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A COMPARATIVE OBSERVATIONAL STUDY OF CEMENTED VS. UNCEMENTED TOTAL HIP ARTHROPLASTY: ASSESSING FUNCTIONAL OUTCOMES.

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ABSTRACT

Background

Total hip arthroplasty (THA) is a common surgical procedure to address hip joint degeneration and related conditions. The choice between cemented and uncemented THA is a matter of debate, influenced by patient characteristics and surgical preferences. This study aims to compare the functional outcomes of cemented and uncemented THA to provide insights into their effectiveness.

Methods

This hospital-based, comparative observational study included 50 cases randomized into Group A (cemented THA) and Group B (uncemented THA). Participants aged 50-80 years with THR indications were selected. Data on demographics, medical conditions, and surgical history were collected. Follow-up assessments were conducted at 6 weeks, 3 months, 6 months, and 2 years post-surgery, measuring pain scores and Harris Hip Scores (HHS). Statistical analysis was performed to compare outcomes.

Results

Group A showed superior early pain relief and function at 6 weeks and 3 months post-surgery, but these differences became statistically insignificant at 6 months. Both groups achieved comparable long-term hip function, with no radiological evidence of complications. Surgical complications were minimal, and a majority of patients in both groups achieved excellent or good HHS scores.

Conclusion

Cemented and uncemented THA approaches offer viable options for patients. While cemented THA initially provides advantages in pain relief and function, uncemented THA ultimately yields similar long-term outcomes. Individual patient factors and preferences should guide the choice between these techniques.

Recommendations

Surgeons and patients should consider individual factors, such as age and bone quality, when deciding between cemented and uncemented THA. Further research with extended follow-up periods is warranted to comprehensively assess long-term outcomes.

Keywords: *Total Hip Arthroplasty, Cemented, Uncemented, Functional Outcomes*
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INTRODUCTION

Total hip arthroplasty (THA), commonly known as hip replacement surgery, is a highly regarded and widely performed orthopedic procedure designed to improve the quality of life for patients suffering from a range of debilitating hip conditions. These conditions often include hip joint degeneration due to aging, osteoarthritis, rheumatoid arthritis, traumatic injuries, or congenital abnormalities [1]. The primary objective of THA is to alleviate pain, restore hip joint function, and enhance a patient's overall mobility and well-being.

One of the fundamental decisions that orthopedic surgeons and patients must make when considering THA is whether to opt for a cemented or uncemented approach. This choice represents a central point of debate within the orthopedic community, and it is guided by various factors, each carrying its own weight in the decision-making process [2]. Cemented THA involves the utilization of a specialized bone cement known as polymethylmethacrylate (PMMA), which serves as a bonding agent between the prosthetic components and the natural bone. This cement creates a secure and stable fixation, providing immediate support to the replaced joint [3]. In contrast, uncemented THA relies on the principle of osseointegration, where the prosthesis is

designed with porous surfaces to encourage the patient's bone to grow into and around the implant, thus achieving long-term stability [4].

The choice between cemented and uncemented THA hinges on various critical factors, each requiring careful consideration. Patient age is a paramount factor, as older individuals may benefit from the immediate stability offered by cemented THA, whereas younger patients may prefer uncemented THA due to its potential for longer-term durability and the preservation of bone stock [5]. Additionally, the quality and density of the patient's bone are significant determinants; those with compromised bone quality may benefit from cemented fixation, which does not rely on bone strength for initial stability. Furthermore, the surgeon's experience and preferences also come into play, as their familiarity with a particular technique can influence the decision-making process.

This study aims to conduct a comprehensive comparative analysis of cemented and uncemented THA, focusing on the functional outcomes achieved by patients following the procedure.

METHODOLOGY

Study Design

This study employed a hospital-based, comparative observational design.

Study Setting

The study was conducted at Indira Gandhi Institute of Medical Science (IGIMS), in Patna, Bihar, India, from a period of March 2022 to April 2023.

Participants

The study comprised 50 patients in total, with 25 cases randomly assigned to each group. On the basis of their age and THR indication, participants were chosen from the pool of qualified candidates.

Inclusion Criteria

- Patients aged 50 to 80 years.

- Patients for whom total hip replacement (THR) was medically indicated.

Exclusion Criteria

- Presence of neurovascular deficit.

- Active infection at the time of assessment.

- Dorr type C classification, which typically indicates poor bone quality.

Randomization

To minimise bias, participants were randomised using a lottery technique into two groups: Group 1 (cemented THR) and Group 2 (uncemented THR). This ensured an equal distribution of patients between the two groups.

Surgical Technique

A single surgeon used the posterolateral technique to perform all THR procedures. This strategy reduced surgical technique variability for every patient in both groups.

Follow-up

At predetermined times after surgery, such as six weeks, three months, six months, and two years, follow-up evaluations were carried out. A thorough functional examination was part of these evaluations, which also included the Harris Hip Score (HHS) assessment to gauge hip joint function and overall patient satisfaction and the Pain Score assessment to gauge postoperative pain levels.

Variables

Key variables included type of THR (cemented or uncemented), pain score and Harris hip score (HHS) at various follow-up time points.

Sample size

Patients who enrolled after filling the inclusion criteria. For calculating sample size the following formula was used:

$$N\Delta = \frac{2(Za+Z1-\beta)2\sigma^2}{2}$$

Where, N= sample size, Z is a constant

Za is set by convention according to accepted a error of 5% as 1.649 Z1-β is set by convention according to accepted 1-β or power of study of 80% as 0.8416Σ is standard deviation

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estimated Δ is difference in the effect between two interventions (estimated effect size).

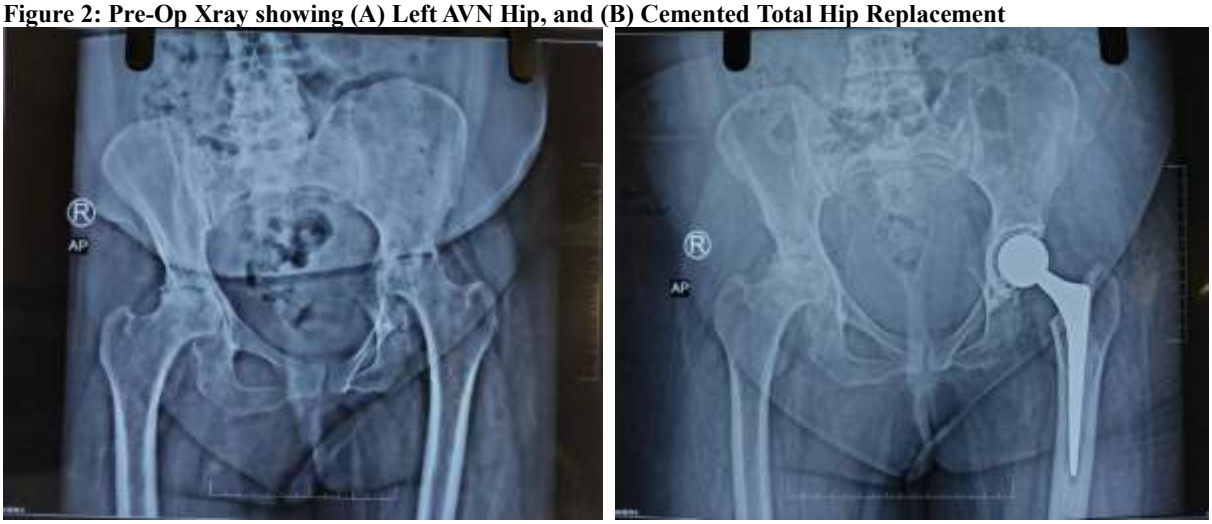
Data Collection

Following up appointments allowed for the collection of data on HHS and pain scores. These were the statistics that were noted and documented for further examination. Consistency and dependability in data gathering were preserved by employing standardised evaluation instruments and protocols.

Figure 1: Pre-Op Xray showing (A) Left Neck of Femur Fracture, and (B) Left Uncemented Total Hip Replacement with Femoral and Acetabular Components

(A) **(B)**

Figure 2: Pre-Op Xray showing (A) Left AVN Hip, and (B) Cemented Total Hip Replacement



(A) **(B)**

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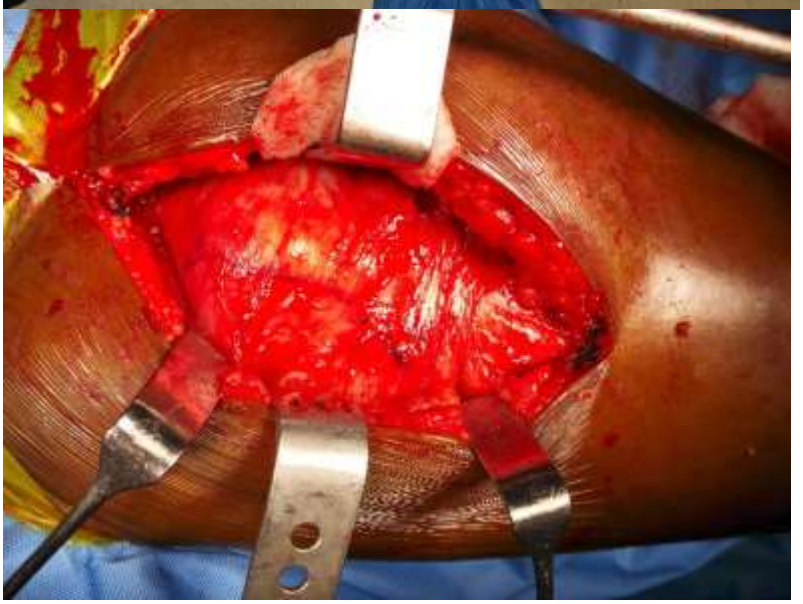
Figure 3: Surgical procedure

Step-1: Preparation and Exposure of Operative site



Step-2: Soft Tissue Exposure

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Step-3: Extraction of Femoral Head

Step-4: Empty Acetabulum after Femoral Head

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Step-5: Preparation of Femoral Stem.

Step-6: Rasping of Femoral Canal

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Step-7: Preparation of Acetabular Cup

Step-8: Placement of Acetabular Component

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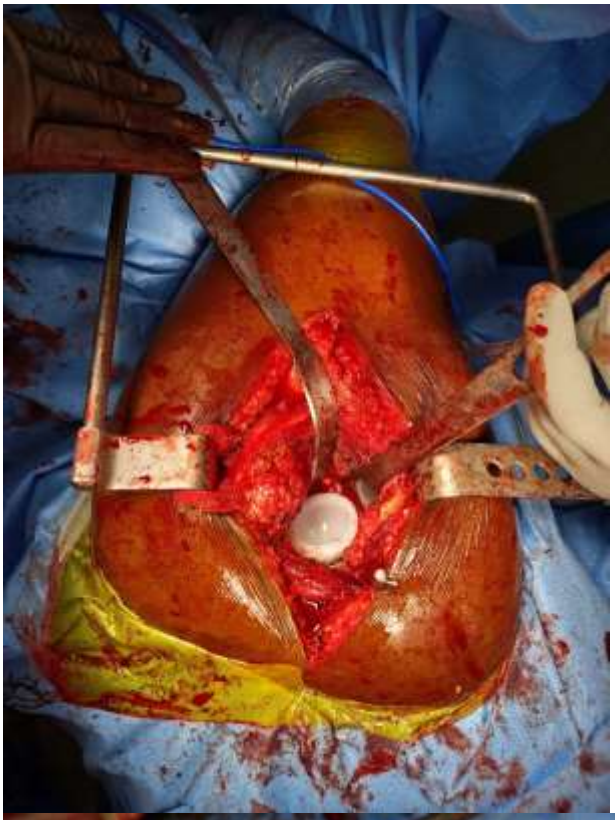
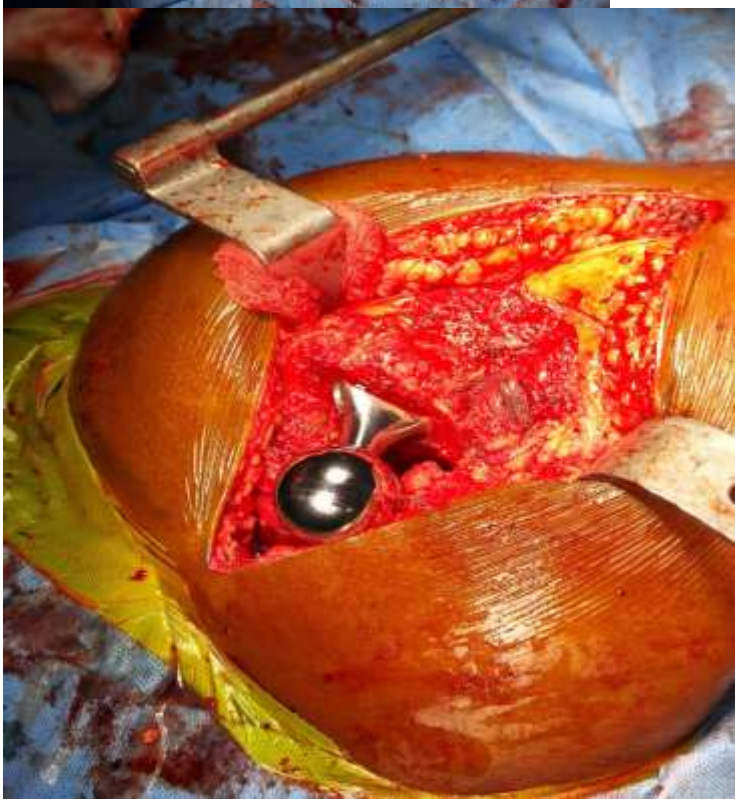


Step-9: Placement of Plastic Spacer



Step-10: Insertion of Femoral Stem

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Statistical Analysis

The data obtained from the study was arranged in a tabulated manner in an Excel sheet, and the data was then subjected to statistical analysis. Statistical analysis is accomplished using an appropriate software program SPSS version 22.0. The baseline parameters and patient data were collected using descriptive statistics. A statistical study was conducted in order to compare the two groups' results. A $p< 0.05$ change is considered to be statistically significant.

Ethical Considerations

The institutional ethics committee granted the study ethical permission. Before being included in the study, each subject gave their informed consent.

Table 1: Demographic and clinical data for the two groups

Variable	Group A (Cemented THR)	Group B (Uncemented THR)
Mean Age (years)	61.2	60.1
Pathology Side (%)		
Left	48%	40%
Right	52%	60%
Duration of Pathology (months)	9.88	8.5
Medical Conditions (%)	44%	40%
Previous Surgery for Fractured Neck of Femur (%)	8%	8%
Types of Pathology (%)		
Femoral Neck Fracture	6%	14%
Hip Osteoarthritis	12%	6%
AVN of Femoral Head	56%	60%
Rheumatoid Arthritis	4%	-
Infected Bipolar Hemiarthroplasty	-	4%
Nonunion of Femoral Neck	4%	4%
Nonunion of Intertrochanteric Femur	-	4%
Hip Joint Infection	4%	-
Periprosthetic Fracture	-	4%

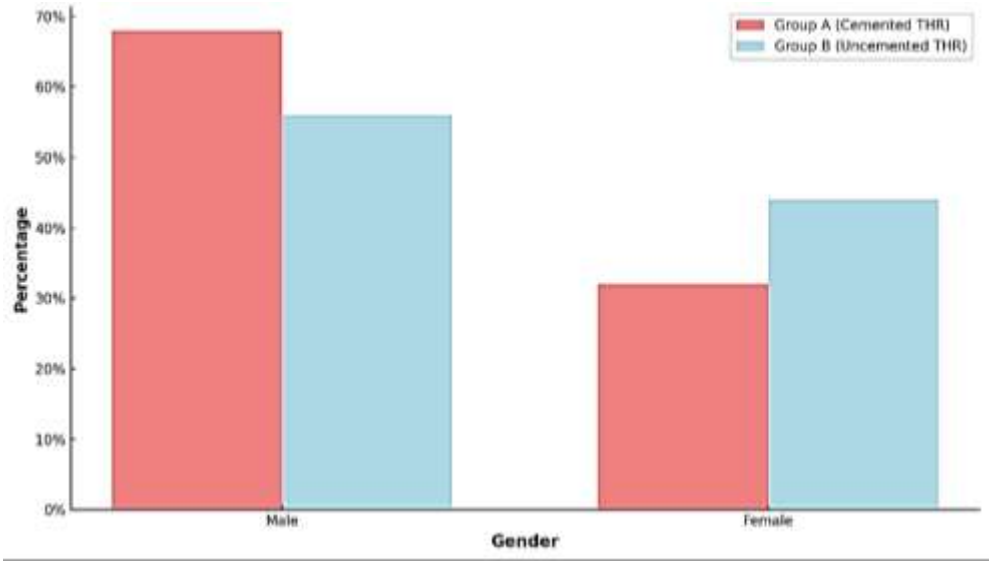

Figure 4: Gender distribution of the study population

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RESULT

In Group A, the average age of participants was 61.2 years, ranging from 52 to 79 years. Among the 25 cases in this group, 17 were males (68%), and 8 were females (32%). Among them, 12 cases (48%) had left-sided pathology, while 13 cases (52%) had right-sided pathology. The average duration of the underlying condition was 9.88 months, and 11 patients had concurrent medical conditions, including hypertension and hyperlipidemia. Two patients had a history of previous surgery for femoral neck fractures, with one undergoing a sliding hip screw (SHS) procedure and the other a dynamic hip screw (DHS) procedure.

In Group B, the mean age of participants was 60.1 years, ranging from 51 to 78 years. Among the 25 cases in this group, 14 were males (56%), and 11 were females (44%). Ten cases (40%) had left-sided pathology, while 15 cases (60%) had right-sided pathology. The mean duration of the underlying condition was 8.5 months, and 10 patients had associated medical conditions, including diabetes mellitus, hypertension, and thyroid disorders. Two patients in this group had a history of previous surgery for femoral neck fractures, one with a cannulated cancellous (CC) screw and the other with bipolar hemiarthroplasty.

The study revealed that age, sex, and the duration of the disease between the two groups had no statistically significant impact on the study's outcomes. Pathologies leading to hip replacement in Group A included femoral neck fractures (6%), hip osteoarthritis (12%), avascular necrosis (AVN) of the femoral head (56%), rheumatoid arthritis (4%), nonunion of the femoral neck (4%), and hip joint infection (4%). In Group B, pathologies included femoral neck fractures (14%), hip osteoarthritis (6%), AVN of the femoral head (60%), infected bipolar hemiarthroplasty (4%), nonunion of the intertrochanteric femur (4%), nonunion of the femoral neck (4%), and periprosthetic fracture around the hip joint (4%).

Pain scores were compared at multiple follow-up intervals after surgery, showing significant differences at 6 weeks ($P \leq 0.05$) and 3 months ($P = 0.001$), indicating superior early pain management in Group A. However, the difference in pain scores between the two groups at 6 months was not statistically significant ($P = 0.19$). Functional scores exhibited a significant difference between Group A and Group B at 6 weeks ($P = 0.004$) and 3 months ($P \leq 0.05$), which became nonsignificant at 6 months ($P = 0.42$). The Harris Hip Score (HHS) showed significant differences between the two groups at 6 weeks ($P \leq 0.05$) and 3 months ($P = 0.012$) but not at 6 months.

HHS results were further categorized into four grades: poor (<70), fair (70–79), good (80–89), and excellent (90–100). In both groups, a majority of patients achieved excellent and good results, with 87% in Group A and 83% in Group B. No radiological evidence of osteolysis or implant loosening was observed, although it's recognized that complications such as aseptic loosening and periprosthetic osteolysis may manifest after longer follow-up periods. Surgical complications were minimal, with one case of excessive blood loss in Group B and one case of temporary sensory deficit in Group A (2%), attributed to neuropraxia resulting from surgical retraction. Conservative management led to full sensory recovery within approximately 3 months. All surgeries were performed using the posterolateral approach, with meticulous repair of short external rotators, preventing postoperative dislocations in both groups.

DISCUSSION

In this comparative study of hip replacement procedures, Group A, with an average age of 61.2 years, showed better early pain management and functional outcomes at 6 weeks and 3 months post-surgery compared to Group B, whose average age was 60.1 years. However, these differences between the two groups became statistically insignificant at the 6-month follow-up mark. The Harris Hip Score (HHS) results mirrored this pattern, with significant differences at 6 weeks and 3 months but not at 6 months, demonstrating comparable hip function in the long term. Importantly, both groups exhibited a majority of patients achieving excellent or good HHS scores. Radiological assessments did not reveal any signs of osteolysis or implant loosening, though it's acknowledged that these complications may emerge later. Surgical complications were minimal, with one case of excessive blood loss in Group B and one case of temporary sensory deficit in Group A, both resolving within 3 months. These findings suggest that while cemented total hip replacements may offer initial advantages in pain relief and function, uncemented prostheses ultimately provide comparable long-term outcomes, making them a viable choice for hip replacement surgery.

In a recent publication by Mäkelä and colleagues [6], a comparison was made between the survival rates of cemented and uncemented hip replacement prostheses in patients aged over 55 years. The study's findings indicated that cemented implants exhibited superior survival rates. This analysis encompassed data from four different countries. Similarly, Hailer *et al*. [7], who examined the Swedish Hip Arthroplasty Register, reported a significant difference in the 10-year survival rates of cemented and uncemented total hip replacements. Cemented implants outperformed uncemented ones, primarily due to the higher

revision rates associated with aseptic loosening of the cup in the uncemented group.

Several studies have also demonstrated improved outcomes with cemented total hip replacements in obese and osteoporotic patients, along with lower rates of intraoperative femur fractures. However, a meta-analysis by Morshed *et al*. [8] did not reveal a significant disparity in the survival rates between the two implant types. Zimmerma *et al*. [9] conducted a study indicating that while entirely non cemented prostheses were more expensive, there were no statistically significant differences in clinical or functional outcomes between non cemented and cemented prostheses up to 12 months post-surgery.

In a recent study by Maggs and Wilson [10], it was asserted that cemented total hip replacement has substantial evidence supporting its excellent outcomes. Surgeons have the flexibility to place the stem according to the patient's anatomy, making it a suitable choice for patients with femoral deformities, osteoporotic bones, or those who have undergone radiotherapy, regardless of age. Short-term clinical results, such as pain relief and early mobilization, are favorable. Moreover, revising cemented total hip arthroplasty is straightforward using the cement-in-cement technique. Many concerns that may have previously discouraged surgeons from using cemented implants have been found to be unfounded. The available evidence does not advocate a significant shift towards the adoption of uncemented implants. Importantly, economic analysis affirms that cemented total hip arthroplasty represents a highly cost-effective option, especially in the context of today's economic challenges.

CONCLUSION

This study compares cemented (Group A) and uncemented (Group B) hip replacement procedures, finding initial advantages with cemented implants in early pain relief and function at 6 weeks and 3 months post-surgery. However, these differences become insignificant at 6 months, with both groups achieving comparable long-term hip function, as indicated by the Harris Hip Score (HHS) results. No radiological evidence of complications was observed, and surgical complications were minimal. This study suggests that both approaches are viable options, and the choice should be tailored to individual patient characteristics and preferences. Further research with longer follow-up periods is needed for a comprehensive assessment of long-term outcomes.

Limitations

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

RECOMMENDATIONS

Surgeons and patients should consider individual factors, such as age and bone quality, when deciding between cemented and uncemented THA. Further research with extended follow-up periods is warranted to comprehensively assess long-term outcomes.

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We are thankful to the patients; without them the study could not have been done. We are thankful to the supporting staff of our hospital who was involved in patient care of the study group.

LIST OF ABBREVIATIONS

THA - Total Hip Arthroplasty
PMMA - Polymethylmethacrylate
HHS - Harris Hip Score
CC - Cannulated Cancellous
DHS - Dynamic Hip Screw
AVN - Avascular Necrosis
SHS - Sliding Hip Screw

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CONFLICT OF INTEREST

The authors have no competing interests to declare.

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