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CASE REPORT

Intraprosthetic dislocation: a potentially serious complication of dual mobility acetabular cups

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Abstract Though dual mobility cups have gained growing popularity as a solution for instability in total hip replacements, these promising devices are subject to a specific implant failure mode, named intraprosthetic dislocation. We present the case of a patient sustaining such an adverse event. The planned revision surgery was postponed 12 months due to a severe heart condition, allowing a rare opportunity to document the natural history of this unusual complication. The small femoral head was found dislodged in the superior part of the metallic shell and had remarkably lost its sphericity. Severe metallic debris and granuloma were found in the proximal femoral region, associated with major periprosthetic bony and soft tissue damage. Surgeons, radiologists, and general practitioners should be aware of this specific complication, its incidence (almost 5 %) and mechanisms (femoral neck to mobile polyethylene insert impingement, leading to rim fatigue and wear of the insert at the capturing area). Diagnosis is mainly based on anteroposterior and modified Lowenstein lateral radiographs of the hip, as an eccentric position of the small femoral head, lying against the concave inner surface of the shell. Prompt component revision should be planned, since delayed management could lead to severe irretrievable damages.

Keywords Total hip replacement · Dislocation · Dual mobility · Metallosis · Revision

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Introduction

Given the increasing number of total hip arthroplasties (THA) being performed yearly, recurrent dislocation and instability, with an incidence ranging from 0.5 % to higher than 10 % [1], represent a major concern, both for the individual patient and healthcare system. When non-operative treatments fail, surgical options include implant reorientation, soft tissue reconstruction, or conversion to specific devices such as bipolar hemiarthroplasty, elevated rim liners, large heads, or constrained devices. Rates of dislocation after revision of THA for instability nevertheless have been reported from 22 to 31 % [2]. Another option is the use of dual mobility cups that have been developed in the late 1970s as an alternative for patients at high risk of dislocation [3].

Dual mobility original design (Fig. 1) is based on an acetabular monoblock highly polished metal shell (cemented or not) running against a modular bipolar head, consisting in a small metallic femoral head (22 or 28 mm in diameter), which is locked to any type of femoral stem and placed in a semi-constraining large polyethylene head. This large polyethylene head (between 46 and 64 mm in diameter) is articulating on both its concave and convex sides (inner and outer articulations), i.e., motion may occur within the bipolar femoral head component as well as between the bipolar component and the acetabular component. Range of motion and stability are increased with these devices, and associated with promising results [4, 5], but unique modes of failure may occur because of their complexity. The most common of these modes of failure is called intraprosthetic dislocation (Fig. 1), which is induced by the loss of polyethylene large head retentiveness and escape of the small femoral head inside the shell. As patients merely complain of discomfort in the groin, diagnosis of this unsettling adverse event requires standard non-weight-bearing anteroposterior and modified Lowenstein (urethral profile) lateral [6] views of the hip, showing femoral head-

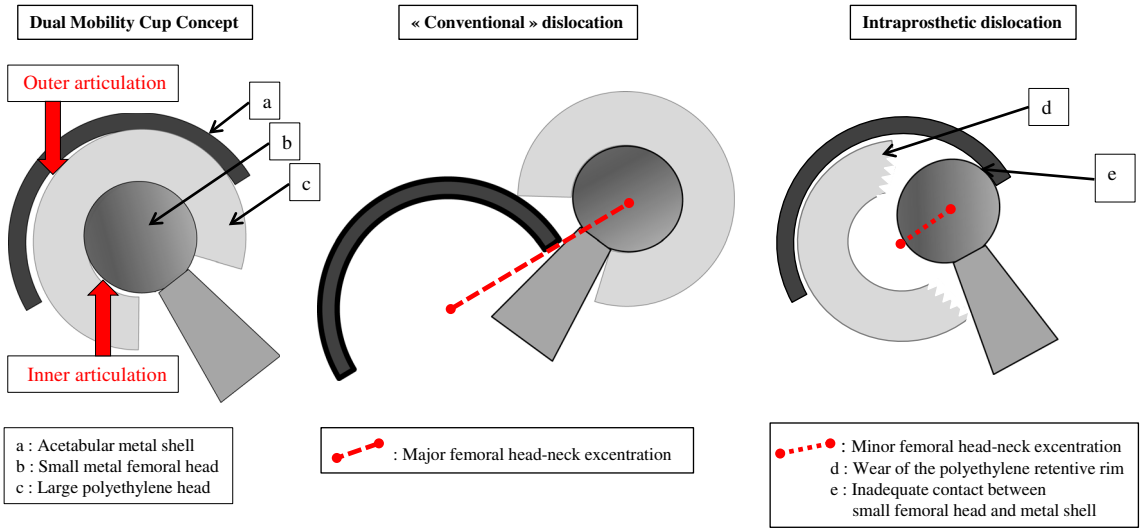

Fig. 1 Schematic concept of dual mobility cups and compared adverse situation "conventional" hip dislocation versus intraprosthetic dislocation

neck major eccentric position, contact of the small femoral head against the inner concave part of the acetabular shell, on occasion bubble-like hyperdensities (deposited metallic debris outlining joint space), but no bead shedding (opaque microfragments) around implants. Outside the orthopedic field, little is known about this recent dual mobility hip implant, and even less about its unique complication which, if unrecognized, is potentially serious. We present here the case of a long-term evolution of such a condition, as a teaching value. The patient was informed that data concerning the case would be submitted for publication, and he consented.

Case report

A 67-year-old patient first presented with recurrent dislocations of his right total hip arthroplasty. His past history included a first total hip arthroplasty 13 years earlier for post-traumatic osteoarthritis. This was revised recently for aseptic loosening and revision was complicated by a *Staphylococcus epidermidis* infection and trochanteric non-union with recurrent dislocations. This was managed through a one-step exchange, using an acetabular reinforcement device with a cemented polyethylene acetabular component (Stryker, Howmedica, Hérouville Saint Clair, France) and a cemented monoblock stem with a 22.2-mm head (Howmedica). Recurrent true hip dislocations emerged despite adequate infection management, trochanter fixation with wires and plate, and immobilization for 6 weeks using a spica cast. The acetabular component was therefore replaced by a cemented dual mobility socket (Medial Cup, Aston, France) (Fig. 2). This yielded an excellent early and mid-term result that lasted 5 years, after which the patient complained of progressively worsening groin pain. He also had a subjective feeling of instability. Routine physical examination, just as laboratory testing, came back negative. Anteroposterior and modified Lowenstein lateral radiographs revealed no evidence of osteolysis, loosening, or recurrent infection (Figs. 3 and 4). These views, however, demonstrated an eccentric location of the femoral head in relation to the acetabular shell, greater than that expected from normal wear, and suggesting intraprosthetic dislocation (Figs. 3 and 4). Surgical revision was indicated but postponed due to the severe cardiac issues of the patient. During this forced waiting period, moderate discomfort of the

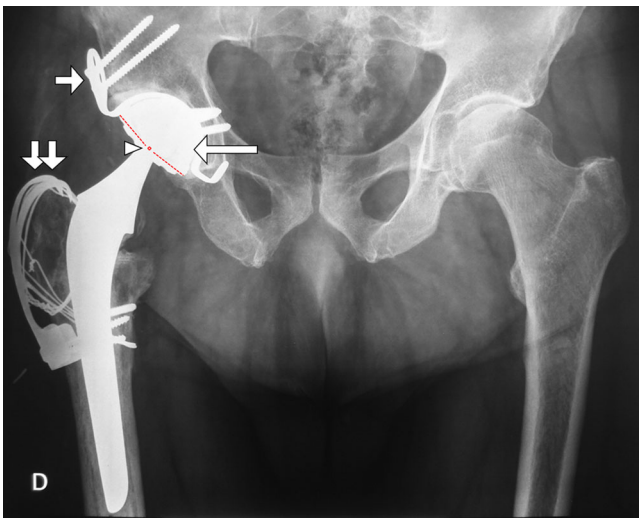

Fig. 2 Standard non-weight-bearing anteroposterior pelvic radiograph taken 6 weeks after the last revision hip surgery for instability in a 67-year-old man showing the properly positioned acetabular reinforcement metallic device (*small arrow*), cemented acetabular shell of a dual mobility cup (*long arrow*), and a trochanteric hook (*double arrows*) to prevent greater trochanteric non-union after repeated transtrochanteric approaches. Note the position of the femoral head-neck centered in the acetabular shell (*arrowhead*)

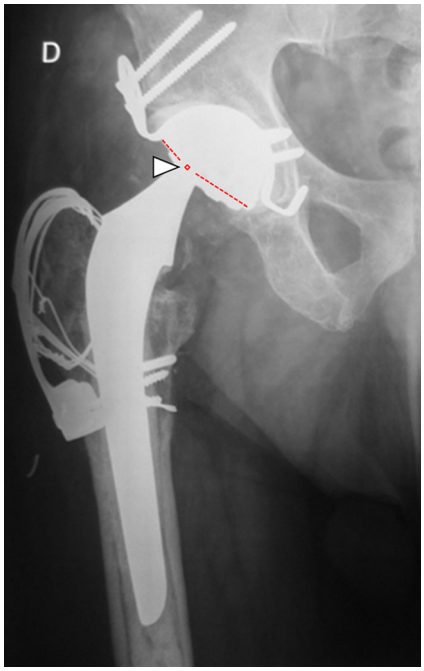

Fig. 3 Anteroposterior hip radiograph 5 years after the last revision showing a characteristic superior eccentric position of femoral head within the acetabular shell (*arrowhead*), lying against the inner concave surface of the acetabular shell, highly suggestive of intraprosthetic dislocation

patient was managed with non-opioid oral analgesics and walking aids. Surveillance anteroposterior and modified Lowenstein lateral radiographs were performed every 3 months to monitor any sudden major component disassembly or bone loss evolution. Revision surgery was thereby performed 12 months following the diagnosis of this complication. The head was found dislodged in the superior part of the metallic socket through a zone of superior polar wear of the polyethylene insert. There was a remarkable loss of head

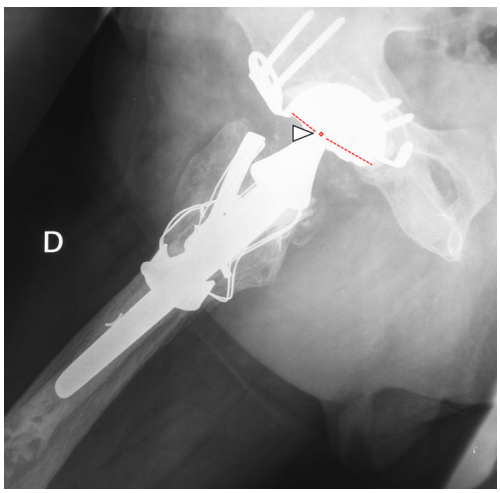

Fig. 4 Urethral profile (= modified Lowenstein lateral view) hip radiograph 5 years after the last revision showing a similar anterior excentration of femoral head within the acetabular shell (*arrowhead*)

sphericity (Fig. 5a), while the polyethylene insert revealed also signs of gross wear (Fig. 5b). However, the metal back socket showed no macroscopic mobility and its concave inner surface was devoid of any scratch. Severe metallic debris and granuloma were found in the proximal femoral region. The monoblock stem was revised and the polyethylene mobile insert changed. Postoperative recovery was uneventful and at the latest follow-up (1 year), the patient was pain free, and his hip was stable.

Discussion

Numerous studies have been published demonstrating the effectiveness of various dual mobility sockets in reducing dislocation rates, either for high-risk patients in primary THAs [5], or to treat recurrent prosthetic dislocation [7]. However, intraprosthetic dislocation remains a specific issue. This event can be described as the head coming out of the polyethylene insert through wear of the retentive rim, and then lodging itself in the metal-back shell, and has been reported with rates ranging from 0.7 to 5.2 % [4, 8]. Patients with intraprosthetic dislocation typically have a nonspecific clinical presentation; however, radiographs will show the characteristic eccentric position of the neck of the femoral component. Intraprosthetic dislocation is related to wear of the retentive rim or its incapacity to prevent the outward migration of the head from a blocked insert. The wear of the rim could be related to recurrent contact with an aggressive neck design, referring either to a large neck diameter or to its unpolished surface, both being responsible for inadequate impingement and high risk of accelerated wear. For similar reasons, the use of skirted heads has to be avoided. The impingement is even more aggressive if the mobility of the insert is limited by fibrosis or blocked by ossifications at the periphery of the cup. The creep of the polyethylene might also play a role in altering the insert-cup congruence [9].

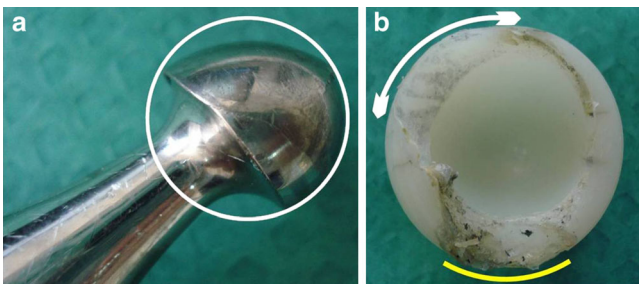

Fig. 5 **a** The explanted femoral component showing an aspherical head (*shown inside a perfect circle*) resulting from an articulation between the metallic femoral head and the inner surface of the metal shell. **b** Examination of the circumference of this liner shows a characteristic superior polished depression reproducing the shape of the head (*white arrows*) and an irregular roughened inferior imprint with raised polyethylene shavings on the flat equatorial edge of the polyethylene due abrasion by an angular sweeping motion of the neck (*yellow arch*)

Three cases of intraprosthetic dislocation have recently been reported with distinct interests. Loubignac et al. reported an early intraprosthetic dislocation, 9 months postoperatively, secondary to several attempts at closed reduction of a posterior dislocation [10]. Two attempts consisted in external manipulation under general anesthesia and curarization, which was unsuccessful. A third attempt was made for close reduction using an orthopedic table under general anesthesia, curarization, and image intensification but led to intraprosthetic dislocation through polyethylene disassembly. Surgical reduction confirmed the diagnosis and revealed an explanted polyethylene insert that did not show any macroscopic wear. Banzhof et al. reported a case of intraprosthetic dislocation resulting of impingement of the outer polyethylene head on the edge of the acetabular component during two forceful attempts at closed reduction [11]. In that particular case, the polyethylene head component had completely dislodged and migrated anteriorly into the psoas tendon. In the third case, a supposed intraprosthetic dislocation remained silent as was finally revealed through extensive metallosis 3 years after the index arthroplasty [12]. At revision, the polyethylene liner was noted dislodged leading to erosion of the metal socket by the prosthetic head. Our case emphasizes a long-term dramatic evolution of a diagnosed intraprosthetic dislocation, associating severe metallosis and proximal femoral osteolysis, as surgical treatment could not be performed due to a severe cardiac condition.

Practitioners should be aware of this specific complication of dual mobility cups. Even if this condition might be nearly asymptomatic, even if pain levels are low, standard non-weight-bearing anteroposterior and modified Lowenstein lateral radiographs are of major importance in order to avoid errors or delayed diagnosis. Remember, an urgent component revision should be planned in order to prevent serious complication. As dual mobility cups are gaining popularity, we believe this information is important to physicians' best practices.

Conflict of interest The authors declare that they have no conflicts of interest related to this study.

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