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Total Hip Arthroplasty Dislocations Are More Complex Than They Appear: A Case Report of Intraprosthetic Dislocation of an Anatomic Dual-Mobility Implant After Closed Reduction

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Background: Total hip arthroplasty is a successful operation for the treatment of hip pain. One of the common complications of hip arthroplasty is dislocation. While reduction of standard prosthetic dislocations is highly successful, new prostheses add the potential for new complications.

Case Report: We present the case of a patient who experienced intraprosthetic dislocation of an anatomic dual-mobility total hip prosthesis after a closed hip reduction and include the prereduction and postreduction radiographic findings.

Conclusion: Emergency department physicians should be aware of intraprosthetic dislocation. This complication can be easily missed because the metal/ceramic femoral head appears to be reduced in the acetabulum.

Keywords: *Arthroplasty–replacement–hip, hip dislocation, hip prosthesis*

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INTRODUCTION

Total hip arthroplasty (THA) is a successful operation for the treatment of hip arthritis, with a projected 174% increase in the United States by 2030.[1] With modern bearings and surgical techniques, the average dislocation rate after THA is approximately 1%.[2] Most dislocated THAs are satisfactorily treated in the emergency department with sedation and closed reduction. Complications associated with closed reduction include failure of reduction, redislocation, periprosthetic fracture, and nerve palsy.[3,4] The type of leg manipulation during reduction depends on the direction of dislocation. Posterior or posterior-superior dislocations are the most common and require vertical traction combined with internal rotation of the leg to bring the femoral head up and away from the pelvis followed by gradual axial traction to distract the leg and allow the femoral head to reduce into the acetabulum.

In 2009, the US Food and Drug Administration approved a new type of mobile bearing total hip prosthesis called an anatomic dual-mobility (ADM) implant that was introduced to improve hip stability and decrease the risk of dislocation (Figure 1). This device consists of a femoral head with dual articulation and a smaller inner femoral head (made of either cobalt chrome or ceramic) that is coupled with and articulates within a larger polyethylene femoral head. The larger outer polyethylene femoral head then articulates with the polished metal acetabular shell.

While rare, a unique failure mode of this device is intraprosthetic dislocation in which the inner bearing dissociates from the larger outer bearing. Although only available in the United States since 2009, the prosthesis has been available in France since the 1970s, and French researchers have reported on their experience with this device.[5] Philippot et al reported that intraprosthetic dislocation has been associated with cup loosening, extrinsic blocking of the polyethylene liner (eg, arthrofibrosis, heterotopic ossification), or polyethylene wear that compromised the dual-bearing engagement and usually occurred several years after the index procedure.[5] Early intraprosthetic dislocation is exceedingly rare, with only a few case reports in the literature.[6-14] Potential causes of early intraprosthetic dislocation are improper assembly of the two bearings at the time of surgery and forceful dislocation or reduction resulting in dissociation.

Radiographic recognition of an intraprosthetic dislocation after reduction may be difficult because the inner metal/ceramic bearing may be located within the acetabular shell, while the larger polyethylene component is dissociated and dislocated. Subtle clues of an intraprosthetic dislocation include eccentricity of the femoral head within the acetabular shell and the presence of a

Figure 1. In the typical dual-mobility construct, a small central metal or ceramic head couples with a large polyethylene head inside the acetabular cup.

bubble sign (Figure 2) on the postreduction radiograph that represents the outer polyethylene bearing in the extraarticular soft tissue.[15] Immediate recognition is essential because surgical intervention is necessary to recouple or replace the dislodged bearing and openly reduce the dislocated prosthesis.

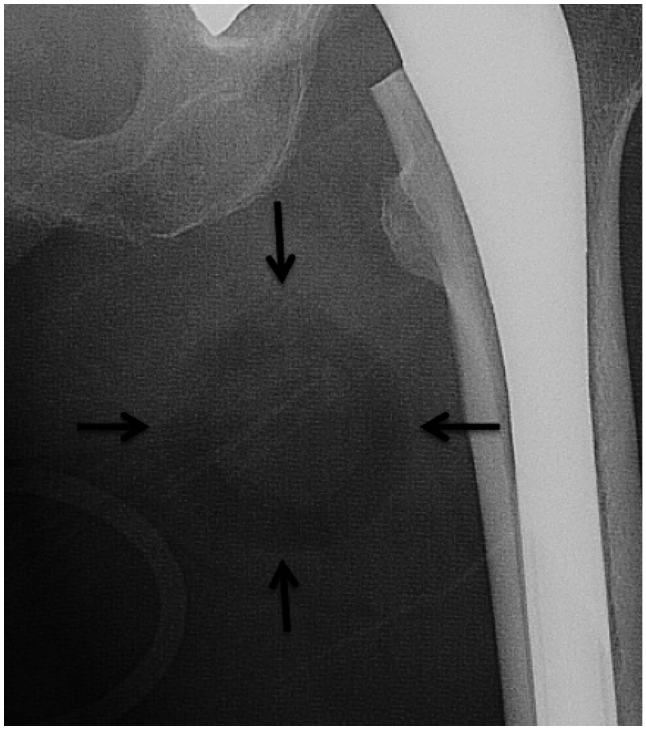

Figure 2. X-ray shows the dislocated and uncoupled polyethylene head in the soft tissue. The arrows surround the bubble sign of the polyethylene head apparent in the soft tissue.

We present the case of a patient who experienced intraprosthetic dislocation of an ADM total hip prosthesis after a closed hip reduction and include the prereduction and postreduction radiographic findings. Our report may assist the treating physician in early identification and treatment of this rare type of dislocation.

CASE REPORT

A 77-year-old female was referred to our institution for painful end-stage osteoarthritis of the left hip. A 54-mm cementless cup with a dual-mobility bearing and a primary cementless stem was implanted through a posterolateral approach. An ADM device (Stryker Orthopaedics) was used because of the patient's risk factors for dislocation (ie, age >75 years, flexibility, hypermobility, active lifestyle, and female sex). The polyethylene liner and the metal head were assembled properly with an implant-specific tool, and the dual-bearing engagement was verified prior to implantation. The hip was stable intraoperatively with good range of motion and no impingement or subluxation. The patient was discharged home with posterior hip precautions on postoperative day (POD) 2.

On the morning of POD 3, the patient slid out of her bed, hyperflexed her knees and hips as she slid into a squatting position, and experienced a dislocation of the left hip posteriorly. During physical examination at the emergency department, she was observed to be neurovascularly intact but unable to move her left hip secondary to pain, and her left leg was shortened and internally rotated. Pelvic radiographs revealed a posterior-superior dislocation (Figure 3). A closed reduction was performed under conscious sedation (propofol) using the technique described by Bigelow[16] in which the ipsilateral leg is grasped, and traction in line with the femur and internal rotation are placed upon the affected hip.

Postreduction films demonstrated the femoral head inside the acetabular shell; however, the femoral head was eccentric to one side of the acetabulum (Figure 4). Upon further inspection of the radiographs, a circular lucency (bubble sign) was noted in the inferomedial aspect of the patient's thigh. Computed tomography (CT) revealed the polyethylene component was in the postero-infero-medial aspect of the thigh (Figure 5A and 5B).

The patient was admitted to the orthopedic service and taken to the operating room. During the procedure, the polyethylene component was found to not only have dissociated from the femoral head but also to have migrated postero-infero-medially approximately 3 cm below the lesser trochanter (Figure 6A). Careful inspection of the cobalt chrome acetabular component did not show any noticeable damage (Figure 6B), and a new polyethylene component was placed (Figure 7). The patient tolerated the procedure well, was allowed to bear weight as tolerated after the surgery, and was discharged on posterior hip precautions for 6 weeks.

DISCUSSION

Since the introduction of dual-mobility implants in 2009, their use in the United States has been on the rise.[6-15] In our

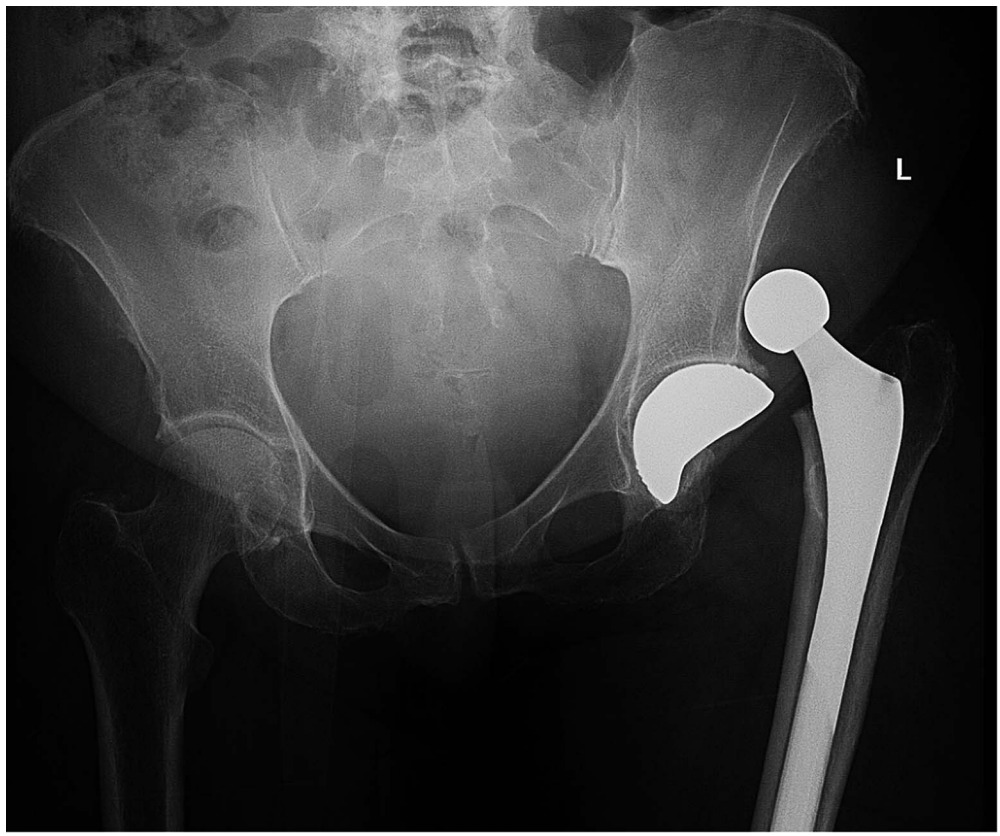

Figure 3. Our patient's initial x-ray after dislocation. The properly coupled large polyethylene head can be seen as a shadow around the small femoral head.

practice, we use dual-mobility implants when we have concerns over dislocation. We consider age >75 years, flexibility, hypermobility, active lifestyle, and female sex to be risk factors for dislocation. We also have begun using dual-mobility implants in patients undergoing revision total hip arthroplasty.

Successful closed hip reductions under conscious sedation are regularly performed in emergency departments. Complications after closed hip reduction are rare and include neurologic deficit, fracture, and the inability to reduce the prosthesis that requires revision surgery.[3,4] Our patient had a unique complication after attempted closed reduction in which the force of the reduction maneuver resulted in an iatrogenic intraprosthetic dislocation of an ADM device. This complication occurs when the polyethylene liner engages the rim of the metallic acetabular shell, and subsequent limb traction results in the dissociation of the small head from the large polyethylene liner, similar to a bottle-opener effect. Few reports of early intraprosthetic dislocations in the English literature identify the reduction as the underlying cause.[7,9,10,13] When an intraprosthetic dislocation occurs, the outer polyethylene bearing can migrate away from the acetabulum. Fehring and Berry report a case in which the bearing was found to be intrapelvic at the time of revision surgery.[8]

An intraprosthetic dislocation can be challenging to identify on postreduction radiographs because the inner femoral head bearing may give the appearance of being satisfactorily reduced. In a 2014 report, the intraprosthetic dislocation was not identified, and the patient was discharged home only to redislocate the smaller inner bearing 6 weeks later.[7] The patient underwent a reduction after the second dislocation, and retrospective review demonstrated that after the initial reduction the smaller femoral head was eccentric in the acetabulum, and the subtle polyethylene shadow was apparent in the soft tissue (the large polyethylene bearing). The patient underwent revision THA after the realization that an intraprosthetic dislocation had occurred. In this case, the cobalt chrome acetabular shell was significantly damaged because of delayed identification, and revision surgery was required.

When evaluating a patient with a hip dislocation, the physician should try to identify whether the prosthesis is an ADM implant. The physician should first inspect for a halo around the radiopaque femoral head. This halo represents the outer polyethylene bearing around the femoral head of an ADM prosthesis. If the prosthesis has a dual-mobility liner, the physician should perform a careful reduction maneuver and have a high index for suspicion of intraprosthetic dislocation. The best leg maneuver to reduce an ADM implant and avoid intraprosthetic dislocation is not known. However, standard hip reduction techniques should be used.

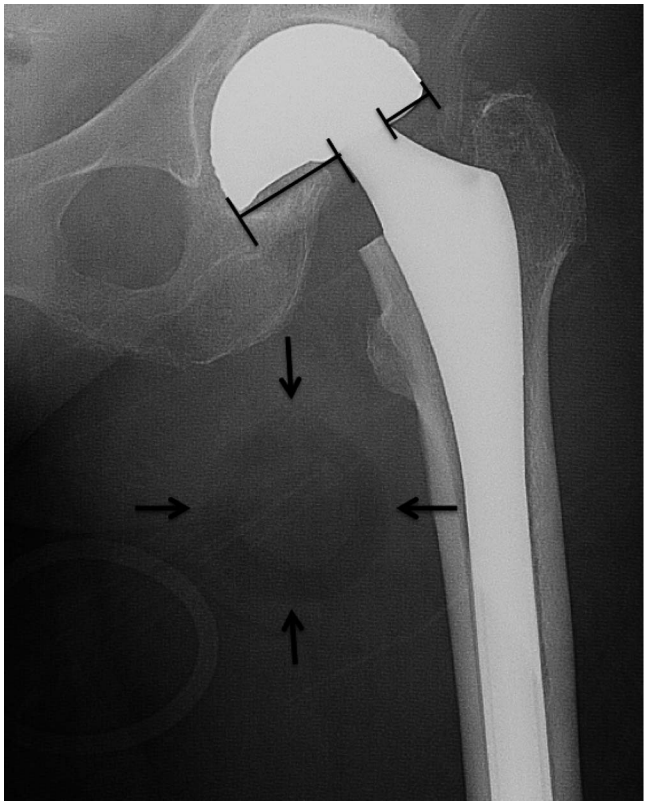

Figure 4. Our patient's x-ray after the reduction attempt. The small femoral head is eccentric inside the acetabular cup. The arrows show the dissociated polyethylene femoral head in the soft tissue.

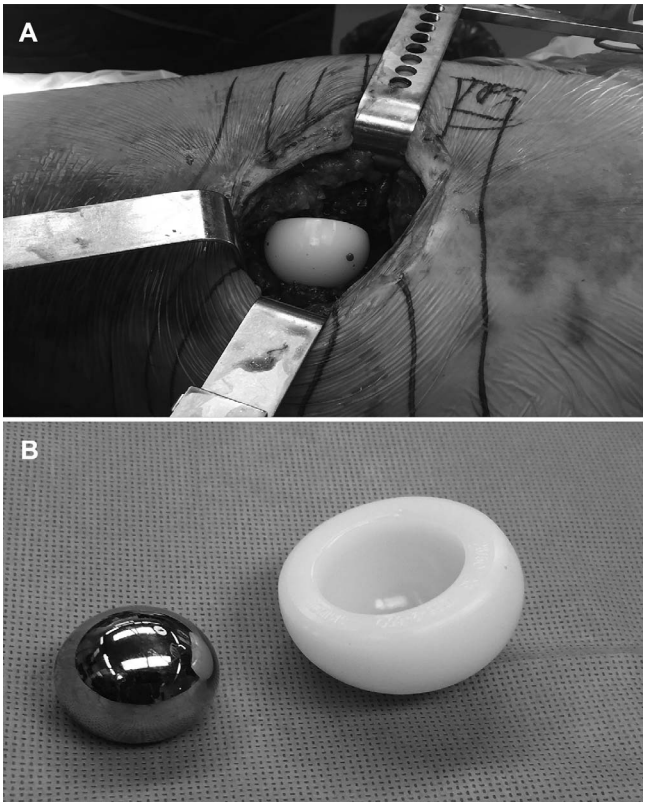

Figure 6. A: Intraoperative photograph of our patient. After slight dissection down, the polyethylene head was visualized and photographed. B: Our patient's dissociated dual-mobility prosthesis in the operating room after removal.

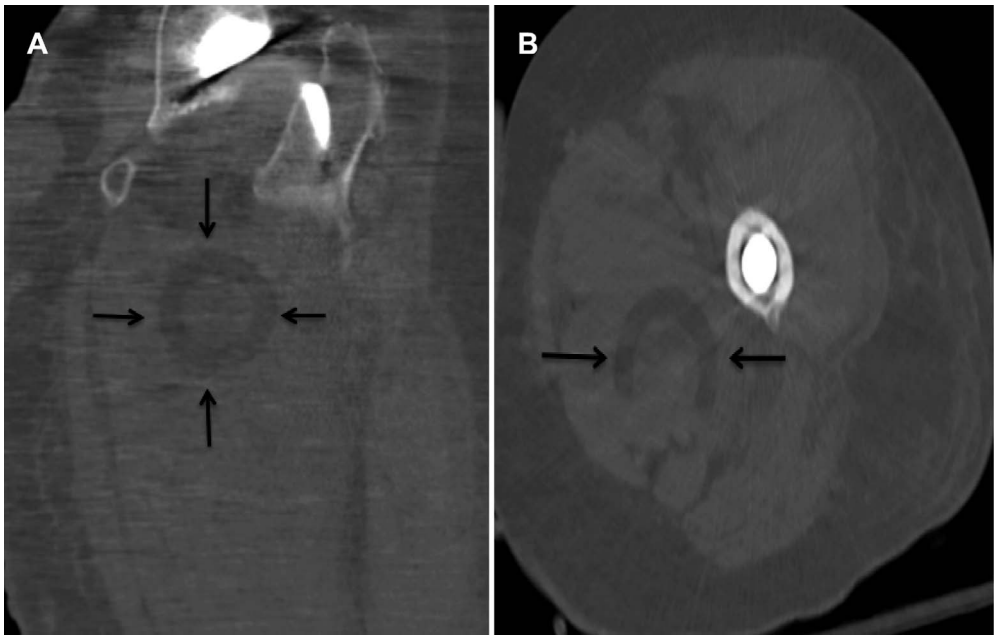

Figure 5. A: Coronal computed tomography (CT) image shows the polyethylene head dissociated and in the soft tissue. The arrows surround the polyethylene head. B: In a similar CT image in the axial plane, the arrows show the polyethylene head.

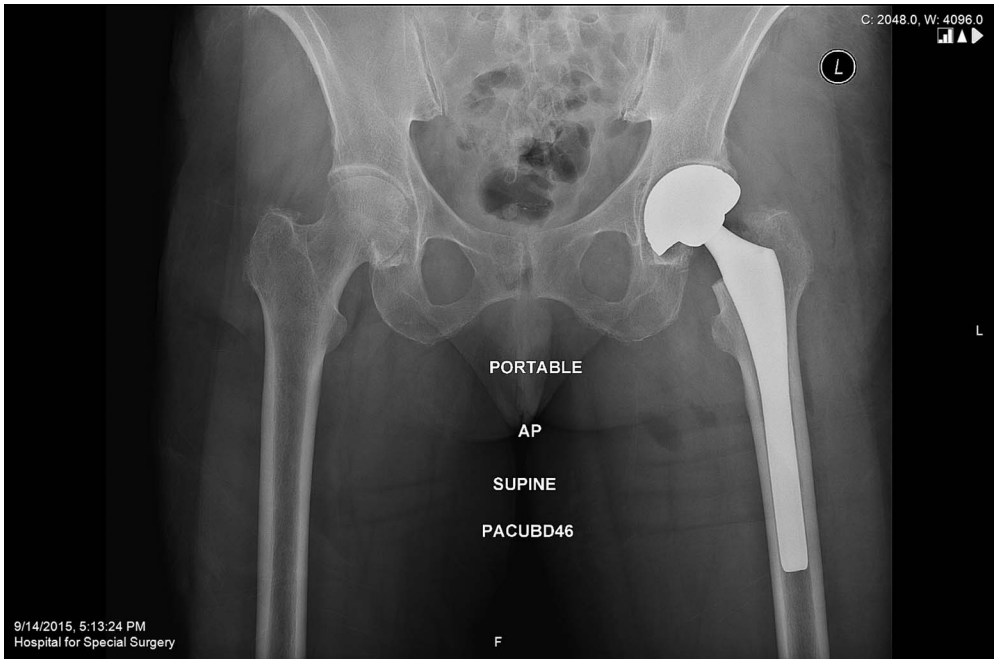

Figure 7. Postoperative x-ray shows the concentric reduction and proper alignment after revision dual-mobility implant.

Certain maneuvers can help avoid intraprosthetic dislocation. First, the reduction should be performed with adequate conscious sedation to relax the soft tissues. Direct axial traction should be avoided to reduce the potential for the bottle-opener effect in which the large polyethylene liner is caught on the acetabular shell and is pulled away from the smaller metal/ceramic femoral head. Instead of applying direct axial traction, an internal rotation force should be coupled with axial traction, allowing the polyethylene liner to elevate away from the acetabulum and avoid catching the acetabular component. If available, fluoroscopic imaging should be used to augment the reduction maneuver. Postreduction radiographs should be carefully evaluated for eccentricity of the femoral head and the presence of a bubble sign. The presence of either can indicate an intraprosthetic dislocation that requires urgent surgical intervention. If there is any doubt, a CT scan can rule out intraprosthetic dislocation.

CONCLUSION

With the recent introduction of ADM total hip prostheses, emergency department physicians should be aware of the new complication of intraprosthetic dislocation. This complication can be easily missed because the metal/ceramic femoral head appears to be reduced in the acetabulum. The physician should evaluate postreduction x-rays for an eccentric femoral head in the acetabulum or bubble sign in the soft tissue. Even when the prosthesis type is unknown, postreduction films should always be evaluated for eccentricity of the femoral head in the acetabulum and for any foreign object in the soft tissue.

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