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Case report

Constrained implant dislocation in total hip replacement. Report of a case

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SUMMARY. A case of a 48 year old female patient is presented. She had recurrent dislocation of her hip prosthesis. Initially, she was treated by open reduction and eventually, with constrained prosthesis revision surgery. In spite of this surgery, the patient persisted with instability and implant dislocation. This dislocation occurred when the femur head dislodged from the polyethylene implant for a total of 3 times. The literature review revealed this kind of constrained implant dislocations is very unusual and only 3 cases have been reported. They are accompanied by rupture of the metal safety ring. In contrast, loose acetabular cup or polyethylene insert with the femur head inside, is the most common presentation. The patient was treated with revision surgery, and a non constrained standard cup was placed and reoriented.

Key words: total hip replacement, dislocation.

RESUMEN. Se presenta el caso de una paciente de 48 años de edad, con luxación recurrente de prótesis de cadera. Inicialmente recibió tratamiento mediante reducción abierta y eventualmente con cirugía de revisión con prótesis constreñida. A pesar de la misma, la paciente persistió con inestabilidad y luxación del implante. Dicha luxación se presentó al desacoplarse la cabeza femoral del implante de polietileno en un total de 3 ocasiones. La revisión de la literatura revela que este tipo de luxación de implantes constreñidos de cadera es poco habitual y sólo en 3 casos se ha reportado y se acompaña de ruptura del anillo metálico de seguridad. En contraste, el desanclaje de la copa acetabular o el inserto de polietileno, permaneciendo la cabeza femoral dentro de este último, es la presentación más común. La paciente fue manejada mediante cirugía de revisión, colocación y reorientación de copa estándar no constreñida.

Palabras clave: artroplastía de cadera, luxación.

Introduction

Implant dislocation is the most feared of early complications of hip replacement. The incidence reported by the literature varies between 0 and 10% in primary arthroplasty and between 10 and 25% in revision arthroplasty.[13] Non surgical treatment of this complication, by closed reduction and external immobilization with braces or a cast, has goods results for as many as two thirds of cases. However, when handled surgically because of recurrent dislocations, satisfactory results do not exceed 60% regardless of the technique chosen.[11] Furthermore, the results are even less encouraging when a specific etiology has not been determined. For these cases, constrained components might be used.

By definition, constrained components of total hip prosthesis include some kind of mechanism preventing the femur head from separating of the polyethylene acetabular cup. The first design of a constrained hip prosthesis was reported by Sivash[17] in 1963. It was made of a single piece implant. Later, it was modified by Russin[15] and made popular throughout Europe[14] even for cases of hip replacement in Parkinson's disease,[15] loss of hip musculature, and cerebral palsy.[9]

The design of the constrained component is such that because of the additional polyethylene in the insert, it substantially increases the contact surface of the polyethylene acetabular cavity around the femur head thus preventing the femur head from being dislodged. Also, it has a metal ring acting as a lock or latch to significantly reduce the opening

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of this cavity. The end effect is a polyethylene insert strongly "embracing" the femur head. Cameron[3] determined that the necessary force to dislodge the femur head from a polyethylene element constrained by the metal ring firmly set is about 300 pounds per inch while it only requires 60 pounds per inch without it. In a similar study, Lombardi et al[10] determined 600 pounds (272 kilograms) of force were needed to dislodge a 32 mm femur head of a constrained component while a force of 325 pounds (147 kilograms) was needed when using a 28 mm head.

Today, the indication to use the constrained components is recurring dislocation of the hip prosthesis secondary to insufficient soft tissues (capsule or abductor muscles) not eligible for repair or reconstruction. Cases of lax soft tissues (not insufficient) due to shortening of the prosthetic implant and/or lateralization may be handled by elongating the femur neck and/or lateralization of the implant. Improperly placing, loosening or wear and tear of the component should be treated by revision of one or both components. Dislocation resulting from pinching and secondary "leverage" of the femoral head against the ring or elevation shown by certain polyethylene inserts, should be treated by revision of the femoral head, the insert or the acetabular component.

Late prosthetic dislocation (> 1 or 2 years postoperatively) may be associated to weight loss, decreased muscle mass and/or chronic disease (cancer, rheumatoid arthritis). When dislocation recurs in spite of a proper component placement, it is very difficult to treat and a constrained prosthesis could be a reasonable choice.

The purpose of this research is to identify the probable risk factors in dislocation of constrained implants in full hip replacement and to review the literature.

Case description

Female patient, 48 years old, with a history of chronic alcohol abuse presenting left femoral head fracture secondary to fall with direct trauma in August 2000. The patient was managed with surgery by replacing the joint for a bipolar type hemiprosthesis. The immediate course was apparently smooth. However, two months after the surgery, the implant dislocated so open reduction of the implant was required. Over 18 months after that, the patient described at least 6 additional events of arthroplasty dislocation. She was treated with surgery by open reduction in all 6 cases. During these procedures, the components of the implant were not revised or modified. Notice that during the last dislocation, the joint was not handled and remained dislocated for a period of about 3 months.

On June 15, 2002 a decision was made to perform revision surgery; the femoral stem was found to be soundly cemented with the proper orientation and anteversion so it remained unchanged. However, the bipolar component was removed and a non cemented acetabular cup was placed. The trochanter region was completely denudated of all muscle insertion. Even if during a reduction with test components arthroplasty was thought to be stable, the impossibility of performing a capsule muscular reinsertion and trochanter musculature urged us to place a constrained polyethylene insert (Biomet, Warsaw, IN, USA). The arch of motion and stability were considered satisfactory so the patient was immediately started on walking.

Over the following 9 months, the patient did not come again for postoperative control and suffered the dislocation of the constrained implant after having fallen from about a 1 meter height in March 2003. Interestingly the dislocation occurred when the femoral head of the polyethylene insert was dislodged in spite of the metal ring (acting as a latch for the constrained component) remaining in place *(Figure 1)*. It was necessary to perform a new surgery where a pressure zone for the insert was found and where the femoral neck had a pinching effect with forced flexion of the joint. The acetabular cup was not modified and the constrained insert was replaced for a new component with the same features.

The patient had a second dislocation of the constrained prosthesis on June 17, 2003, again dislodging the femoral head of the polyethylene insert. Likewise, it required open reduction and changing again the polyethylene component. The insert showed characteristics similar to those of the previously revised component albeit to a lesser extent *(Figure 2)*.

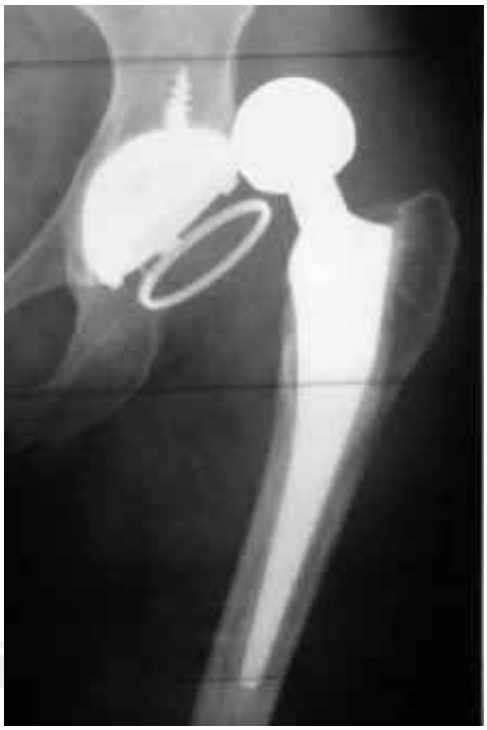

Figure 1. Dislocation of constrained hip prosthesis. Notice that the constrained polyethylene insert remains in place and the metal safety ring is intact. Inclination of the safety ring corresponds to the elevated lip of the polyethylene insert.

Five weeks after the surgery, the patient presented a third dislocation of the constrained component with the same characteristics: dislocation between the femoral head and the constrained polyethylene insert sparing the metal safety ring. In spite of the fact that the acetabular cup placement and fixation were acceptable, it was felt to be slightly neutral (not anteversed). This might have been a conditioning factor of the previous pinching effect between the polyethylene insert and the femoral head. The decision was to revise it. The new acetabular cup was placed at approximately 35° anteversion and 45° abduction. This time, we decided to place the standard, non constrained polyethylene insert. It still produced a pinching effect with the femoral neck on the ends of the arches of motion *(Figure 3)*. With the standard insert, and once the joint was reduced, we got an excellent, very stable arch of motion. However, it was not possible to rebuild the articular capsule or reinsert the trochanter musculature which had already been previously documented. In spite of such stability, we insisted with the patient on the need for using a hip abductor device and limb weight bearing was differed.

Time lapsed from the last surgery until this report was prepared, has been five months.

The patient has done satisfactorily using, until the time this paper was written, a hip abductor belt to protect the arthroplasty with no further dislocations. However, she needs to continue using the belt because of the lack of muscles in the trochanter region.

Discussion

Instability due to recurring dislocation of the hip prosthesis is a major challenge for orthopedic surgeons. Some risk factors include previous hip surgery and revision surgery, posterior surgical approach, insufficient abductor muscles, pseudoarthrosis of the greater trochanter, retroverted acetabulum orientation, elevated hip rotation center, postoperative management, neuromuscular alterations, and cooperation of the patient.[4,5,12,13]

As an additional finding, we saw that while properly placing the acetabular component is paramount in primary hip replacement, we believe that in the case of constrained arthroplasty, this margin of error is even smaller. While the polyethylene constrained component and the locking metal ring design aim at "embracing or seizing" the femoral head to prevent it from dislodging from the insert. The result of this effect is a more limited arch of motion rather than a non constrained component. In other words, it is not possible to increase implant stability without sacrificing freedom of motion at the same time. Hence, the femoral neck will pinch against the constrained insert when arches of motion are extreme by exerting lever forces against it, even on a properly placed component. This finding has been previously described by Lombardi et al[10] on a constrained implant similar to that of our case stating the arch of motion is directly proportional to the size of the femoral head and inversely proportional to the femoral neck diameter so that a 98° arch of motion was found with a 32 mm femoral head and the arch of motion was only 85° with a 28 mm head.

We are yet to find a response to why implant dislocation between the femoral head and the constrained com-

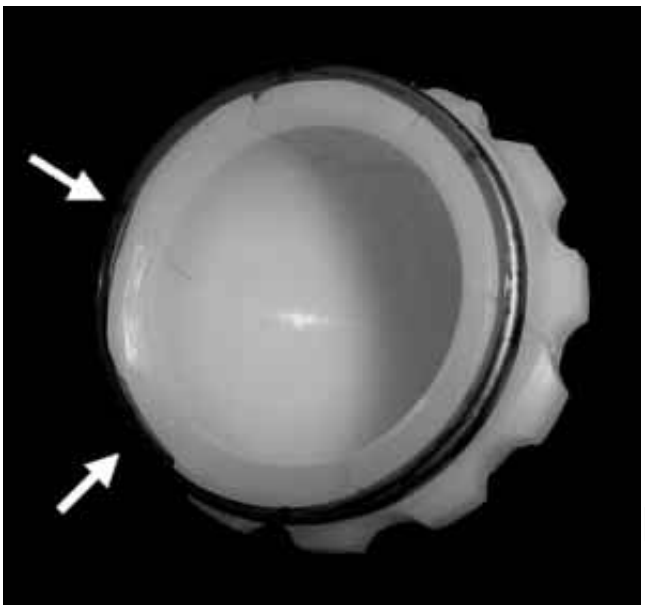

Figure 2. Constrained acetabular component and metal safety ring. Notice two pinching zones by the femoral neck marked on the polyethylene (arrows).

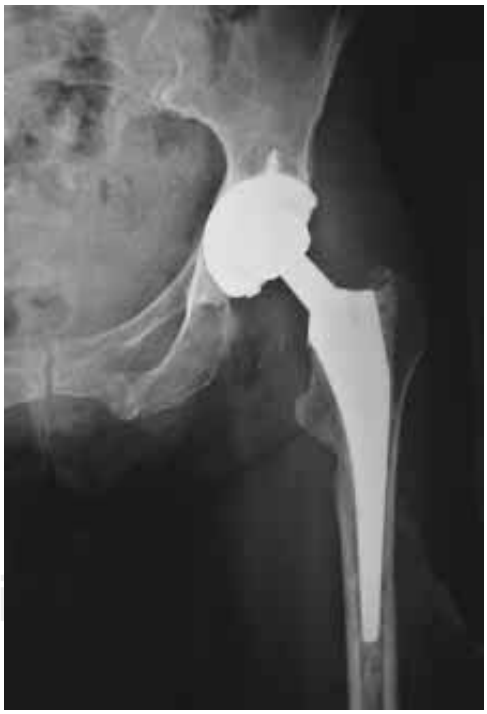

Figure 3. Postoperative X rays showing the placement of a standard acetabular implant. The femoral stem was not revised.

ponent occurred contrary to the variety more commonly reported in the literature when the polyethylene insert is the one dislodging from the acetabular cup. Moreover, this was the same occurrence in all hip replacement dislocations and none was damaged, ruptured or dislodged from the latch or safety ring of the constrained component as described in similar cases of constrained component failure[7]. A review of the literature revealed that only 3 additional cases have presented this mode.[2,7]

The ideal eligible patient for constrained hip replacement is middle aged, inactive, with hip recurring dislocation in spite of properly placed components with good fixation. The etiology of such cases is usually due to insufficient soft tissue (capsule or muscles) and patient cooperation is a factor over which the orthopedic surgeon has little o no effect. Constrained components should be considered as a last resource and after other choices have been exhausted. Even after constrained hip replacement, the incidence of dislocation has been reported between 4% and 29%.[1,6] Constrained components should be used cautiously to manage recurring hip dislocation and when choosing them, component orientation should be carefully set together with the transoperative arch of motion and preferably 32 mm femoral heads should be used with a polyethylene insert with no elevation in its circumference.

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