Intraprosthetic Dislocation of a Contemporary Dual-Mobility Design Used During Conversion THA

ANDREW N. ODLAND, MD; RAFAEL J. SIERRA, MD

abstract

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Although dual-mobility sockets have been in clinical use for decades in other parts of the world, they recently gained popularity in the United States as an option for primary and revision total hip arthroplasty (THA). Improvements in dual-mobility socket technology include articulation with a metal insert impacted into a metal shell and a femoral head made of highly cross-linked polyethylene. The results and complications associated with the use of dual-mobility sockets employing these technologic advancements are not known. Specifically, intraprosthetic dislocation is a well-known complication of these implants and has been reported extensively in the literature. To the authors’ knowledge, its occurrence in a modern dual-mobility socket has not been reported. The authors report a case of early intraprosthetic dislocation of a contemporary dual-mobility design used to convert a patient to THA after failed fixation of intertrochanteric hip fracture. At retrieval, there was evidence that the outer bearing may have ceased moving, causing localized focal impingement of the implant neck on the retentive ring. The authors theorized that external hip impingement (pelvic against trochanter) and previous surgery that led to the formation of scar tissue could have caused the outer bearing surface to cease its motion. This ultimately led to impingement of the femoral component neck on the retentive ring, which led to the intraprosthetic dislocation. Dual-mobility cups provide an attractive option to decrease wear and improve stability. Further research is needed to establish the ideal construct design and materials. [Orthopedics. 2014; 37(12):e1124-e1128.]

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Dual-mobility cups provide an attractive option to decrease wear and improve stability. Their applications in complex total hip arthroplasty (THA) are particularly appealing. Intraprosthetic dislocation, however, is a known potential complication. The authors present a case of intraprosthetic dislocation after conversion THA.

**Case Report**

A 77-year-old man underwent conversion of failed cephalomedullary fixation to THA in July 2011. Fourteen years earlier, he underwent uncomplicated fixation of a posterior wall acetabular fracture. In December 2010, he underwent cephalomedullary nail fixation for comminuted intertrochanteric hip fracture. Six months after surgery, he presented with right hip pain and limited mobility. Radiographs showed femoral head screw cutout and nonunion of the intertrochanteric fracture, with distal migration of the nail and broken distal screws (Figure 1). Conversion to THA was performed in July 2011. A dual-mobility construct was chosen because of the increased risk of dislocation.

On the acetabular side, the construct included a 64-mm Tritanium (Stryker, Mahwah, New Jersey) shell fixed with multiple screws. A 48-mm cobalt chrome modular dual-mobility liner (Stryker) was impacted into the shell. The polyethylene femoral head was size 28/54. On the femoral side, a tapered fluted modular stem was used (Waldermar, Link, Hamburg, Germany). A 28-mm head was used (Figure 2). The patient did well postoperatively and resumed normal activity. He had no problems until June 2013 (almost 2 years after surgery), when he had subluxation. He noticed shortening of the extremity and weakness in the leg when weight bearing. He presented to the authors’ clinic 1 week after the initial episode, and radiographs showed intraprosthetic dislocation (Figure 3). Because of the patient’s medical history, he underwent appropriate preoperative evaluation, and 1 week later, revision THA was performed.

At revision, retrieval of the components showed significant focal wear of the polyethylene retentive ring to the smaller articulation (Figure 4). No appreciable wear was noted on the outer bearing, and that bearing was within the metal liner. There were no appreciable signs that the bearing had ceased moving. Fibrotic tissue was noted within the acetabular cavity, but it was no different than that seen during other revision cases to suggest overt arthrofibrosis. Once the bearing was retrieved,
attempts to relocate it on the side table were not successful unless the appropriate surgical reduction device was used. However, redislocation of the bearing occurred when an appropriate levering force was placed on the edge where the polyethylene showed signs of impingement.

**DISCUSSION**

Dislocation after THA is a major concern for orthopedic surgeons and patients. Dislocation is relatively rare after primary THA. The rate could be as low as 0.5% early, but as high as 10% with increasing follow-up. Its prevalence is highly dependent on surgical technique, approach, and femoral head size. However, postoperative dislocation increases substantially after revision and conversion THA. Studies have shown early dislocation rates of 7% to 10%. A meta-analysis showed a 10.7% median dislocation rate of THA after femoral neck fracture. Few studies have described conversion to THA after failed cephalmelodullary nailing of intertrochanteric fractures, but 1 small series showed a dislocation rate of 3 of 19 (16%) hips.

The dual-mobility construct was developed by Bousquet in 1974 in an effort to decrease dislocation rates after THA. The design consists of 2 articulating surfaces. The first is a large-diameter articulation between a metallic cup and a polyethylene insert, and the second is a smaller-diameter articulation between the femoral head and the retentive polyethylene insert. This was believed to provide the best of both worlds: a smaller head produced lower torque forces and thus less wear, and the mobile polyethylene liner created what was effectively a large head that increased jump distance and thus provided an inherently more stable hip. Numerous medium- and long-term reports noted a decrease in dislocation rates with this construct. However, a known complication of this implant is intraprosthetic dislocation, or failure of the smaller articulation where the femoral head becomes displaced out of the polyethylene head.

Philippot et al recently reviewed 81 intraprosthetic dislocations and attempted to discern a cause for each. They reported 3 distinct reasons for dislocation and developed the following classification system. Type 1 intraprosthetic dislocation is characterized by the absence of arthrofibrosis and cup loosening. Type 2 is characterized by blockage or ceasing of motion of the polyethylene liner as the result of an extrinsic process. Type 3 is caused by cup loosening. In the current case, because the retentive ring showed wear and impingement in only 1 distinct area, the authors concluded that the outer bearing may have ceased moving, causing localized focal impingement of the implant neck on the retentive ring. This case would be characterized as type 2 intraprosthetic dislocation. Although there was no evidence of ceased motion of the bearing at retrieval, this is the only explanation for the focal impingement-induced damage to the retentive ring.

Numerous possible causes of blockage of the outer articulating surface have been suggested. These include heterotopic ossification, arthrofibrosis surrounding the acetabular cup and polyethylene, and impingement as a result of trochanteric nonunion. The authors theorized that external hip impingement (pelvic against trochanter) and previous surgery that led to the formation of scar tissue could have caused the outer bearing surface to cease its motion.

Damage to the retentive ring was seen on retrieval. Impingement of the femoral component neck onto 1 distinct area was seen and caused damage to the retentive ring. In this case, the size of the taper of the femoral component was 12/14 and the femoral head was not skirted. The most proximal aspect of the femoral head increases in diameter, however, and could be a problem when it is used with this construct (Figure 5). An increased incidence of intraprosthetic dislocation was seen with thicker femoral necks; therefore, skirts or thick implant necks should be avoided with dual-mobility sockets.

Another potential complication of the dual-mobility construct, as recently reported, is failure of the inner articulation during attempted closed reduction after dislocation. The metal femoral head was reduced into the metal acetabular shell, leaving the polyethylene femoral head component dislocated in the surrounding soft tissue. Previously published studies of intraprosthetic dislocation included several series of dual-mobility components using standard ultra-high-molecular-weight polyethylene (UHMWPE) gamma irradiated in air. The modular dual-mobility cup design uses highly cross-linked polyethylene. This dual-mobility design was laboratory tested to analyze wear rates under numerous adverse conditions, such as femoral head abrasion, impingement, and ceased motion of the outer bearing surface. The investigators found that, even under a simulated condition of ceased motion of the outer bearing surface and induced impingement (as the authors assume was the scenario in the current patient), wear rates were still significantly lower than seen under ideal conditions in dual-mobility cups using UHMWPE. They concluded that the use of highly cross-linked polyethylene instead of UHMWPE would help to mitigate the damage resulting from ceasing of motion at the outer bearing and

Figure 5: The proximal aspect of the femoral head increased in diameter.
thus decrease the likelihood of intraprosthetic dislocation. The concern, however, is that the decreased material properties of highly cross-linked polyethylene may lead to failure because of the potential for increased cracking once impingement occurs within the smaller bearing and retention ring. Although it is most likely neither causal nor consequential to the complication reported here, and although it is common practice in revision arthroplasty, manufacturers do not recommend mixing acetabular and femoral components from different device manufacturers, as was done in this case.

**CONCLUSION**

Instability is an important problem in THA. Numerous advances have been made in an effort to decrease the incidence of dislocation. Overall, these advances have been successful and orthopedic surgeons now have more solutions for the unstable patient. Dual-mobility cups provide an attractive option to decrease wear and improve stability. However, intraprosthetic dislocation remains a potential complication despite continuing evolution and advancement in component technology. Further research is needed to establish the ideal construct design and materials.

**REFERENCES**


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**Table**

<table>
<thead>
<tr>
<th>Study</th>
<th>Total No. of Hips</th>
<th>Follow-up, y (Range)</th>
<th>No. of IPDs</th>
<th>Complicated by IPD, %</th>
<th>Mean Time to IPD</th>
<th>Reason for IPD</th>
<th>Component Type</th>
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<tbody>
<tr>
<td>Philippot et al, 2006&lt;sup&gt;10&lt;/sup&gt;</td>
<td>106</td>
<td>10</td>
<td>2</td>
<td>1.9</td>
<td>N/A</td>
<td>Type 1 (wear only)</td>
<td>Cup: NOVAE; Stem: Profil-1&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Philippot et al, 2008&lt;sup&gt;12&lt;/sup&gt;</td>
<td>438</td>
<td>Mean, 17 (12-20)</td>
<td>23</td>
<td>5.3</td>
<td>N/A</td>
<td>Type 1, 2, and 3</td>
<td>Cup: NOVAE; Stem: PF&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>Philippot et al, 2009&lt;sup&gt;7&lt;/sup&gt;</td>
<td>384</td>
<td>15.3 (12-20)</td>
<td>14</td>
<td>3.6</td>
<td>N/A</td>
<td>N/A</td>
<td>Cup: NOVAE; Stem: PF&lt;sup&gt;c&lt;/sup&gt;, or PRO&lt;sup&gt;d&lt;/sup&gt; (16-mm neck)</td>
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<tr>
<td>Boyer et al, 2011&lt;sup&gt;8&lt;/sup&gt;</td>
<td>240</td>
<td>22</td>
<td>10</td>
<td>4.1</td>
<td>9 y, 11 mo</td>
<td>N/A</td>
<td>Cup: NOVAE; Stem: PF&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>Hamadouche et al, 2012&lt;sup&gt;14&lt;/sup&gt;</td>
<td>168</td>
<td>Mean, 6 (5-8)</td>
<td>4</td>
<td>2.4</td>
<td>6</td>
<td>N/A</td>
<td>Cup: Tregor&lt;sup&gt;e&lt;/sup&gt;; Stem: Respect&lt;sup&gt;f&lt;/sup&gt;</td>
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<td>Combes et al, 2013&lt;sup&gt;15&lt;/sup&gt;</td>
<td>2480</td>
<td>7 (0.17-11)</td>
<td>7</td>
<td>0.3</td>
<td>7</td>
<td>N/A</td>
<td>Cup: 9 different designs; Stem: 4 different designs</td>
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<td>Philippot et al, 2013&lt;sup&gt;16&lt;/sup&gt;</td>
<td>1960</td>
<td>N/A</td>
<td>81</td>
<td>4.0</td>
<td>9</td>
<td>Type 1=26; Type 2=41; Type 3=14</td>
<td>Cup: NOVAE; Stem: PF&lt;sup&gt;c&lt;/sup&gt;, or PRO&lt;sup&gt;d&lt;/sup&gt; (13-mm neck)</td>
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<tr>
<td>Philippot et al, 2013&lt;sup&gt;17&lt;/sup&gt;</td>
<td>100</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
<td>Cup: NOVAE (highly cross-linked polyethylene); Stem: Corail&lt;sup&gt;g&lt;/sup&gt;</td>
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</table>

**Abbreviations:** IPD, intraprosthetic dislocation; N/A, not applicable.

<sup>a</sup>NNOVAE, Serf, Decines, France.
<sup>b</sup>Profil-1, Serf.
<sup>c</sup>PF, Serf.
<sup>d</sup>PRO, Serf.
<sup>e</sup>Tregor, Aston Medical, St Étienne, France.
<sup>f</sup>Respect, Aston Medical.
<sup>g</sup>Coral, DePuy, Warsaw, Indiana.
acetabular cup system to prevent dislocation after primary total hip arthroplasty: analysis of 384 cases at a mean follow-up of 15 years. *Int Orthop.* 2009; 33(4):927-932.


