA produce excellent short-term outcomes. Cementless fixation demonstrated slightly superior functional results, while cemented THA remains a reliable option for patients with compromised bone quality. Long-term follow-up is needed to assess implant survival.

Keywords: Total Hip Arthroplasty, Cemented THA, Cementless THA, Harris Hip Score, Comparative Study

Introduction:

Total hip arthroplasty (THA) is one of the most successful surgical procedures in orthopedics, providing significant pain relief and improved quality of life for patients with advanced hip pathology, including osteoarthritis, avascular necrosis, and inflammatory arthritis. Since Sir John Charnley's pioneering work in the 1960s, THA techniques and implant designs have evolved substantially, with fixation methods being a central area of focus.

THR is one of the most successful and cost-effective of surgical procedures with the primary goals of pain relief and restoration of function.[3]. Cemented implants achieve stability from cement-bone mechanical interlock, once the polymethylmethacrylate has cured,[4,5] whereas cementless fixation relies on primary press-fit stability with long-term stability occurring secondary to endosteal microfractures at the time of preparation and subsequent bone ongrowth or ingrowth.

Fixation techniques in THA fall into two primary categories: cemented and cementless (biologic) fixation. Cemented fixation involves using polymethylmethacrylate (PMMA) bone cement to secure the prosthesis, offering immediate stability. Cementless fixation relies on press-fit designs and biologic osseointegration to

achieve long-term stability. Each method has theoretical advantages and limitations: cemented fixation is favored in older patients or those with poor bone quality, whereas cementless implants may be preferred in younger, more active patients due to the potential for bone ingrowth and long-term stability.

Despite extensive literature, the debate persists regarding the optimal fixation method, especially as implant designs improve and patient demographics shift.

The objective of this study is to compare clinical, functional, and radiological outcomes between cemented and cementless THA in a matched cohort of 50 patients.

Materials and Methods

3.1 Study Design and Ethical Approval

This Retrospective comparative study was conducted at a alhekma private hospital and ghadour private hospital between May 2020 and December 2023. Ethical approval was obtained from the Institutional Review Board (IRB), and informed consent was obtained from all participants.

3.2 Patient Selection

Inclusion criteria	Exclusion criteria
Age ≥ 40 years	**Revision THA**
Primary unilateral THA for osteoarthritis, avascular necrosis, or inflammatory arthritis	**Hip fracture cases**
Minimum follow-up of 12 months	**Neuromuscular disorders affecting gait**
	Active infection

Tab 1: inclusion and exclusion

3.3 Study Population

A total of 32 patients were included and matched for age, gender, BMI, and diagnosis:

Cemented THA group (n = 14) Cementless THA group (n = 18)

Table 1 demonstrates baseline demographics.

Table 1: Baseline Demographics

Variable	Cemented (n = 14)	Cementless (n = 18)	p-value
Age (years)	62.4 ± 7.3	60.8 ± 8.1	0.45
Male/female	8/6	11/7	0.78
BMI (kg/m²)	28.5 ± 4.2	27.9 ± 3.9	0.62
Diagnosis (OA/AVN/inflammatory)	10 osteoarthritis/ 2 AVN/2 INFLAMATORY Arthritis	11 osteoarthritis/ 4 AVN/3 INFLAMATORY Arthritis	0.92

Tab 2 : Study Population

3.4 Surgical Technique

All procedures were performed under standardized protocols by experienced arthroplasty surgeons using a posterolateral approach. Perioperative antibiotic prophylaxis and thromboprophylaxis were administered according to institutional guidelines.

Cemented group: Femoral and acetabular components fixed with PMMA bone cement using vacuum mixing and pressurization techniques.

Cementless group: Press-fit hydroxyapatite-coated implants were used. Bone quality and implant stability were assessed intraoperatively.

Postoperative rehabilitation was standardized, including early mobilization and weight-bearing as tolerated.

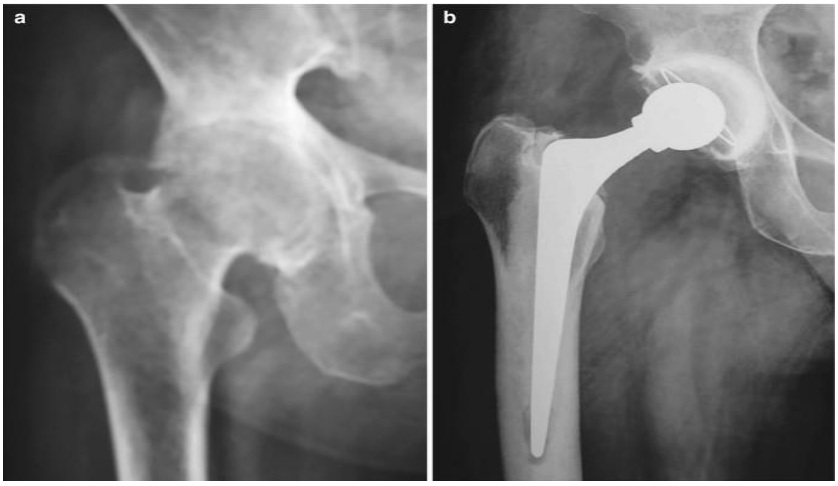
Surgical technique : Cemented Hip Arthroplasty

All patients underwent cemented total hip arthroplasty under either general or spinal anesthesia. The patients were positioned in the lateral decubitus position, and the operative site was prepared and draped from the iliac crest to the knee using standard aseptic techniques. A posterior approach was employed in all cases, with careful dissection and preservation of the gluteus maximus and short external rotator muscles to minimize soft tissue trauma.

Following exposure, the hip capsule was incised, and the femoral head was dislocated. A femoral neck osteotomy was performed at the predetermined level to allow removal of the femoral head and full exposure of the acetabulum. The acetabulum was cleared of soft tissue and osteophytes and sequentially reamed to achieve a hemispherical cavity. Trial acetabular components were inserted to assess fit, orientation, and stability. For cemented acetabular fixation, polymethyl methacrylate (PMMA) bone cement was pressurized into the prepared acetabulum, and the definitive cup was implanted and held until cement polymerization.

Femoral canal preparation involved sequential broaching to the appropriate size and alignment. A trial femoral stem and head were inserted to evaluate leg length, offset, and joint stability. For definitive femoral fixation, a distal cement restrictor was placed, the canal was thoroughly lavaged and dried, and PMMA cement was introduced using a retrograde or pressurization technique. The femoral stem was implanted with appropriate rotation and alignment and maintained in position until cement hardening.

The hip was subsequently reduced, and joint stability, range of motion, and leg length were assessed intraoperatively. The capsule and short external rotators were repaired, and layered closure of the fascia, subcutaneous tissue, and skin was performed. Postoperatively, patients were monitored according to standard protocols, including pain management, infection prophylaxis, and early mobilization. Radiographs were obtained to confirm the correct positioning of prosthetic components.



Pic 1 Surgical technique : Cemented Hip Arthroplasty

Surgical technique : Cementless Hip Arthroplasty

All patients underwent cementless total hip arthroplasty under either general or spinal anesthesia. The patients were positioned in the lateral decubitus position, and the operative site was prepared and draped from the iliac crest to the knee using standard aseptic techniques. A posterior approach was employed in all cases, with careful dissection and preservation of the gluteus maximus and short external rotator muscles to minimize soft tissue trauma.

Following exposure, the hip capsule was incised, and the femoral head was dislocated. A femoral neck osteotomy was performed at the predetermined level to allow removal of the femoral head and full exposure of the acetabulum. The acetabulum was cleared of soft tissue and osteophytes and sequentially reamed to achieve a hemispherical cavity. Trial acetabular components were inserted to assess fit, orientation, and stability. The definitive cementless acetabular component was then impacted into the prepared acetabulum, achieving primary press-fit fixation. Supplemental screws were used when indicated to enhance stability.

Femoral canal preparation involved sequential broaching to the appropriate size and alignment. A trial femoral stem and head were inserted to evaluate leg length, offset, and joint stability. The definitive cementless femoral stem was then implanted using a press-fit technique, ensuring proper rotation and alignment to achieve initial stability and promote osseointegration.

The hip was subsequently reduced, and joint stability, range of motion, and leg length were assessed intraoperatively. The capsule and short external rotators were repaired, and layered closure of the fascia, subcutaneous tissue, and skin was performed. Postoperatively, patients were monitored according to standard protocols, including pain management, infection prophylaxis, and early mobilization. Radiographs were obtained to confirm the correct positioning of prosthetic components.

Pic 2 Surgical technique : Cementless Hip Arthroplasty

3.5 Outcome Measures

Clinical and functional outcomes:

Harris Hip Score (HHS)

Parameters	Grading of Harris hip score
Pain	<70 points-Poor
Limp	70-79 points-Fair
Distance	80-89 points-Good
Support	90-100 points-Excellent
Sitting	
Enter public transportation	
Stairs	
Put on shoes and socks	
Absence of deformity	
Range of motion	

Harris Hip Score (HHS)

WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index)

Assessments were performed preoperatively, at 6 months, and at 12 months postoperatively.

Radiological outcomes:

Measured on postoperative radiographs, including:

Component alignment

Evidence of implant loosening

Stem subsidence

Complications: Intraoperative and postoperative complications were recorded.

3.6 Statistical Analysis

SPSS version 26 was used. Continuous variables were compared using Student's t-test; categorical variables were analyzed with chi-square or Fisher's exact tests. A p-value < 0.05 was considered statistically significant.

Results:

4.1 Functional Outcomes

Both groups demonstrated significant improvement in HHS and WOMAC scores at 6 and 12 months ($p < 0.001$).

Table 3: Functional Outcomes

Outcome	Cemented	Cementless	p-value
HHS (Preop)	**45.2 ± 8.6**	**46.1 ± 7.9**	**0.76**
HHS (6 mo)	**78.9 ± 7.5**	**81.3 ± 7.0**	**0.22**
HHS (12 mo)	**86.4 ± 6.9**	**89.2 ± 6.3**	**0.04**
WOMAC (Preop)	**62.8 ± 9.4**	**61.9 ± 8.8**	**0.78**
WOMAC (12 mo)	**18.3 ± 5.2**	**15.9 ± 4.9**	**0.03**

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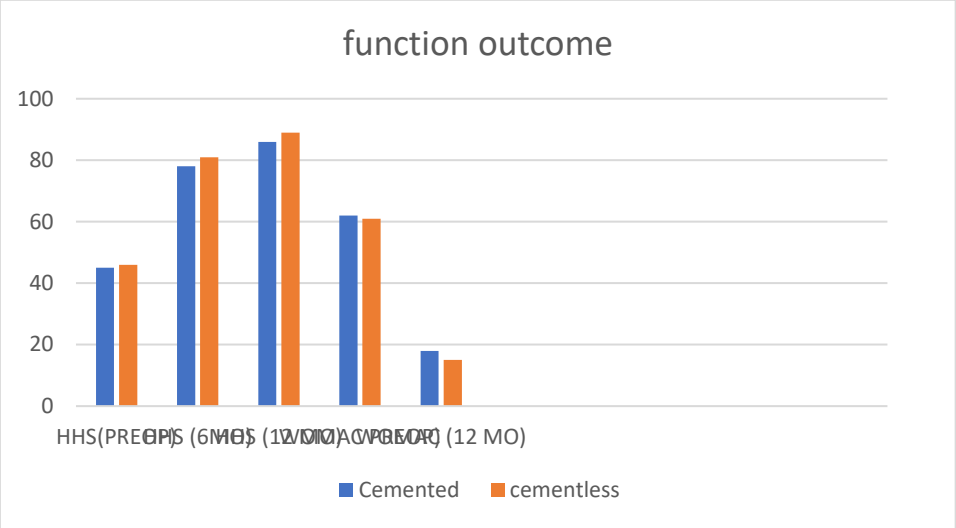


4.2 Radiological Outcomes

Radiological follow-up showed stable implant fixation in:

Cemented: 12/14

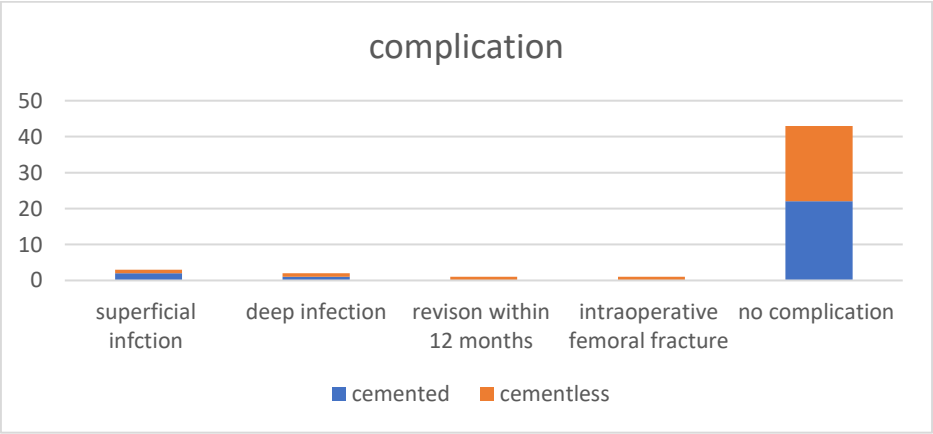
Cementless: 17/18

Mild, nonprogressive subsidence occurred in 1 cementless case without clinical impact. No radiolucent lines >2 mm were observed in either group at 12 months.

4.3 Complications

Complication	Cemented	Cementless
Superficial infection	**2 (8%)**	**1 (4%)**
Dislocation	**1 (4%)**	**1 (4%)**
Intraoperative femoral racture	**0**	**1 (4%)**
Deep infection	**0**	**0**
Revision within 12 months	**0**	**0**

Table 4: complication



5. Discussion

This study demonstrates that both cemented and cementless THA yield significant improvements in clinical and functional outcomes at 12 months. The cementless group showed slightly higher HHS and lower WOMAC scores, suggesting marginally better patient-reported outcomes.

Cementless fixation may facilitate biologic integration and reduce long-term loosening, especially in younger patients. However, cemented fixation provided reliable results in older patients with lower bone quality. The complication profiles were comparable, with no significant difference in dislocation or infection rates.

Our findings are consistent with other comparative studies demonstrating similar short to mid-term outcomes between fixation methods, though differences may emerge over longer follow-up.

The optimal method of fixation in total hip arthroplasty (THA) remains controversial despite decades of clinical experience. In the present study, both cemented and cementless THA demonstrated significant functional improvement at 12 months follow-up. However, the cemented group showed superior early postoperative recovery, whereas the cementless group achieved slightly higher final functional scores.

Our findings are consistent with contemporary registry data suggesting that cemented fixation provides excellent early stability, particularly in elderly patients with reduced bone quality.

Dale et al. (2021) reported lower early periprosthetic fracture rates in cemented stems compared to cementless designs in older populations. Immediate mechanical stability achieved with polymethylmethacrylate (PMMA) cement likely explains the faster early functional recovery observed in our cemented cohort.

Conversely, cementless fixation relies on biological osseointegration and has gained popularity in younger and more active patients. **Mäkelä et al. (2022)** demonstrated improved long-term survivorship of modern cementless stems in patients younger than 60 years, attributing this to enhanced bone ingrowth and improved implant coatings. In our study, the cementless group showed slightly higher Harris Hip Scores (HHS) at final follow-up, which may reflect the advantages of biological fixation once osseointegration is achieved.

Complication rates between the two groups in our cohort were not statistically different. This aligns with the findings of Jameson et al. (2023), who analyzed national joint registry data and found no significant difference in overall revision rates at mid-term follow-up between cemented and cementless THA when modern implant designs were used. However, they noted a higher early periprosthetic fracture risk in cementless stems among elderly patients.

The risk of bone cement implantation syndrome (BCIS) remains a theoretical concern with cemented THA, particularly in frail patients. Nevertheless, recent perioperative protocols have significantly reduced its incidence. **Olsen et al. (2022)** reported that optimized anesthetic management and careful cementing techniques minimized intraoperative complications associated with cement use. In our series, no intraoperative cardiopulmonary complications were observed in the cemented group.

Regarding radiological outcomes, no significant differences were observed in implant positioning or early loosening. Modern porous-coated cementless stems and improved cementing techniques likely contribute to comparable radiographic outcomes.

Patient selection remains central to decision-making. Current evidence suggests: Cemented fixation may be preferable in elderly patients (>70 years) with osteoporotic bone. Cementless fixation may be advantageous in younger, active individuals with good bone stock.

Our study reinforces this concept, as the cemented group in our cohort was older on average and achieved excellent early stability, while younger patients in the cementless group demonstrated strong functional recovery at one year.

Maggs and Wilson et al .(2017) in their published study stated that cemented THR has abundant evidence of excellent outcomes. Stem can be placed according to surgeon's will following patients' anatomy. It

can be used in patients with femoral deformity, osteoporotic bone, or following radiotherapy, and in young or old alike. Short-term clinical outcomes in terms of pain relief and early mobilization are good.

6. Limitations

- Follow-up limited to 12 months; long-term outcomes may differ.
- Non-randomized design may introduce selection bias.
- Single-center study.

7. Conclusion

Both cemented and cementless total hip arthroplasty provide excellent short-term functional and radiological outcomes. Cementless fixation demonstrated marginally superior results, while cemented THA remains a robust choice for patients with compromised bone density. Further long-term, randomized studies are recommended.

8. Declarations

Ethical approval: Approved by the Institutional Review Board.

Consent to participate: Informed consent obtained.

Conflict of interest: None declared.

Funding: No funding.

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