CASE REPORT

Early Dissociation of a Cemented Constrained Tripolar Acetabular Liner with Fracture of the Locking Ring: A Case Report

Isabel Dinis Ferreira, João Cura Mariano, Francisco M. Lucas, Fernando M. Judas

Department of Orthopedics, Centro Hospitalar e Universitário de Coimbra, Faculty of Medicine, University of Coimbra, Praceta Prof. Mota Pinto, 3000-075 Coimbra, Portugal

ABSTRACT

Constrained acetabular components can be used to treat or prevent instability after primary and revision total hip arthroplasty (THA), namely, in neurologic disorders. The purpose of this study was to report early mechanical failure of a constrained tripolar acetabular liner used for recurrent dislocation. A 66-year-old man, with Parkinson's disease and cognitive disorders, underwent primary cemented THA for the treatment of a cervical femoral fracture. After six dislocations, a constrained tripolar acetabular liner was cemented in a metallic support ring, with an excessive abduction angle. Two years and 2 months later, a dislocation of the bipolar component with breakage of the locking metal ring was occurred following a hyperflexion adduction maneuver on the hip joint. A new similar implant was cemented in the existing metallic ring. Dislocation is a multifactorial problem and a distressing complication of total hip prostheses. In our case, repetitive impingement forces originated by the malposition of the liner were probably the main reason for the early failure of the implant. Revision of the malpositioned component is perhaps the most effective type of surgical intervention in the treatment of dislocation. Cemented constrained tripolar acetabular liner can be a valid option in the salvage of an unstable total hip prosthesis, in patients with neurologic disorders. The well position of the liner is one of the key points to a successful outcome, avoiding the occurrence of impingement against the femoral neck.

Key words: Cemented constrained tripolar acetabular liner, complications, constrained acetabular liner, total hip prostheses

INTRODUCTION

Despite total hip arthroplasty (THA) has become one of the most successful interventions in reconstructive orthopedic surgery, instability and prosthetic loosening remains a disappointing complications, and two of the most common reasons for revision.[1]

Several factors may contribute to the risk of dislocation, including malpositioning of prosthetic components, insufficient or weak abductor muscles, inadequate soft tissue tension, incongruence of head and acetabular liner, presence of impingement, as well as combinations of these factors. Component malpositioning and abductor insufficiency are two of the most important recognized causes of recurrent dislocation.[2,3]

The treatment of prosthetic instability remains a challenge. The limitations of existing approaches to address instability have led to the development of options: Constrained liners, dual mobility, and large heads.[4]

Constrained liners gained interest in the late 1990s and have become one of the most popular options worldwide to treat instability. Despite their success, failure rates with constrained components are as high as 25–29% in some series.[5] A review of the failed tripolar constrained implants at the Mayo Clinic found an average time to failure of only 28.4 months, with a

Address for correspondence:
Isabel Dinis Ferreira, Department of Orthopedics,Centro Hospitalar e Universitário de Coimbra (CHUC), 3000-075, Coimbra, Portugal. E-mail: ferreiraid@gmail.com

total failure rate of 11%.[6] Other authors have suggested that constrained acetabular liners have failure rates ranging from 4% to 29% at short-term follow-up and up to 42% at long-term follow-up.[7]

With constrained liners, restricted range of motion is responsible for impingement of the femoral neck on the cup. Impingement is responsible for high stress transmission to multiple interfaces, leading to liner damage, locking mechanism failure, dislocation, and loosening. Five types of implant failure have been described.[6,8] These include failure at the bone-implant interface (Type I), failure at the shell-liner interface (Type II), failure of the locking mechanism resulting in dislocation of the bipolar-liner interface (Type III), dislocation of the prosthetic head at the inner bearing of the bipolar component (Type IV), and infection (Type V).

The purpose of this article is to show an early Type III failure of a cemented constrained tripolar liner, implanted with an excessive abduction angle.

CASE REPORT

In 2016, a 66-year-old man underwent primary cemented THA for the treatment of a cervical femoral fracture, using a posterior surgical approach. The patient presented Parkinson's disease and cognitive disorders and a body mass index of 27.1 kg/m^2. Two months later, he had the first dislocation of the hip prosthesis, treated by closed reduction. In late 2016, after six dislocations, the patient was operated to stabilize the hip [Figure 1]. The cemented acetabular component was removed, and a Trident® constrained acetabular liner was cemented in a metallic support ring. The cemented femoral stem was well-fixed and well-oriented.

The Stryker Trident® constrained acetabular system uses a tripolar constrained liner. The femoral head snaps into an inner polyethylene liner with metal backing, which is free to rotate within an outer polyethylene liner, i.e., an inner bipolar bearing articulating within an outer, true liner [Figure 2].

Post-operative radiograph had been showed malposition of the constrained liner, with an excessive abduction angle [Figure 2]. The patient was allowed to bear weight as tolerated and was scheduled for routine follow-up. Unfortunately, he did not attend to the routine follow-up, and there is no record of any hip radiography performed after the hospitalization period. However, according to the patient the post-operative course was uneventful.

Two years and 2 months after the revision surgery, the patient was presented to our emergency department. He was filling the tire of his car in a crouching position and felt severe pain in the right hip, following a violent hyperflexion-adduction maneuver on the hip joint, and he was not able to stand up by himself. The event was witnessed by a family member. On examination, the right lower extremity was shortened and internally rotated with limited range of motion secondary to pain. Plain radiographs confirmed posterosuperior dislocation of the bipolar component of the constrained liner and fracture of the locking ring [Figure 3]. Failure had occurred at the bipolar-liner interface (Type III dislocation).

Anew revision surgery was performed with the patient in the lateral decubitus position under general anesthesia, and the hip was exposed through a standard posterior approach. Intraoperative inspection of the explanted tripolar liner showed polyethylene damage in the bipolar component and in the rim of the outer liner, including creeps and abrasions, and breakage of the locking ring at 6 O'clock with moderate deformation [Figure 3].

The femoral head was well fixed within the bipolar component and had been removed. The femoral stem was well aligned and stable, the acetabular metallic support ring and the polyethylene outer liner were well-fixed — no signs of infection.

Using chisels and powered acetabular reamers, the polyethylene outer liner and the cement mantle were removed carefully. When the polyethylene was thin enough, it was removed easily by hand tools without the risks of bone fractures and bone stock loss. A new Trident® constrained tripolar acetabular liner was cemented in the secure existing metallic support ring, and a new 22-mm femoral head was placed. No complications were reported in the perioperative course and during the hospitalization period, and he did not have episodes of instability.

At most recent follow-up (6 months), the patient presented an asymptomatic hip and expressed satisfaction with the surgery

Figure 1: Pre-operative radiograph of the pelvis demonstrating a posterosuperior dislocation of the cemented total hip prosthesis (recurrent instability)

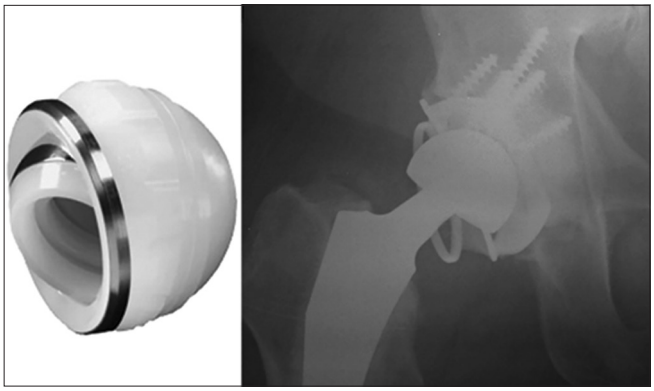

Figure 2: Antero-posterior radiograph showing revised construct. After six dislocations, a constrained tripolar acetabular liner was cemented in a metallic support ring. The liner was implanted with an excessive abduction angle

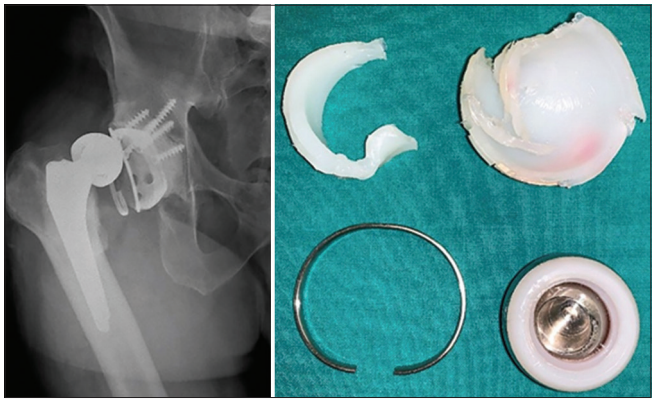

Figure 3: Antero-posterior radiograph of the hip showing posterosuperior dislocation of the bipolar component of the constrained liner and fracture of the locking ring. (Type III dislocation), at 2 years and 2 months of follow-up. Macroscopic examination of the retrieval acetabular implant showed locking ring breakage and polyethylene damage in the bipolar component and in the rim of the outer liner

Figure 4: Antero-posterior radiograph of the hip after the second revision surgery showing acceptable position of components

result. Post-operative radiograph image of the pelvis showed a favorable orientation of the liner and no signs of instability [Figure 4]. The patient was clinically able to walk without external support.

DISCUSSION

Dislocation is a multifactorial problem and a distressing complication of THA. Several methods have been used to manage recurrent dislocation. Constrained acetabular systems can provide a solution, in selected patients, namely, in Parkinson's and cognitive disorders. It is indicated for both primary and revision arthroplasty scenarios. Failure of the locking liner ring and loosening of the acetabular cup are the primary causes of mechanical failure with constrained liners.[9]

Our patient had a history of recurrent dislocations of cemented THA, which was treated nonoperatively (six dislocations). To prevent more dislocations, a revision surgery was performed. The cemented cup was removed, and a constrained tripolar liner was cemented on a metallic support ring.

The post-operative radiograph has been showed an excessive inclination of the constrained linear witch can originate an impingement against the femoral neck and dissociation of the prosthetic components. Favorable results can be achieved when the abduction angle of the acetabulum is between 35 and 50 degrees and an anteversion angle of between 0 and 20 degrees.[10]

Despite the presence of these risk factors, the patient did not report hip pain and prosthesis instability until the dissociation of the prosthetic components, i.e. during a period of 2 years and 2 months.

A breakage of the ring was observed during the revision surgery. The femoral head was well-fixed within the bipolar component. The femoral stem was well aligned and stable, the acetabular metallic support ring and the polyethylene outer liner were well fixed.

Revision of the malpositioned component is perhaps the most effective type of surgical intervention in the treatment of dislocation. The liner was removed and a new Trident® constrained tripolar acetabular liner was cemented directly into the metallic support ring, with favorable inclination. We accepted the abduction angle of the metallic support ring; it was moderately high.

Macroscopic examination of the retrieval acetabular implant showed locking ring breakage and polyethylene damage. These lesions were surely caused by repetitive impingement forces against the femoral neck that occurs with a reduced arc of motion and were favored by malposition of constrained linear.

Constrained liners have an important role in the armamentarium of the adult reconstruction surgeon. The use of cemented Trident® constrained tripolar acetabular liner can be indicated in selected cases, such as neuromuscular and cognitive disorders and in elderly patients at risk of recurrent dislocations, avoiding the malposition of the liner into a position where impingement might occur, and avoiding the cementation of the liner into a grossly malpositioned shell.[11]

Dissociation/dislocation of the bipolar interface has been a previously documented complication of constrained liners with breakage or no breakage of the locking ring. We believe that the breakage of the ring has been occurred before and no during the violent hyperflexion adduction maneuver on the hip joint that originated the dissociation of the bipolar interface. Unfortunately, there is no record of any hip radiography performed after the hospitalization period of the first revision surgery.

Nevertheless, mechanical failure of the implant at 2 years and 2 months of follow-up is an unacceptable result in a patient with a low level of physical activity. Longer-term follow-up will be required for all constrained liners to elucidate the rate of osteolysis, aseptic loosening, and unique component failure mechanisms.

CONCLUSION

Cemented constrained tripolar acetabular liner can be a valid option in the salvage of an unstable THA, in patients with neurologic disorders. The well position of the liner is one of the key points to a successful outcome, avoiding the occurrence of impingement against the femoral neck.

Declarations

This study is exempt from ethical approval in the authors' institution.

The authors have followed the protocols of their work center on the publication of data.

AUTHORS' CONTRIBUTIONS

All authors contributed to the writing and collection of data and they have participated in the surgery.

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