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A Prospective Study to Evaluate the Clinical and Functional Outcome of Uncemented Total Hip Replacement

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ABSTRACT

Background: Total hip replacement (THR) is a well-established procedure for relieving pain and restoring function in patients with advanced hip pathology, including avascular necrosis (AVN) and osteoarthritis. Uncemented THR has gained popularity due to its potential for biological fixation, preservation of bone stock, and lower risk of cement-related complications. This study aimed to evaluate the clinical, functional, and radiological outcomes of uncemented total hip replacement in patients with primary or secondary AVN.

Methods: This prospective observational study was conducted at Shri B.M. Patil Medical College, Vijayapura, Karnataka, India, between March 2024 and December 2025. Forty-one patients undergoing uncemented THR were included. Preoperative assessment included demographic data, clinical evaluation, and Modified Harris Hip Score (MHHS). Surgeries were performed via the posterolateral approach, with standardised postoperative rehabilitation. Functional outcomes were assessed at 6 weeks, 3 months, and 6 months using MHHS. Radiographs were obtained to evaluate the acetabular cup angle, stem position, and implant stability. Complications were recorded. Statistical analysis included descriptive statistics, cross-tabulations, and p-values <0.05 were considered significant.

Results: The mean age of patients was 44.66 ± 13.18 years, with 65.9% males. Primary AVN accounted for 65.9% of cases, and 51.2% of surgeries involved the right hip. MHHS improved significantly from a preoperative mean of 32.12 ± 3.47 to 92.78 ± 2.05 at 6 months ($p<0.001$), indicating substantial functional recovery. Radiologically, the mean cup angle was 46.85 ± 2.03°, with 95.1% of femoral stems in neutral alignment. The overall complication rate was low (14.6%), including thigh pain (4.9%), dislocation (2.4%), infection (2.4%), and nerve injury (2.4%). At 6 months, 82.9% of patients achieved excellent functional outcomes, 14.6% good, and 2.4% fair. Age and AVN type did not significantly influence functional outcomes ($p=0.098$ and 0.231, respectively).

Conclusion: Uncemented total hip replacement is a safe and effective procedure, providing excellent early functional outcomes, predictable radiological positioning, and a low rate of complications. Age and AVN type do not significantly affect postoperative recovery, supporting the use of uncemented THR in a broad patient population.

Keywords*: Uncemented total hip replacement, Avascular necrosis, Modified Harris Hip Score, Functional outcome, Complications, Prosthesis alignment.*

INTRODUCTION

Total hip replacement (THR) is widely recognized as one of the most successful orthopedic procedures for managing debilitating hip disorders. It provides pain relief, restores mobility, and improves overall quality of life in patients with end-stage hip pathologies such as osteoarthritis, rheumatoid arthritis, avascular necrosis (AVN) of the femoral head, and post-traumatic arthritis [1,2]. THR can be performed using either cemented or uncemented prostheses. Cemented prostheses, which rely on polymethylmethacrylate (PMMA) for fixation, were historically the standard; however, cement-related complications, including cement implantation syndrome, aseptic loosening, and difficulties during revision surgery, have prompted the increased use of uncemented implants [3,4].

Uncemented THR, also known as press-fit arthroplasty, relies on achieving primary mechanical stability and subsequent biological fixation through osseointegration. The success of uncemented THR depends on accurate component sizing, optimal cup orientation, stem alignment, and preservation of bone stock [5]. It is especially preferred in younger, more active patients who are likely to place higher biomechanical demands on the prosthesis [6]. In India, AVN of the femoral head is one of the leading indications for THR, with primary AVN commonly resulting from idiopathic, corticosteroid-induced, or alcohol-related causes, while secondary AVN arises from trauma, hemoglobinopathies, or metabolic disorders [7,8].

Functional outcomes after THR are commonly assessed using the Modified Harris Hip Score (MHHS), which evaluates pain, gait, functional ability, range of motion, and activities of daily living [9]. Several studies have demonstrated that uncemented THR leads to excellent postoperative functional outcomes with low rates of complications [10,11]. However, most available literature is limited to Western populations, and there is a paucity of prospective data from India on both clinical and functional outcomes in patients undergoing uncemented THR.

This study was designed as a prospective observational analysis to evaluate the clinical and functional outcomes of uncemented THR in patients with primary or secondary AVN, with a focus on functional recovery, radiological parameters, complications, and the influence of demographic factors such as age and sex. The aim was to provide evidence-based guidance on the efficacy and safety of uncemented THR in the Indian context.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Orthopaedics at B.L.D.E. (Deemed to be University), Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka, India. The study was carried out between 1st March 2024 and 31st December 2025, with patient follow-up at six weeks, three months, and six months postoperatively.

Study Population and Sample Size

Patients diagnosed with primary or secondary osteoarthritis of the hip (excluding infective causes) and meeting inclusion criteria were considered for the study. Sample size estimation was based on a prior study by Prabhulingreddy Patil et al., which reported a dislocation proportion of 2.78%. Using a 95% confidence level and a 5% margin of error, the required sample size was calculated using the formula:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

where Z = 2.576, p = 0.0278, and d = 0.05, resulting in an estimated 41 patients. Consecutive eligible patients were enrolled after informed consent.

Inclusion Criteria

1. Age > 20 years
2. Primary or secondary unilateral hip osteoarthritis (excluding infective pathologies)
3. Willingness to adhere to follow-up schedule

Exclusion Criteria

1. Patients unfit for surgery
2. Bilateral hip pathologies requiring bilateral arthroplasty
3. Revision hip surgeries
4. Infective hip conditions

Data Collection

Eligible patients were screened by the Orthopaedics Department. Demographic details, medical history, and clinical complaints were recorded. Comprehensive physical examination included gait analysis, limb length measurement,

deformity assessment, and evaluation of hip range of motion (flexion, extension, abduction, adduction, medial and lateral rotation). Specific hip tests were performed as indicated.

Preoperative Investigations
Routine preoperative investigations included complete blood count, renal function tests, random blood sugar, bleeding and clotting times, urinalysis, viral markers (HIV, HBsAg, HCV), blood grouping, and Rh typing. Imaging included X-ray pelvis with bilateral hips (anteroposterior view) and chest X-ray. ECG and 2D echocardiography were performed as indicated. CT or MRI was obtained when required for surgical planning.

Preoperative Preparation
All patients were counselled regarding surgery, expected outcomes, complications, and postoperative rehabilitation. The Modified Harris Hip Score (MHHS) was documented preoperatively. Implant sizing was templated, and patients were medically optimised. Prophylactic antibiotics were administered according to institutional protocol, and the surgical site was aseptically prepared.

Surgical Procedure
All surgeries were performed by a single surgical team to minimise variability. Uncemented total hip arthroplasty was performed via the posterolateral (Southern-Moore) approach. Patients were positioned in lateral decubitus. Skin incision was made over the greater trochanter and femoral shaft, followed by blunt dissection of the gluteus maximus and short external rotators. The hip capsule was exposed and incised in a T-shaped fashion.

Femoral neck osteotomy was performed at a predetermined level. Sequential reaming of the acetabulum and femoral canal was done to accommodate press-fit uncemented components. Trial reduction was performed to assess stability, leg length, and range of motion before final implantation. Wound closure was performed in layers with drains as needed.

Postoperative Management
Postoperatively, the hip was maintained in 25–30° abduction using an abduction pillow. Patients were mobilized with static and dynamic quadriceps exercises on day 1, progressing to full-weight bearing with a walker from day 2. Analgesics and dual broad-spectrum antibiotics (piperacillin-tazobactam and amikacin) were administered intravenously for five days. Thromboembolic prophylaxis was given for three weeks. Wounds were monitored, and sutures were removed on days 12–15. Patients were discharged with instructions on hip precautions, wound care, exercises, and follow-up.

Follow-up Protocol
Patients were followed at six weeks, three months, and six months. Functional outcomes were assessed using the Modified Harris Hip Score, evaluating pain, gait, mobility, and activities of daily living. Radiographs were obtained at each visit to assess implant position, loosening, heterotopic ossification, and bone ingrowth. Postoperative complications such as infection, dislocation, nerve injury, periprosthetic fracture, leg length discrepancy, and implant loosening were recorded.

Data Management and Statistical Analysis
Data were entered into Microsoft Excel and analysed using SPSS version 20. Continuous variables were expressed as mean ± SD or median (IQR), while categorical variables were expressed as frequencies and percentages. Independent t-tests or Mann–Whitney U tests compared continuous variables; Chi-square or Fisher's exact tests were used for categorical variables. ANOVA or Kruskal–Wallis tests compared multiple groups. A p-value <0.05 was considered statistically significant. Functional outcomes were classified as excellent (90–100), good (80–89), fair (70–79), or poor (<70) according to MHHS.

Ethical Considerations
The study protocol was approved by the Institutional Ethics Committee (BLDE (DU)/IEC-SBMPMC/139/2023-24, Date: 10/02/2024). Written informed consent was obtained from all participants. Confidentiality of patient data was maintained, and all procedures adhered to the Declaration of Helsinki and Good Clinical Practice guidelines.

RESULTS AND OBSERVATIONS

Table 1: Age and Gender Distribution of Patients Undergoing Uncemented Total Hip Replacement (N=41)

Age Group (years)	Male (n, %)	Female (n, %)	Total (n, %)
18–20	1 (2.4%)	0 (0.0%)	1 (2.4%)
21–40	10 (24.4%)	5 (12.2%)	15 (36.6%)
41–60	16 (39.0%)	9 (22.0%)	25 (61.0%)
Total	27 (65.9%)	14 (34.1%)	41 (100%)

Table 2: Diagnosis and Side Distribution of Patients Undergoing Uncemented Total Hip Replacement (N=41)

Diagnosis	Frequency (n)	Percentage (%)	Side Affected	Frequency (n)	Percentage (%)
Primary AVN	27	65.9	Right	21	51.2
Secondary AVN	14	34.1	Left	20	48.8
Total	41	100.0	**Total**	41	100.0

Table 3: Functional and Radiological Outcomes of Patients Undergoing Uncemented Total Hip Replacement (N=41)

Parameter	Follow-up / Measure	Mean ± SD / Frequency	Range / Percentage	p-value / Observation
Modified Harris Hip Score (HHS)	Pre-operative	32.12 ± 3.47	–	Baseline hip function
	6 Weeks Post-op	80.32 ± 2.39	–	<0.001*
	3 Months Post-op	87.34 ± 2.41	–	<0.001*
	6 Months Post-op	92.78 ± 2.05	–	<0.001*
Radiological Parameter – Cup Angle (°)	–	46.85 ± 2.03	43–52	Normal acetabular positioning
Stem Position	Neutral	39	95.1%	Proper alignment
	Varus	2	4.9%	Minor malalignment; no valgus cases

Table 4: Complications and Functional Outcome Grading at 6 Months Post Uncemented Total Hip Replacement (N=41)

Parameter	Category / Grade	Frequency (n)	Percentage (%)	Observation
Complications	No Complications	35	85.4	Majority of patients had no issues
	Thigh Pain	2	4.9	Most common complication
	Dislocation	1	2.4	Rare occurrence
	Infection	1	2.4	Rare occurrence
	Nerve Injury	1	2.4	Rare occurrence
Functional Outcome (Modified HHS)	Excellent (90–100)	34	82.9	Most patients achieved excellent outcomes
	Good (80–89)	6	14.6	Good functional recovery
	Fair (70–79)	1	2.4	Mild functional limitation
	Poor (<70)	0	0.0	No patients had poor outcomes

Table 5: Association of Age Category and Diagnosis with Functional Outcome Grades at 6 Months (N=41)

Parameter	Category	Excellent (n=34)	Fair (n=1)	Good (n=6)	Total	p-value	Observation
Age Category (years)	18–20	0 (0.0%)	0 (0.0%)	1 (16.7%)	1	–	Small sample in this age group
	21–40	12 (35.3%)	1 (100.0%)	2 (33.3%)	15	0.098	No significant association between age and outcome
	41–60	22 (64.7%)	0 (0.0%)	3 (50.0%)	25	–	The majority of excellent outcomes in 41–60 years
Diagnosis	Primary AVN	24 (70.6%)	0 (0.0%)	3 (50.0%)	27	0.231	No significant association between diagnosis type and outcome
	Secondary AVN	10 (29.4%)	1 (100.0%)	3 (50.0%)	14	–	Both primary and secondary AVN patients achieved good/excellent outcomes

DISCUSSION

In this study, 41 patients underwent uncemented THR over a period of 22 months, and functional, radiological, and clinical outcomes were systematically assessed. The cohort predominantly comprised middle-aged adults, with 61% of patients aged 41–60 years and a mean age of 44.66 ± 13.17 years. Males constituted 65.9% of the study population. These findings align with prior studies, which reported a higher prevalence of AVN and hip osteoarthritis in middle-aged males [12,13].

Functional Outcomes: The Modified Harris Hip Score (MHHS) improved significantly from a preoperative mean of 32.12 ± 3.47 to 92.78 ± 2.05 at six months postoperatively. At six weeks, patients showed substantial functional recovery (mean MHHS 80.32 ± 2.39), which continued to improve at three months (87.34 ± 2.41) and six months. This gradual improvement reflects both the effectiveness of uncemented prostheses in restoring hip biomechanics and the importance of early mobilization and physiotherapy. Similar findings have been reported in studies by Kim et al. and Berry et al., demonstrating that uncemented THR provides rapid and sustained functional recovery [14,15].

Radiological Outcomes: Proper implant positioning is critical to prevent dislocation, loosening, and wear-related complications. In this study, the mean acetabular cup angle was 46.85 ± 2.03°, within the optimal range of 40–50°, and 95.1% of femoral stems were in neutral alignment. Only two stems (4.9%) showed varus positioning, with no cases of valgus misalignment. These results indicate that the surgical technique employed ensured accurate component placement, which is consistent with literature emphasizing that precise cup and stem orientation reduces early complications and enhances long-term prosthesis survival [16,17].

Complications: The overall complication rate was low (14.6%), with the most common being thigh pain (4.9%), followed by single cases of dislocation, infection, and nerve injury (2.4% each). The low incidence of complications reflects meticulous surgical technique, adherence to aseptic protocols, and structured postoperative care. Comparable studies have reported complication rates ranging from 10–20% in uncemented THR, highlighting the relative safety of this approach [18,19].

Functional Outcome Grading: At six months, 82.9% of patients achieved excellent functional outcomes (MHHS 90–100), 14.6% had good outcomes, and 2.4% had fair outcomes. No poor outcomes were observed. Cross-tabulation revealed that 64.7% of excellent outcomes occurred in the 41–60 years age group, but statistical analysis ($p=0.098$) demonstrated no significant correlation between age and functional outcome. Similarly, diagnosis type (primary vs secondary AVN) did not significantly affect outcomes ($p=0.231$). These findings suggest that uncemented THR reliably restores function irrespective of age or AVN etiology.

Clinical Implications: The study underscores the efficacy of uncemented THR in the Indian population, providing excellent functional recovery, low complication rates, and predictable radiological outcomes. It highlights the importance of careful preoperative planning, proper patient selection, and adherence to standardized surgical techniques to achieve optimal results. Early mobilization and rehabilitation play a crucial role in ensuring progressive functional improvement and patient satisfaction.

Limitations: This study is limited by its single-centre design and relatively short follow-up of six months. Long-term outcomes, including prosthesis survival, wear, and late complications such as aseptic loosening, periprosthetic fractures, or heterotopic ossification, were not assessed. Additionally, the sample size was relatively small, although adequate for initial functional outcome analysis based on power calculations. Multi-centre studies with longer follow-up are needed to validate these findings and provide more comprehensive guidance.

CONCLUSION

Uncemented total hip replacement is a safe and effective procedure for patients with primary or secondary AVN, providing significant improvement in functional outcomes and a low incidence of complications. Patient age and AVN type do not significantly influence.

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