



## Femoral prosthesis neck fracture following total hip arthroplasty : A case report

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**Fracture of the femoral prosthesis neck following total hip arthroplasty is not common. We report a case of femoral prosthesis neck fracture in an adult male patient following modular, uncemented total hip arthroplasty. This case report further emphasizes the importance of the potentially high loading situation in the prosthetic femoral neck. On the other hand, the occurrence of a femoral prosthesis neck fracture in a cementless system denotes a well fixed distal stem and calls for a difficult revision procedure usually requiring an extended trochanteric osteotomy for stem retrieval.**

**Keywords :** total hip replacement ; femoral stem ; trunion fracture.

### INTRODUCTION

Fracture of the femoral prosthesis following total hip arthroplasty is not common. Although several reports of femoral stem fractures have been published, there are only a few reports documenting a femoral prosthesis neck fracture (7). Whereas the mechanisms and material factors associated with femoral stem fracture are well known, risk factors associated with femoral prosthesis neck fracture are poorly understood.

We report a case of femoral prosthesis neck fracture in an adult male patient following total hip arthroplasty with a fully porous-coated AML cementless stem and a cementless Duraloc cup.

### CASE REPORT

In March 2000, a 25-year-old male patient (height = 174 cm, weight = 78 kg) with ankylosing spondylitis with bilateral hip involvement underwent bilateral uncemented total hip replacement with a Co-Cr alloy fully porous-coated (titanium porocoat) size 10 AML cementless stem and a cementless Duraloc cup (DePuy) with a small femoral neck. The patient did well with no complications. In September 2006, he felt sudden pain in his right hip and heard a cracking sound while climbing stairs, and fell to the ground. He was no longer able to bear weight on his right limb. He was brought to our emergency department where a diagnosis of fracture of the femoral prosthesis neck was made on the basis of radiographs (Fig. 1). Three days later, he underwent a revision arthroplasty of the right hip (Long revision AML cementless femoral stem of size 10 and long skirted neck) using an extended trochanteric osteotomy (Fig. 2).

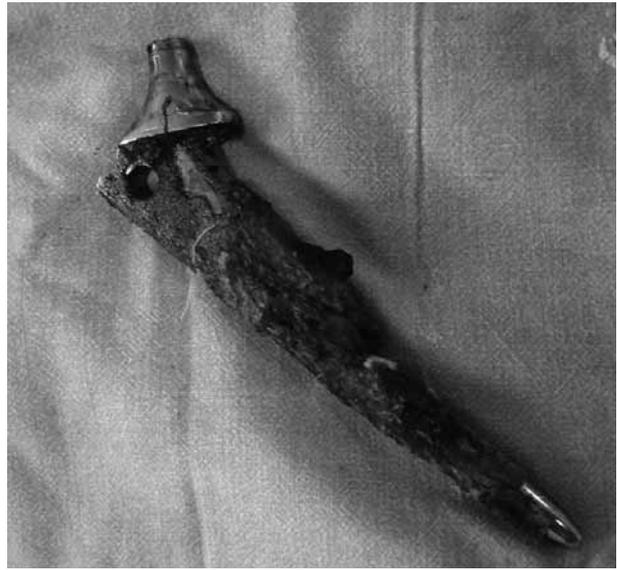
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**Fig. 1.** — Femoral prosthesis neck fracture in a modular hip design system.

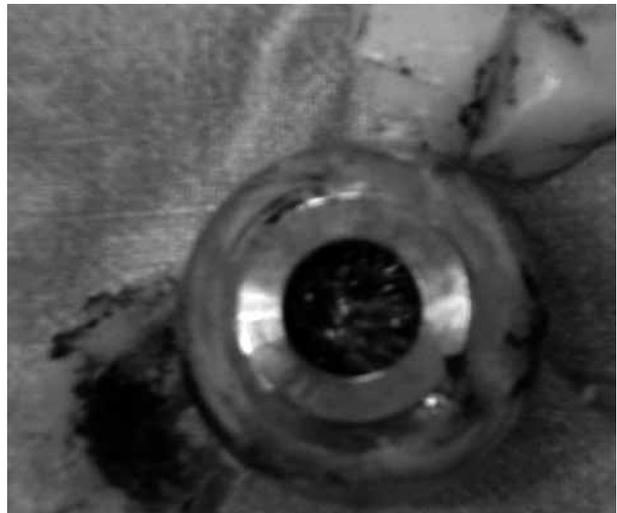


**Fig. 3.** — Intraoperative photograph of the retrieved implant showing fracture of the femoral neck.



**Fig. 2.** — Postoperative radiograph of same patient following revision using an extended trochanteric osteotomy.

Intraoperatively, the femoral prosthesis was found to be broken through the neck taper just below the level of the head of the prosthesis (Fig. 3 & 4). The femoral stem was found to be well fixed, without



**Fig. 4.** — Intraoperative photograph of the retrieved prosthetic femoral head showing fracture of the femoral neck inside the femoral head.

any evidence of loosening. No evidence of component malpositioning was present. No signs of corrosion or defect of the material were noted on the femoral neck or head ; however detailed metallurgical analysis was not done because of lack of facilities.

## DISCUSSION

Fracture of the neck of a femoral prosthesis is rarely reported. Implant loosening, varus implant positioning, excessive activity, excessive body weight, metallurgical defects, defective implant material, stress risers from nicking the prosthesis, bilateral hip disease and calcar resorption are known clinical factors associated with femoral prosthesis stem fracture (7), but factors associated with fracture of the femoral prosthesis neck are poorly understood.

We could find only a few articles in English literature related to fracture of the femoral prosthesis neck following total hip arthroplasty. Burstein and Wright (2) reported two cases in 1985 with a Trapezoidal-28 prosthesis. They reported metal fatigue caused by cyclic tensile stresses as the mechanism of failure in this region where the stresses are thought to be primarily compressive.

Rand and Chao (7) reported three cases in 1987 (2 cases with a Trapezoidal-28 prosthesis and one with a Müller straight stem prosthesis). They criticized the design of the prosthesis neck. They also mentioned increased activity, varus positioning of the stem and increased body weight as risk factors. They also implicated defects of welding of the neck to the head as a possible mechanism of failure. However these were all monoblock prostheses, and this possibility can be excluded by employing a modular component in which welding is not used, like in our case.

Vatani *et al* (9) reported nine cases (8 in men and 1 in a woman) with cemented stems of the monoblock Charnley type (Medical Tec, Brazil). They also analyzed the risk factors associated with this fracture. They found no metallographic, chemical or microhardness defects and blamed the faulty neck design, especially the presence of a neck with sharp confluence radius. They suggested several methods to reduce or eliminate this possible complication of total hip arthroplasty. They stressed upon optimized surgical techniques to improve the fixation of the implant to the bone and cautioned against varus positioning of the femoral stem. They also emphasized the importance of optimal quality control of implant material as well as design incor-

porating reinforcement in the stress zone, and avoidance of sharp edges and excessive offset.

Morgan-Hough *et al* (6) reported the first case of femoral prosthesis neck fracture with current modular hydroxyapatite coated hip designs. They implicated fatigue as the culprit because of stressful bending forces that result from partial or complete loss of support of the proximal stem, while the distal end remains rigidly fixed in cement (cantilever effect).

Botti *et al* (1) reported a similar case of trunion fracture in a size 18 fully porous coated AML stem (DePuy); they attributed the cause of trunion fracture to likely damage incurred during previous revision surgery, coupled with the increased susceptibility to corrosion associated with a modular femoral component with a long skirted neck.

Gilbert *et al* (4) reported 2 cases of intergranular corrosion-fatigue failure of cementless modular femoral stems (PCA, Howmedica) with a cobalt-alloy head and a cobalt-alloy stem. Both implants failed less than one millimeter distal to the taper junction between the head and the stem (outside of the taper). The fractures occurred at the grain boundaries of the microstructure and appeared to be the result of three factors: porosity at the grain boundaries; intergranular corrosive attack, initiated both at the head-neck taper and at the free surface; and cyclic fatigue-loading of the stem.

Unnanuntana *et al* (8) also reported 2 cases of trunion fractures of fully porous coated AML femoral stems, which they attributed to smaller trunion (9/10 instead of the larger 12/14 trunion as in our case), the deep grooves machined into the surface of the trunion, and intergranular corrosion. Grivas *et al* (5) also reported neck fracture in a proximally coated cementless titanium stem due to a combination of factors including the reduced section of the neck and potential stress riser effect of either the laser marking or the edge of neck machining. Wilson *et al* (10) reported high mechanical forces and a poor geometric shape match between the neck and the stem as the predisposing factor for corrosion leading to femoral neck fracture in a total hip replacement.

Our case report is an interesting case report of a femoral prosthesis neck fracture with current

modular non-hydroxyapatite coated cementless hip designs. Modularity helps a surgeon to assemble a custom prosthesis at the time of surgery ; however each connection is a new site for fretting, disassociation, and corrosion (3). In our case, no evidence of fretting or corrosion was found. This further emphasizes the importance of potentially high loading situations in the prosthetic femoral neck and repetitive cyclic loads in this region as the most possible reason for its failure. We would also like to emphasize the fact that the occurrence of a femoral prosthesis neck fracture in a cementless system denotes a well fixed distal stem and calls for a difficult revision procedure usually needing a coronal split of the femur for stem retrieval.

Our conclusion is that while strict design and material standards should be applied to modular hip prostheses, patients should also be educated to limit their activities to a moderate level to minimize the cyclical tensile stresses over the femoral prosthesis neck.

## REFERENCES

1. **Botti TP, Gent J, Martell JM, Manning DW.** Trunion fracture of a fully porous-coated femoral stem. *J Arthroplasty* 2005 ; 20 : 943-945.
2. **Burstein A H, Wright TM.** Neck fractures of femoral prostheses. *J Bone Joint Surg* 1985 ; 67-A : 497-499.
3. **Collier JP, Mayor MB, Jensen RE et al.** Mechanisms of failure of modular prostheses. *Clin Orthop Relat Res* 1992 ; 285 : 129-139.
4. **Gilbert JL, Buckley CA, Jacobs JJ, Bertin KC, Zernich MR.** Intergranular corrosion-fatigue failure of cobalt-alloy femoral stems. A failure analysis of two implants. *J Bone Joint Surg* 1994 ; 76-A : 110-115.
5. **Grivas TB, Savvidou OD, Psarakis SA et al.** Neck fracture of a cementless forged titanium alloy femoral stem following total hip arthroplasty : a case report and review of the literature. *J Med Case Reports* 2007 ; 1 : 174.
6. **Morgan-Hough, Tavakkolizadeh A, Purkayastha S et al.** Fatigue failure of the femoral component of a cementless total hip arthroplasty. *J Arthroplasty* 2004 ; 19 : 658-660.
7. **Rand JA, Chao Y.** Femoral implant neck fracture following total hip replacement. *Clin Orthop Relat Res* 1987 ; 221 : 255-259.
8. **Unnanuntana A, Chen DX, Unnanuntana A, Wright TM.** Trunion fracture of the Anatomic Medullary Locking A Plus femoral component. *J Arthroplasty*. 2010 May 28. [Epub ahead of print]
9. **Vatani N, Comando D, Acuña J, Prieto D, Caviglia H.** Faulty design increases the risk of neck fracture in a hip prosthesis. *Acta Orthop Scand* 2002 ; 73 : 513-517.
10. **Wilson DAJ, Dunbar MJ, Amirault JD, Farhat Z.** Early failure of a modular femoral neck total hip arthroplasty component : A case report. *J Bone Joint Surg* 2010 ; 92-A : 1514-1517.