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CASE REPORT

Severe corrosion after malpositioning of a metallic head over the Morse taper of a cementless hip arthroplasty. A case report

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KEYWORDS

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Summary Morse tapers are frequently used in total hip replacement to achieve precise adjustment of lengths and femoral offset. Mechanically, they do not raise any specific problems so long as strict positioning requirements are observed and elements from different manufacturers are not mixed together. We report a case in which the implant induced unexplained pain at 2 years, in relation to a defective fit between the metallic head and the Morse taper. Asymmetric partial fit of the head onto the taper was detected on control X-ray and was implicated as causing metallosis due to excessive release of metal debris from the Morse taper. Revision required femoral stem exchange because of the damage to the Morse taper as well as replacing the cup with new metal-metal bearings. Evolution was favorable at 3 years' follow-up. Most hip replacements include a Morse taper; the present clinical case is a reminder that strict positioning rules are to be respected, without which corrosion and wear may lead to mechanical failure.

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Introduction

Morse tapers were introduced in the early 1970s to provide head-neck modularity, facilitating adjustment of lengths and isolated change of bearings [1,2]. The mechanical principle of the Morse taper enables good "automatic" centering and symmetric grip ensuring adherence between the two components (metal, or metal-ceramic) [3,4]. This modularity,

however, involves an extra mechanical interface which may be subject to corrosion [3–5] or metal fracture [6,7]. We here present a case of defective fit of a metal head onto the Morse taper, which induced unexplained pain around the large-diameter metal-metal bearings implant. The patient has been informed of the intention to publish her case, and has given her agreement.

Observation

A 58-year-old woman was referred for crural and inguinal pain that persisted for 2 years following a non-cemented

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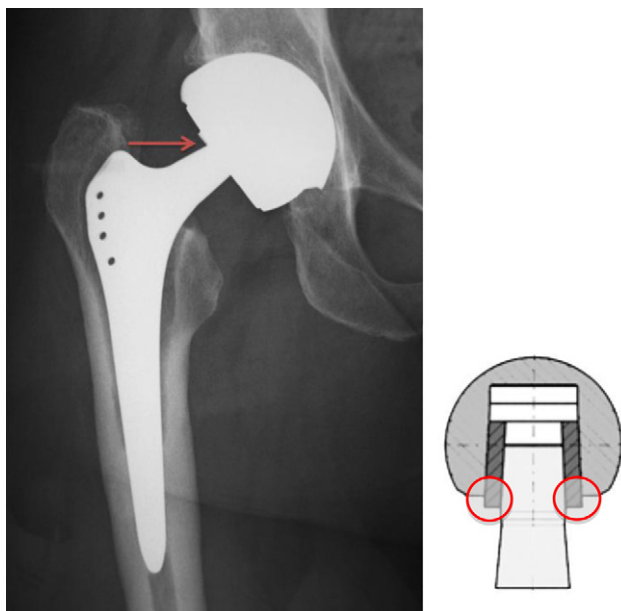


Figure 1 Antero-posterior (AP) X-ray just before implant replacement, showing defective fitting of the head-adaptor assembly onto the Morse taper of the pivot. The arrow points to the projection of the ring, which should not be asymmetrical. The diagram shows that the medium-sized ring should not project asymmetrically (circles).

large-diameter metal-metal bearings total hip replacement (THR). All the components and joint parts came from the same manufacturer (Zimmer, Étupes, France):

- a 52 mm Durom™ cup;
- a size-2 lateralized Alloclassic™ Ti-6Al-4Ni femoral pivot with 12/14 mm 5° 38' Morse taper;
- a 46 mm diameter femoral head with high-carbon forged chromium cobalt Metasul™ bearings;
- a medium-size adaptor for the junction between the head (18/10 taper) and the modular neck (12/14 taper).

The assembly was positioned on the implant neck before reduction. A peroperative femoral fissure at the bottom of the greater trochanter was managed using two cerclage wires. The area between the medial part of the greater trochanter and the shoulder of the femoral stem was grafted with cancellous bone from the femoral head. Five weeks' postoperative non-weight-bearing was prescribed.

A year after the THR, the patient complained of inguinal and trochanteric pain; distal iliopsoas release was performed and the cerclage wires removed, without changing any implant component. Pain failed to improve, and onset of crural pain led to referral to our center. The patient had a Postel-Merle-d'Aubigné (PMA) score of 9, and presented with 5 mm shortening of the left lower limb. Soft-tissue ultrasound found periprosthetic liquid effusion, but without any solid formation suggestive of pseudotumor. Joint puncture and bacteriological analysis ruled out infection. Antero-posterior X-ray found 5 mm subsidence of the femoral pivot with distal pedestal. Above all, the juncture between the Morse taper and the adaptor was abnormally visible, with an inadequate connection angle (Fig. 1), suggestive of

an adaptation defect between the Morse taper and the head/adaptor assembly.

Bipolar revision reutilized the posterolateral approach. Severe metallosis was observed and synovectomy performed. Abnormal mobility was found between the head/adaptor assembly and the 12/14 Morse taper of the pivot, with serious damage to the taper, preventing readaptation: even after several impactions, abnormal rotational mobility persisted around the taper axis. The femoral pivot lacked osseointegration, and could be extracted without femorotomy. The acetabular component was osseointegrated but with retroversion. Revision used an impacted Allofit™ cup (Zimmer, Étupes, France), 32 mm Metasul™ insert (Zimmer, Étupes, France) and cemented self-blocking Müller femoral component (Zimmer, Étupes, France). Macroscopic retrieval analysis found Morse taper wear caused by poor impaction of the head/adaptor assembly (Fig. 2). The 12/14 Morse taper of the pivot showed macroscopic wear and pitting, indicating considerable corrosion. There was, however, no abnormal mobility between the adaptor and the femoral head (Fig. 2). Periprosthetic tissue histology found fibrous remodeling, with inflammatory infiltrate composed of lymphocytes, plasmocytes and numerous multinuclear giant cells resorbing fine black particles consistent with metallosis. There was no histological evidence of Atypical Lymphocytic Vasculitis-Associated Lesion (ALVAL) [8].

Three years post-revision, the patient's PMA score was 17 and control X-ray showed neither osteolysis nor any implant component migration (Fig. 3).

Discussion

Although the Morse taper of the head-neck junction is an apparently effective locking mechanism, it may be subject to micromovement [9,10] even if the components are properly fitted. Micromovement allows synovial liquid into the junction space, with possible consequent fretting corrosion [9–12]. Such corrosion may lead to fatigue fracture of the taper, especially in implants with a modular double taper (one end fitted into the femoral head and the other into a pivot shaft) [6,12] and more rarely with a one-ended taper [5], or to weakening, then fracture of a ceramic head [13]. Corrosion phenomena resulting in metal debris [3,10,11,14] were worsened in the present case by defective fitting of the Morse taper, accelerating wear and inducing very early metallosis. Inflammatory reaction to metallosis may cause crural pain [15,16]. In the present case, extensive metallosis may have contributed to loosening the femoral pivot, causing crural pain. Likewise, the liquid reaction metallosis in the hip may explain the inguinal pain. The remaining question is the origin of the metallosis:

- if the femoral loosening was primary, it could have induced metallosis by micromobility of the titanium alloy pivot; however, the femoral pivot surface did not in fact show significant damage (Fig. 2);
- contact between the metal wires and the pivot may have induced a galvanic effect; however, the pain persisted and the lesions continued to develop even after removal of the wire;



Figure 2 Retrieval photos, showing abnormal Morse taper wear. There was corrosion, but without serious damage to the inner surface of the adaptor (triangles). The presence of bone (arrows) on the rehabitable surface of the cup confirmed fixation. The femoral pivot surface showed no damage, but also no significant new bone growth.

- the bearings could be the cause of metallosis, although several factors point away from this possibility:
 - the high-carbon forged chromium-cobalt bearings showed no macroscopic abnormality (scoring, scratching or grinding),
 - there was no abnormal pseudotumoral reaction (on ultrasound) or ALVAL (on histology) as seen in case of metal-metal bearings dysfunction,
 - in case of metal-metal bearings dysfunction, pain generally occurs after a pain-free interval of 2 years on average for pseudotumor [8,16] and 5 to 6 years for ALVAL [8,17], and there was no such pain-free interval in the present case. Moreover, if it had been an ALVAL reaction, symptoms would have persisted after implanting new metal-metal bearings [8,17], which was not the case;
- defective Morse taper adaptation would thus seem to have been the main factor inducing metallosis, as there was no pain-free interval and the very early damage sustained by the taper (Fig. 2) suggests intense early metal debris release.

To the best of our knowledge, this is the first such case to be reported in the literature. The phenomenon was referred to by Goldberg et al. [3], who showed that even a very slight angular defect in implanting the head onto the Morse taper could make the junction unstable, with increased friction followed by accelerated corrosion and metallosis. The



Figure 3 Antero-posterior (AP) and lateral X-rays 3 years after revision, showing no loosening or recurrence of osteolysis.

present case confirms this hypothesis: radiography showed an asymmetric aspect of the adaptor, and the retrieval study showed major damage to the Morse taper. The asymmetric locking onto the taper resembled what is found with drawers in old furniture, with a misleading impression of what in fact is precarious fixation. To prevent this phenomenon, we, like Callaway et al. [13] recommend screwing the head onto the cone during positioning, to avoid any adaptation defect, then impacting strongly. The adaptation rings used in the large-head DuromTM system and the open geometry of certain head sizes have been implicated in elevated metal ion production due to increased modularity [18]. We did not assay blood ions in the present case, which is an important study limitation, as it seems likely that titanium assay would have definitively confirmed the origin of the metallosis and THR failure. Even so, the severe early Morse taper damage bears out the hypothesis that defective locking of the head onto the taper was the cause of the failure here observed.

Conclusion

The present observation stands as a reminder that Morse tapers, however widespread, may lead to THR failure. Implant adaptation onto the taper requires not only painstaking drying but also great attention to secure the mechanical connection. Whatever the material of the head, we recommend tightening it onto the Morse taper with a screwing movement, then completing fixation by strong impaction.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

- [1] Judet R, Siguiet M, Brumpt B, Judet T. Porous metal total hip prosthesis without cement. *Rev Chir Orthop* 1978;64(Suppl. 2):14–21.
- [2] Grosjean G, Courpiet JP, Moindreau M, Hunou N, Mathieu M, Hamadouche M. Should monoblock cemented stems be systematically revised during revision total hip arthroplasty? A prospective evaluation. *Rev Chir Orthop* 2008;94:670.
- [3] Goldberg JR, Gilbert JL, Jacobs JJ, Bauer TW, Paprosky W, Leurgans S. A multicenter retrieval study of the taper interfaces of modular hip prostheses. *Clin Orthop Relat Res* 2002;401:149–61.
- [4] Kop AM, Swarts E. Corrosion of a hip stem with a modular neck taper junction: a retrieval study of 16 cases. *J Arthroplasty* 2009;24:1019–23.
- [5] Bobyn JD, Tanzer M, Krygier JJ, Dujovne AR, Brooks CE. Concerns with modularity in total hip arthroplasty. *Clin Orthop Relat Res* 1994;298:27–36.
- [6] Unnanuntana A, Chen DX, Unnanuntana A, Wright TM. Trunion fracture of the anatomic medullary locking a plus femoral component. *J Arthroplasty* 2011;26(3):504.e13–6.
- [7] Atwood SA, Patten EW, Bozic KJ, Pruitt LA, Ries MD. Corrosion-induced fracture of a double-modular hip prosthesis: a case report. *J Bone Joint Surg (Am)* 2010;92:1522–5.
- [8] Delaunay C, Petit I, Learmonth ID, Oger P, Vendittoli PA. Metal-on-metal bearings total hip arthroplasty: the cobalt and chromium ions release concern. *Orthop Traumatol Surg Res* 2010;96:894–904.
- [9] Hallab NJ, Messina C, Skipor A, Jacobs JJ. Differences in the fretting corrosion of metal-metal and ceramic-metal modular junctions of total hip replacements. *J Orthop Res* 2004;22:250–9.
- [10] Jacobs JJ, Gilbert JL, Urban RM. Corrosion of metal orthopaedic implants. *J Bone Joint Surg (Am)* 1998;80:268–82.
- [11] Jacobs JJ, Skipor AK, Patterson LM, et al. Metal release in patients who have had a primary total hip arthroplasty. A prospective, controlled longitudinal study. *J Bone Joint Surg (Am)* 1998;80:1447–58.
- [12] Grupp TM, Weik T, Bloemer W, Knaebel HP. Modular titanium alloy neck adapter failures in hip replacement-failure mode analysis and influence of implant material. *BMC Musculoskelet Disord* 2010;4(11):3.
- [13] Callaway GH, Flynn W, Ranawat CS, Sculco TP. Fracture of the femoral head after ceramic-on-polyethylene total hip arthroplasty. *J Arthroplasty* 1995;10:855–9.
- [14] Fraitzl CR, Moya LE, Castellani L, Wright TM, Buly RL. Corrosion at the stem-sleeve interface of a modular titanium alloy femoral component as a reason for impaired disengagement. *J Arthroplasty* 2011;26:113–9.
- [15] Iida H, Kaneda E, Takada H, Uchida K, Kawanabe K, Nakamura T. Metallosis due to impingement between the socket and the femoral neck in a metal-on-metal bearing total hip prosthesis. A case report. *J Bone Joint Surg (Am)* 1999;81:400–3.
- [16] Donell ST, Darrach C, Nolan JF, et al. Early failure of the Ultima metal-on-metal total hip replacement in the presence of normal plain radiographs. *J Bone Joint Surg (Br)* 2010;92:1501–8.
- [17] Willert HG, Buchhorn GH, Fayyazi A, Flury R, Windler M, Köster G, et al. Metal-on-metal bearings and hypersensitivity in patients with artificial hip joints. A clinical and histomorphological study. *J Bone Joint Surg (Am)* 2005;87:28–36.
- [18] Vendittoli PA, Amzica T, Roy AG, Lusignan D, Girard J, Lavigne M. Metal ion release with large-diameter metal-on-metal hip arthroplasty. *J Arthroplasty* 2011;26(2):282–8.