

## A Case Report-Neck fracture of a cemented stainless-steel femoral modular stem, 8 years after Total Hip Arthroplasty

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**Abstract :** Total Hip Replacement is a method of prosthetic reconstruction of the acetabulum and proximal femur following hip joint destruction. Prosthetic fractures have been reported after primary surgery ; with majority of them at the prosthetic stem. Few had fracture through neck of prosthetic stem. Here, we report a rare case of fracture neck of prosthetic stem within 10 year of implantation in a patient with high Body Mass Index (BMI) and stressful daily activities.

**Keyword :** Total Hip Replacement, Prosthetic Fracture, Fatigue Fracture.

### I. INTRODUCTION

Total hip arthroplasty has evolved greatly, since John Charnley first introduced its concept [1]. Development of modular femoral stem-neck and dual mobility cup in acetabulum has contributed in better functional outcomes in morbid hips. However, all these implants are subjected to wear and tear, particularly in the long term [2]. Implant failures in form of fatigue fractures are infrequent complications (1 to 11%) in hip arthroplasty [1, 2]. Overall ten-year survival rate of hip prosthesis is about 80% [3]. THR in active young population require more stable and durable construct, as they have long life expectancy and repeated higher loading stresses.

Prosthesis material and design, its implantation technique combined with subjective variations in patients are the major determining factors affecting its longevity. Patient-related factors include male gender, increased weight, tall height, high-activity levels, bilateral hip disease, lumbar spine disease, and the presence of bilateral total hip replacements. Surgery-related factors include varus orientation of the stem, poor proximal fixation coupled with rigid distal fixation leading to cantilever bending/fatigue, asymmetrical cement mantle, undersized femoral component, and poor proximal bone support (absence of the calcar) [4]. Factors relating to the prosthesis comprise improper material selection, manufacturing or metallurgic defects, and design flaws leading to unbalanced stress [5].

The femoral neck is a significantly loaded region in total hip prosthesis. Its fracture is rare [6]; very few cases have been documented till now. These fatigue fractures can be prevented by selecting higher tensile metals like chromium-cobalt, titanium with better pressure loading [7]; newer adaptable stems; acetabular cup styles and improved surgical techniques matched to the individual needs of patients.

### II. CASE REPORT

Forty-one-year male underwent a primary bilateral Total Hip Arthroplasty in 2007, subsequent to Avascular Necrosis (Grade 4) induced Secondary Osteoarthritis of bilateral hip.



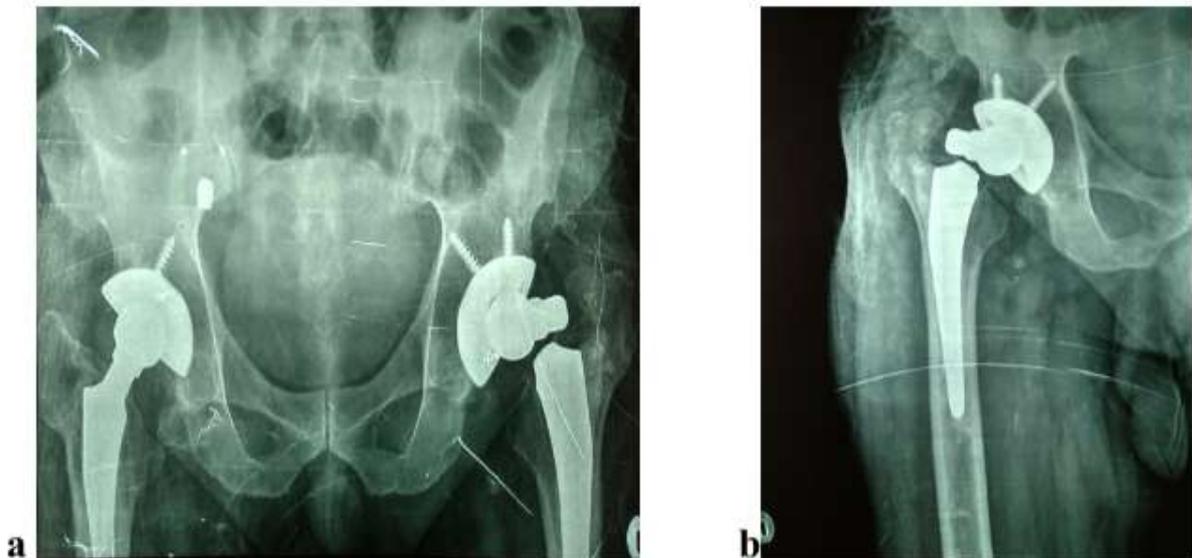


**Figure1.** Pelvis with both hip joint x-ray (a) Year 1998 x-ray showing involvement of right head; (b) Year 2007 x-ray with involvement of bilateral hip joints; (c) Post-operative x-ray; (d) One month follow up; (e) One year follow up.

His joints were reconstructed with cemented INOR modular straight stem design (small;133mm) with head insert having standard neck (28mm) of stainless steel, acetabular uncemented component by DEPUY (Duraloc sector cup 58) mm and ENDURON (10D 28x58 or 70) as polyethylene liner. The modular head was available in two sizes (22mm and 28mm) with three neck sizes (short, standard, and long) to adjust the offset and length. The stem design corresponds to standard Muller type with availability in four sizes (130, 133, 138 and 143mm).

The patient was 6 feet tall with 98kg weight and demands high activity status, as required by his profession. He had history of chronic alcoholic intake along-with tobacco chewing. Southern approach was utilized, with bearing surface of metal on polyethylene liner. The patient was otherwise healthy. He remained asymptomatic, ambulatory and pain-free after 2 months of surgery.

In April 2015 (8 years postoperatively), the patient had a trauma due to fall on left hip. Following the event, he presented to our casualty department with pain and was unable to bear weight. There was clicking sound on hip examination. Radiographs were taken which showed bilateral hip arthroplasty with fracture of left sided femoral stem neck without any involvement of bone.



**Figure2.** (a) Anteroposterior view of pelvis with both hips showing left broken femoral neck. (b) Anteroposterior view of hip joint with femur showing broken implant with no bone fracture.

Preoperative blood investigations were normal. Examination of CT scan of pelvis with hip joints showed 15 and 17 degrees of antversion; 37 and 55 degree of inclination in right and left acetabular cup respectively with femoral version of 18 degrees in both hips.

The patient was planned for revision dual mobility Hip Replacement Surgery. Southern approach was taken to extract the acetabular cup with liner and screw. The femoral component could not be retrieved by stem

extractor, so we utilized trochanteric osteotomy to remove femoral stem and cement extraction. The extracted femoral stem showed fracture at tapered smallest cross-section of neck of femoral stem. The polyethylene liner showed normal aging. Impaction bone grafting with allograft was done prior to placement of cemented ADES dual mobility cup (56mm) with insert of longer neck (Modular Head –Muller Type; 28, +3.5 long) for better abductor mechanism. To achieve better fixation in shaft; large femoral stem of Muller Type with (7.5XL, length 250mm) was used. Osteotomy was closed with stainless-steel Tension banding wire encircling. Post-operative course was uneventful; patient was mobilized on third day with partial weight bearing supported by walker. At follow-up examinations, eight months postoperatively, the patient remains independently mobile and pain free with a good range of motion having Harris Hip Score of 90.

**Figure 3.** (a) Extracted total hip prosthesis, (b) and (c) Margin surface of broken femoral neck, (d) and (e) are post-operative images, (f) Four months follow up, (g) Eight months follow up.



### III. DISCUSSION

Various reported cases of fractured femoral stem had showed similar observations. Most of the patients were young adult men with heavy built and high activity level [8-10]. Due to repeated heavy loading cycles in these patients, the implants were subjected to increased stress. Large stress and more wear in implants make them vulnerable to fatigue fractures.

Correct component positioning is critical for the stability of the prosthesis in total hip arthroplasty. The optimal cup position is about  $45 \pm 10$  degree of abduction and  $20 \pm 10$  degree of version [11]. Vertical orientation of acetabular cup makes them prone to dislocation and increased wear-tear. In the case under study angle of inclination of acetabular cup was 55 degree and version 18 degree with no incident of dislocation. Hence cup placement may vary a lot, according to surgeon technique.

Femur neck works as a lever arm in balancing forces across the joint. It is subjected to unsymmetrical stress along its varied diameter. Taper design of the implanted femoral stem with fixed neck; produce significant loading at the smallest cross-section point. Factors contributing to fracture include defects in welding of the neck to the prosthesis [13], heavy laser etching in the region [14], and crevice corrosion associated with the head-neck junction [15]. Vatani et al. observed 9 fractures though the neck of femoral stem in 35 total hip arthroplasties using a Charnley type modular 28 head [16]. The fractures occurred after mean 4 (0.3–6) years. All fractures were due to an inadequate confluent radius causing abnormal transmission forces through the neck.

#### IV. CONCLUSION

Femoral stem fracture cannot be attributed to a single cause. Various modalities work at different level leading to increased wear and tear in implants. The repeated insults to vulnerable point add up over the years leading to its breakage. In this case, patient's heavy body with tall stature and high working causes increased stress over the narrow neck of stainless steel implant over the years. Finally causing fatigue fracture at the neck stem junction.

These adverse events could be prevented by using chromium-cobalt or titanium prosthesis having higher yield and better strength. Newer modular designs also have higher yield and better strength.

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#### FINANCIAL DISCLOSURES AND CONFLICTS OF INTERESTS

There are no financial disclosures to be made for this study for the immediate or foreseeable future. There are no conflicts of interests.

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