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INVESTIGATING STEM SUBSIDENCE IN UNCOLLARED UNCEMENTED STEMS FOR BIPOLAR HIP HEMIARTHROPLASTY IN OSTEOPOROTIC PATIENTS: A PROSPECTIVE STUDY

Orthopaedics

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ABSTRACT

Introduction: The femoral neck, vulnerable due to its junctional placement, plays a crucial role in the blood supply to the femoral head, which is important in preventing avascular necrosis. Hip hemiarthroplasty is the standard procedure for elderly patients with femoral neck fractures, using either monoblock or modular prostheses. Uncemented uncollared prostheses have shown benefits, though long-term fixation in osteoporotic bone remains a challenge, particularly with femoral stem subsidence. **Aim:** To assess stem subsidence in bipolar hip hemiarthroplasty using uncemented, uncollared prostheses in osteoporotic patients. **Objectives:** To explore osteoporosis as a risk factor for stem subsidence, and to quantify stem subsidence over time via serial follow-ups. **Methods:** The study enrolled 23 patients aged 50-80 with femoral neck fractures. DEXA scans confirmed osteoporosis (Z score > -2.5) in 21 patients, who underwent surgery using uncemented uncollared femoral stems from the Latitud™ system. Radiographs were taken at 3, 6, and 12 months post-surgery to assess stem subsidence by measuring the distance from the greater trochanter to the stem shoulder. **Results:** subsidence was significant, with mean sinking scores of 0.897±0.269 at 3 months, 1.44±0.397 at 6 months, and 2.14±0.534 at 12 months ($p<0.00001$). The greatest subsidence occurred between 3-6 months and continued at a slower rate through 12 months. **Conclusion:** Stem subsidence in osteoporotic patients is influenced by the degree of osteoporosis, with the most significant subsidence occurring within the first six months. Long-term follow-up is needed to assess further biomechanical changes.

KEYWORDS

Bipolar Hemiarthroplasty, Stem Subsidence, uncemented prostheses

INTRODUCTION

Osteoporotic hip fractures, particularly common among the elderly, significantly impact healthcare systems. These injuries also occur in young patients involved in sports or high-energy traumas. A specific type of intracapsular hip fracture is the femoral neck fracture, which connects the femoral head and shaft. The femoral neck is brittle due to its junctional placement, and its blood supply to the femoral head is critical in cases of displaced fractures and younger patients to avoid avascular necrosis[1,2]. Hip arthroplasty is the standard treatment for older patients with femoral neck fractures. Hip hemiarthroplasty uses two main prosthesis types: monoblock and modular. The collared Thompson hemi-arthroplasty is the most commonly used monoblock implant but is challenging to adjust intraoperatively, often failing to replicate the patient's original hip geometry accurately. Modular hemiarthroplasty consists of the stem, neck, and head components, allowing surgeons to customize the size during surgery for better anatomical restoration[3]. Porous coatings were introduced to implant surfaces in the late 1970s to improve osseointegration, but issues like thigh pain, bead shedding, and loosening arose. These implants require skilled surgeons for successful osseointegration. Advances in porous coatings have improved clinical outcomes. Initially used for dental implants, calcium phosphate ceramics were adapted for orthopaedic use to enhance implant osseointegration, with hydroxyapatite (HA) chosen for its chemical properties and role in bone mineral content[4]. Osteoporotic femurs differ in shape from normal femurs, with increased bone density leading to widened bones and thinner cortices, potentially affecting long-term hip prosthesis fixation[5]. Femoral stem subsidence, the distal movement of the stem relative to the greater trochanter, will be studied in uncemented uncollared femoral stems in osteoporotic patients.

AIMS AND OBJECTIVES

AIM: To assess the measure of stem subsidence in bipolar hip hemiarthroplasty with uncemented, uncollared prosthesis in osteoporotic patients.

OBJECTIVES:

1. To study osteoporosis as a risk factor for stem subsidence in bipolar hip hemiarthroplasty patients.
2. To quantitate the post operative stem subsidence at serial follow-ups.

MATERIALS AND METHODOLOGY:

Inclusion Criteria:

1. Patients with age 50 – 80 years with femur neck fracture
2. Osteoporotic patients (Z score > 2.5)

Exclusion Criteria:

1. Patients with inflammatory conditions like rheumatoid arthritis, hip osteoarthritis, avascular necrosis of femoral head
2. Patients not willing to participate in the study
3. Carcinomas
4. Smokers

A group of 23 patients with fractured neck of femur, within the age group 50-80 years were enrolled for the study. DEXA scan was performed for all the patients pre-operatively. Out of 23 patients, 21 patients with proven osteoporosis as per DEXA scan, with a Z score > -2.5 were included in the final study. Whereas 2 patients with osteopenia or normal bone mineral density were excluded. Uncemented uncollared femoral stem from the Latitud™ total hip replacement system from Meril Orthopaedics was used for all the patients. All the patients were followed up with radiographs at 3 months, 6 months, and 12 months postoperatively. Stem subsidence was evaluated from an anteroposterior hip or pelvis plain radiograph by measuring the difference in distance from the greater trochanter's peak to the stem shoulder perpendicular to the axis of the femur stem. The anteroposterior pelvic or hip plain radiograph was taken in supine position, centring on the symphysis and 120cm distance of the film focus.

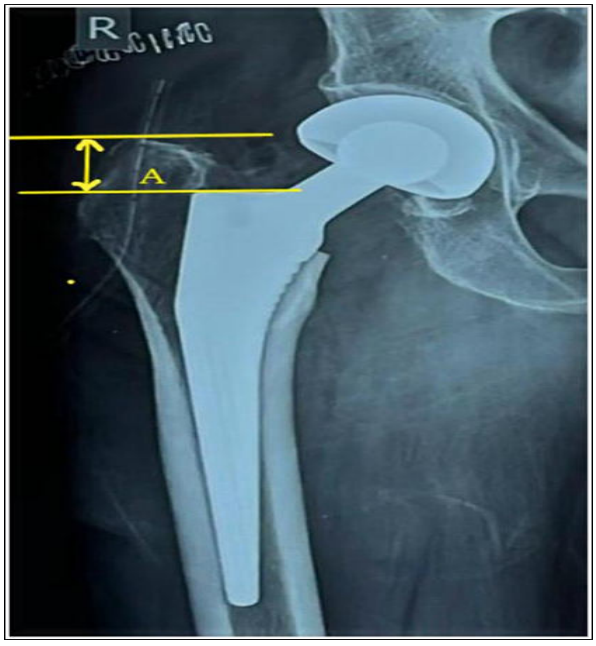

Fig 2. A – Showing Greater trochanter tip to stem shoulder distance

OBSERVATION AND RESULTS

Table 1: Comparison Of Mean STEM Sinking At 3 Months, 6 Months and 12 Months (Repeated ANOVA)

STEM Sinking	Mean±SD	F-value	P-value
3 Months	0.897±0.269	222.87	P<0.00001 S
6 Months	1.44±0.397		
12 Months	2.14±0.534		

Table 2: Distribution Of Patients According To Z-Score

Z-Score	No. of patients	Percentage
-2.5 to -3.00	14	66.7
-3.00 to -3.5	06	28.6
>-3.5	01	4.8
Total	21	100%

DISCUSSION

Uncemented collarless total hip replacement relies on press fit and osseointegration for stability, but early femoral stem subsidence can occur before osseointegration, affecting leg length and hip stability. Subsidence rates range from 5% to 61.5% in elective hip replacements, although uncemented stems like the Corail have a 97% 15-year survival rate (Dorr et al., 2016)[13]. Concerns exist about using collarless stems in osteoporotic bones due to proximal femoral bone loss. Dorr et al. (2016) classified proximal femurs into Classes A, B, and C based on cortical thickness and canal shape. Classes A and B are suitable for uncemented prosthetics, while Class C's broad canal and lack of structural integrity may lead to early implant subsidence, loosening, and failure. Collar-style prostheses were designed for osteoporotic bones to reduce subsidence and enhance rotational stability. However, recent advancements in uncemented stem technology have challenged the unsuitability of collarless prostheses for osteoporotic patients, with studies showing equivalent functional outcomes and survival rates across all bone classes.

The study assessed stem sinking in 21 osteoporotic patients with z-scores > -2.5 following uncemented uncollared stem implantation. The mean stem sinking was 2.14 mm at 1 year, with most occurring in the first 6 months during weight-bearing. Bone mineral density correlated with stem sinking, peaking at 3.41 mm in patients with a z-score of -4. One patient had a postoperative infection treated with antibiotics, and no revisions were required for implant loosening or stem sinking. Limitations include the small sample size and the short follow-up period. A longer follow-up is needed to evaluate the impact of stem sinking on implant stability and revision surgery.

RESULTS

The mean STEM Sinking scores were 0.897±0.269 at 3 months, 1.44±0.397 at 6 months, and 2.14±0.534 at 12 months, showing a significant difference across these time points ($p<0.00001$). The mean differences between 3 and 6 months (0.543), 3 and 12 months (1.243), and 6 and 12 months (0.700) were all statistically significant ($p<0.0001$). Most patients (66.7%) had Z-Scores between -2.50 and -3.00, followed by 28.6% with Z-Scores between -3.00 and -3.5.

CONCLUSION

The extent of stem subsidence increased with the increase in the level of osteoporosis in the patients (as measured by the z scores). Maximum initial subsidence was seen in the first 6 months of follow-up, as the patient started weight bearing without any functional impairment or need for repeat surgery at 1 year. However, a long term follow-up beyond 1 year is needed to assess further biomechanical changes.

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