Closed Reduction of a Dislocated Total Hip Arthroplasty With a Constrained Acetabular Component

Robert J. Gaines, MD, and Mitchell Hardenbrook, MD

Hip dislocation is a troubling complication of total hip arthroplasty. The rate of dislocation for a primary hip arthroplasty may be as high as 10% and more than double that for revised total hip arthroplasty, secondary to recurrent dislocations.[1,2] With most primary dislocations, successful treatment can be obtained with closed reduction and bracing or casting.[3] However, hips with recurrent dislocations may require further operative treatment to address the cause of instability. These procedures include capsulorrhaphy, trochanteric advancement, the use of elevated liners, and revision of the femoral or acetabular component. Constrained liners have been used as a salvage procedure.

The use of constrained liners has been shown to decrease the rate of dislocation in patients with deficient soft tissues.[1,4,5] However, these components restrict motion and, as a consequence, impart higher stresses across implant-host interfaces.[1,4] These devices, when combined with proper patient selection, offer a reasonable treatment option to confer stability to the hip. Anderson and colleagues[4] reported a 71% success rate using a constrained acetabular component for patients undergoing revision hip arthroplasty for instability. Despite the design of constrained implants to improve inherent stability, they still have significantly high rates of dislocation. Some experienced surgeons report 9% to 29% dislocation rates.[4,5] Historically, treatment of a dislocated total hip arthroplasty with a constrained liner required open reduction of the prosthesis and revision of the damaged polyethylene liner and locking ring mechanism. More recently, there have been reports of successful closed reduction of dislocated constrained total hip arthroplasty provided the constrained liner remained secured to the acetabular component.[6,7]

We present a case report of a modification of a previously described method for reduction of a dislocated constrained total hip arthroplasty.

Case Report

A man in his early 70s underwent a primary right total hip arthroplasty for osteoarthritis. Within 1 week of surgery, he suffered his first dislocation. At the time, the patient was managed conservatively with abduction bracing, but he continued to have recurrent dislocations over the next several years. During that time, the patient underwent 2 revisions of his hip arthroplasty.

The patient continued to have recurrent dislocations, with approximately 18 hip dislocations since his primary surgery. The patient initially presented to our institution 7 years after primary surgery when he was in his late

Figure 1. Dislocation of the femoral component with an intact constrained acetabular component.

Dr. Gaines is Lieutenant Commander, Medical Corps, United States Navy, and Resident, Department of Orthopedic Surgery, Bone and Joint/Sports Medicine Institute, Naval Medical Center Portsmouth, Portsmouth, Virginia.
Dr. Hardenbrook is Lieutenant Commander, Medical Corps, United States Navy, and Assistant Professor of Surgery, Uniformed Services University of the Health Sciences, Department of Orthopedic Surgery, Bone and Joint/Sports Medicine Institute, Naval Medical Center Portsmouth, Portsmouth, Virginia.

Address correspondence to: Robert J. Gaines, MD, Naval Medical Center Portsmouth, 27 Effingham St., Portsmouth, VA 23708 (tel, 757-218-6920; fax, 757-953-0362; e-mail, orthogaines@hotmail.com).

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Figure 2. The hip was placed in a perched position at the aperture of the acetabulum, with care to maintain this position when the patient was transferred from the traction table.

Figure 3. Spontaneous reduction of the femoral component.

70s. He continued to complain of instability of the right hip and had difficulty with ambulation. At the time of the initial presentation, the patient had 4 dislocations requiring sedation for closed reduction over the previous month. The decision was made to revise the patient's right total hip arthroplasty to a locked liner (DePuy Duraloc constrained liner, Warsaw, Ind) with a 28-mm femoral head (Zimmer, Warsaw, Ind). At the time of surgery, the patient's right hip was noted to have a large pseudocapsule with incompetent, short, external rotators. The patient recovered from surgery without complications. Postoperatively, he was able to ambulate without assistive devices and no longer had instability of the prosthetic joint.

However, 4 years after revision of his right hip arthroplasty to a constrained liner, the patient presented to our emergency room complaining of pain and inability to weight bear after bending and reaching to the right. Radiographs in the emergency department demonstrated that the revised total hip arthroplasty had dislocated. The femoral head had disengaged from the constrained acetabular liner, but the polyethylene liner and constrained ring remained intact within the acetabular cup (Figure 1).

The patient's health had deteriorated over the years, and he was a high-risk surgical candidate with multiple comorbidities. Because of the significant surgical risk of yet another revision of the patient's total hip arthroplasty, we decided to attempt closed reduction of the hip under general anesthesia. We used the reduction technique described by Harman and colleagues[7] and McPherson and colleagues[6] in attempting the closed reduction. A fracture table was utilized in the reduction maneuver. Under anesthesia, both reduction maneuvers were attempted as described by the authors. These techniques were successful in bringing the femoral head into a perched position at the aperture of the constrained liner; however, we were unable to fully reduce the femoral head within the constrained liner. After 40 minutes of anesthesia and multiple attempts to fully reduce the prosthesis, the decision was made to leave the components in the perched position (Figure 2). The patient was awakened from anesthesia and transferred to the postanesthesia care unit with an abduction pillow placed between his lower extremities. The patient was admitted for medical optimization in preparation for revision of his total hip arthroplasty.

On postoperative day 1 after the failed closed reduction, the patient reported that he felt his hip reduce when he adjusted his position in his hospital bed. A portable anteroposterior radiograph of the right hip showed concentric reduction of the prosthesis (Figure 3). The patient was placed in an abduction brace and allowed to fully weight bear. The brace was discontinued 1 month postreduction. At 18 months postreduction, the patient is a community ambulator, and he has not dislocated his hip, had any symptoms of instability, or had any radiographic signs of component loosening.

Discussion

Constrained hip prostheses fail, essentially, in 2 different ways. It can be a relatively slow, progressive deformation with levering of the femoral head, which allows recoil of the polyethylene liner and locking ring, or a rapid deformation that permanently disrupts the constrained construct.[4,8] An in vitro study by Harman and colleagues[7] defined the forces required to lever the femoral head from the Poly-Dial constrained liner (DePuy, Warsaw, Ind). They studied both 28-mm and 32-mm femoral heads and found that the average torque for the initial dislocation of a 28-mm head was 69 Nm. The torque required for subsequent dislocations a second and third time decreased by 24% and 8%, respectively. The authors were unable to achieve lever-out dislocations with 32-mm femoral heads and found that dislocation for this prosthesis occurred at the polyethylene–acetabular cup interface with significant damage to the polyethylene.[7]

In order to clinically obtain a successful reduction of a constrained prosthesis, the mechanism itself must remain intact, and failure should have occurred by deformation only. This allows for reduction of the femoral head by producing plastic deformation of the polyethylene and the constrained ring with a sustained force opposite to that which caused the dislocation. To date, closed reductions have been achieved with the Poly-Dial[7] and Duraloc constrained liners (both DePuy products). Their relatively simple designs offer an advantage over articulated bipolar or tripolar constrained acetabular components in that the reduction force can be maintained in line with the cup.

Reduction of an articulated acetabulum is much more difficult owing to the multiple planes in which the force may be directed. To the best of our knowledge, at the time of this report, a closed reduction of this type of arthroplasty has not been accomplished. In fact, in a recent case report, the closed reduction of a constrained tripolar component was described as impossible.[9] Prior to reduction, it is important to assess the integrity of the acetabular cup, liner, and ring with appropriate radiographs. A dissociation of the cup and liner would preclude a closed reduction. In addition, failure of the constraining ring would require surgical revision of the components because the integrity of the system is disrupted. The force required to reduce a 28-mm femoral head in vitro was 310 lb, and this force may need to be sustained for 20 minutes to effect a reduction in vivo.[7]

There have been reports of successful closed reductions of constrained acetabular liners. The 2 reduction techniques used in these reports are similar.[6,7] We attempted closed reduction for this patient in accordance with these reports. Under anesthesia, the patient was placed on a fracture table, and with the use of traction and adduction, the femoral head was placed at the aperture of the polyethylene liner. Next, the hip was gently abducted to 20° or 30° and the hip flexed to approximately 30°. Fluoroscopy was used to ensure that the femoral head had remained in its perched position. Next, with an axial load placed on the femur from the flexed knee, pressure was applied across both greater trochanters, loading the femoral head perpendicular to the acetabular cup.

In previously published reports, if this procedure proved unsuccessful, then an open reduction, revision of the components, or both was recommended. However, as outlined in this case report, the hip that has failed this technique may spontaneously reduce. Leaving the femoral head at the aperture and placing an abduction pillow between the patient's legs allowed the continuous force generated by the patient's resting muscle tension through the pelvic girdle to produce enough force to overcome the constraint of the liner. Though closed reduction could not be obtained intraoperatively, enough force was ultimately generated to allow the head to pass through the ring of the liner. Though it is difficult to reach conclusions on the basis of a single case, a couple of considerations can be contemplated. First, this case highlights the difficulty of reducing a dislocated constrained prosthesis. The patient's resting muscle tension could be a powerful ally to aid in the reduction maneuver. Therefore, we recommend that, after perching the femoral head at the aperture, surgeons allow the patient's muscle relaxation to lighten. This would allow the surgical team to utilize the patient's own muscle tension to aid in reduction. Second, this case shows that failed intraoperative reduction that is not a result of permanent liner deformation or blocked by tissue interposition can still be reduced given the opportunity. Perhaps allowing 24 to 48 hours to pass after the failure to fully reduced the perched femoral head could prevent an open reduction procedure. Reduction via this method should be just as effective as the direct reduction procedure and confer similar stability to the hip prosthesis. Keys to any reduction of the constrained acetabulum are the same: well-fixed components and a competent constrained liner.

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Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government.

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