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Surgical Technique

Removing Cemented Dual Mobility Liners From Acetabular Components: A Technical Tip for a Challenging Surgical Problem

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ABSTRACT

Dislocation remains the leading cause of failure following revision total hip arthroplasty. Dual mobility (DM) constructs, including monoblock cups designed for cementation, reduce but do not eliminate this risk. Cemented DM constructs offer several unique advantages in revision total hip arthroplasty, and as such, they have gained popularity. Despite their advantages, a portion of these implants will require revision for infection or recurrent dislocation. Removal of a cemented DM cup presents numerous challenges, and there is no effective published technique. Here, we present an effective technique for the safe removal of one design of cemented DM cup.

Introduction

Dislocation remains the leading mode of failure following revision total hip arthroplasty (THA), accounting for 13%-28% of revision THA cases [1-5]. Revision surgery, particularly for recurrent dislocation, presents many unique challenges as surgeons must contend with bone loss, abductor dysfunction, and deficient posterior capsular tissue. This culminates in a higher rate of postoperative dislocation following revision surgery [6]. To mitigate this risk, multiple techniques, including large femoral heads [6-9], constrained liners [9-13], and dual mobility (DM) [14-16] constructs have been utilized with success.

DM bearings offer several benefits. These bearings maximize femoral head size and alter hip biomechanics, leading to improved postoperative stability [14,17-22]. By maximizing femoral head size, DM constructs increase the head-to-neck ratio, jump distance, and range of motion prior to impingement [7]. However, not all acetabular components offer modular DM options, and in the revision setting, it may be advantageous to adjust the effective acetabular position. In these cases, cemented DM constructs—that is, a monoblock DM cup, designed for cementation, cemented into an existing acetabular component—offer a viable solution. This technique has been biomechanically validated [21], and several small studies [23-31] have reported favorable outcomes at early follow-up.

Given the advantages of cemented DM constructs, in addition to their clinical success in small series of patients, it is expected that utilization of this technique will increase. With increased utilization, the necessity to revise these constructs is inevitable. Early anecdotal experience with removal of cemented DM cups indicates this can be a challenging endeavor. Therefore, there is an urgent need for identification of an effective technique for removal of these cemented DM components. Here, we present one such technique.

Surgical technique

There are several reasons why removing cemented DM acetabular cups from within a larger, metal acetabular component may be difficult. Despite manufacturer recommendations, surgeons often maximize cup size in an attempt to maximize effective femoral head diameter at time of implantation of the cemented DM cup. This, in turn, leads to minimal cement mantle for working access during attempted removal. Additionally, to make matters worse, most available designs have peripheral ridges to improve

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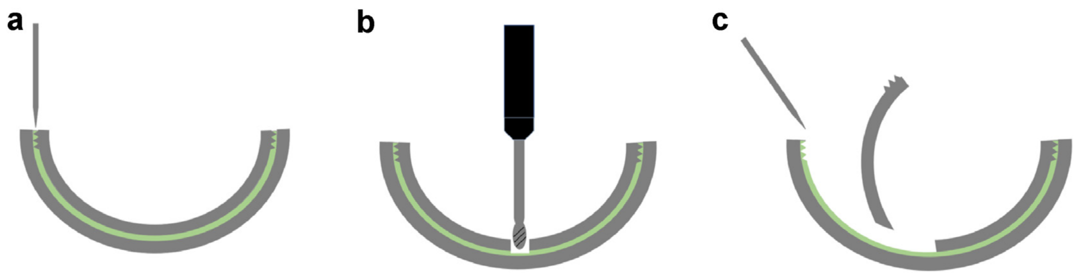

Figure 1. Cross section of a cemented DM cup cemented (green) within an acetabular component, demonstrating (a) lack of cement interface access due to lack of cement mantle left and peripheral ridges precluding mantle access, (b) helicoidal burr cutting across the cemented DM cup but leaving the acetabular component unscathed, and (c) an osteotome being used to centrally dislodge the hemicemented DM component following cutting.

component fixation. While these are biomechanically advantageous for fixation, they also serve to block access for cement removal (Fig. 1).

This issue is compounded by the fact that commercially available cemented DM cups are made of either cobalt-chromium or stainless steel, leading to increased hardness. Unfortunately, removal of the outer acetabular component at the bone-implant interface is often not possible as access to supplemental screw fixation is not possible without first removing the cemented DM cup (Fig. 2). For this reason, we have used the following technique with success in removing cemented DM acetabular components.

A standard posterolateral approach to the hip is performed, and the acetabular component is exposed circumferentially (Fig. 3). The cement interface is then assessed to determine if an adequate mantle is available for access and to safely remove the component. It has been our experience that this is often not the case (Fig. 4). If it is determined that the room left for cement mantle at implantation is inadequate for interface access, we then utilize a metal-cutting helicoidal burr to cut through the cemented DM cup across its entire diameter (Figs. 1 and 3). In our experience, this will require approximately 20-30 minutes to complete and will require 2-3 helicoidal burrs for completion. To minimize metal debris during this step, we recommend using ultrasound gel to capture metallic debris as previously described [32]. While we do feel this technique is safe, surgeons should be careful to ensure overzealous use of the metal cutting burr does not lead to severe damage of the underlying acetabular component when the intention is acetabular component retention. Typically, intermittent irrigation will allow clear visualization of the cement interface as the burr is used to cut through the monoblock DM component.

Once the cemented DM cup has been halved, an osteotome is used to hit the hemicomponent into middle of the acetabular component, disengaging the peripheral ridges of metal from their cemented mantle. The relief from cutting the cup in half allows this to occur with relative ease (Figs. 1 and 3). This process is then repeated for the other hemicomponent, at which point the cement mantle will be left unobstructed and removal of the acetabular component can proceed normally. Alternatively, a new liner (a constrained liner, for instance, if being revised for persistent instability) can be cemented into the retained acetabular component. We have found that the relief provided by the kerf of the helicoidal burr is critical to allow disengagement of the peripheral ridges of the cup in the cement interface. This technique is safe and provides an easy solution to an otherwise difficult problem.

Discussion

Revision THA burden is expected to increase by 43%-70% by 2030 [5]. Recurrent instability continues to be a leading mode of failure in THA and represents a complex clinical challenge to overcome [1-3]. Innovative solutions, including DM constructs, have provided an attractive option for surgeons with evidence to support their use in cases of persistent instability [17-21]. Recently, DM cups intended for cementation have become available. In some circumstances, these cemented constructs are advantageous as they allow correction of effective acetabular position (both acetabular version and inclination) and for the use of DM when modular options are not available, facilitating the retention of well-fixed acetabular components during revision THA [27].

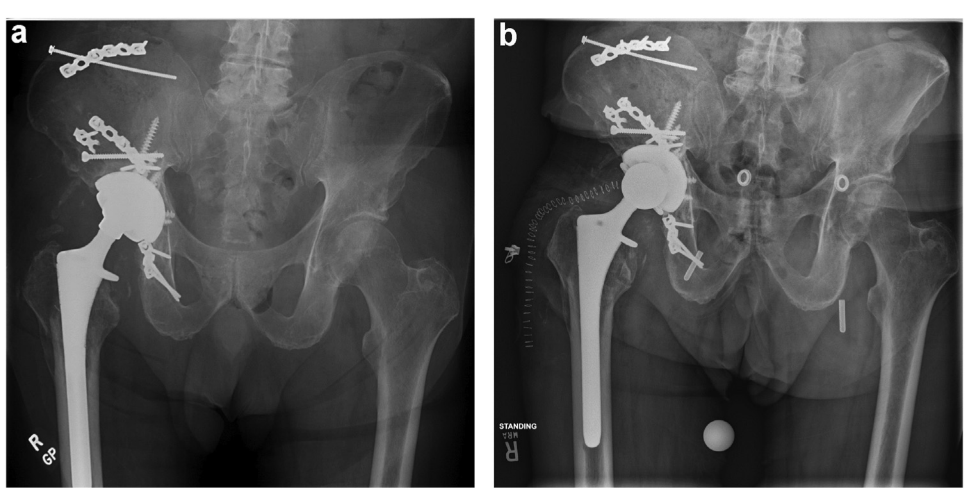

Figure 2. Case example demonstrating preoperative (a) radiographs of a patient with recurrent instability in the setting of a cemented dual mobility component. The patient was revised to a cemented constrained liner, and (b) the dual mobility component was removed using the technique contained within.

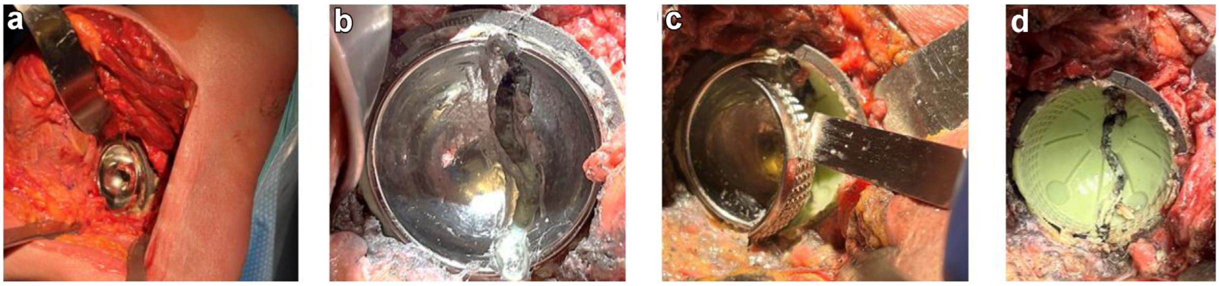

Figure 3. In situ photos of the removal technique demonstrating (a) adequate acetabular exposure via a posterolateral approach, (b) burr cut cemented DM cup allowing for midline relief for subsequent, (c) removal of the hemicomponent using a centrally directed blow with an osteotome, and (d) remaining cement mantle following successful component removal. Note the mantle that previously secured the peripheral cup ridges.

As with the introduction of any new technology, outcomes must be assessed for the occurrence of unique and unanticipated complications. In the case of DM, there are reports of intraprosthetic dislocation (IPD) and corrosion with the use of cobalt-chromium modular liners [33-35]. While cementing a monoblock DM cup into an existing, well-fixed, or newly implanted porous acetabular implant avoids the issue of corrosion at the cup-liner interface, these components remain susceptible to IPD [23,27]. IPD, while uncommon, is of particular importance given that its occurrence generally requires reoperation. The reported rates of IPD in the literature vary from 0%-5.2% [36-38]. However, small series, reporting on cemented DM cups have reported higher rates of IPD (up to 11%) [27]. This is likely due to the utilization of these constructs in complex reconstructions that are inherently at higher risk for both extraarticular and IPD [39].

Therefore, while DM has been demonstrated to reduce the occurrence of instability following revision THA [14,25,28,29], it is clear that not all recurrent instability will be mitigated [23,26]. Revision for other reasons, including infection, will also be necessary in some patients [24,26]. The removal of modular DM liners has been the topic of prior publications. However, the removal of cemented DM liners presents unique challenges. Prior authors have discussed the removal of cemented polyethylene liners either using 2 screws [40] or reamers to simply thin the liner, allowing for manual removal [41]. However, in the setting of a cobalt-chromium or stainless steel cemented DM cup, these techniques are not helpful. Despite manufacturer recommendations, during implantation, it is typical that surgeons maximize the size of the implanted DM cup such that effective femoral head size is maximized. This leaves little access to the cement mantle interface between components. Additionally, circumferential peripheral ridges on most available cemented DM components further decrease access to the interface between components and provide robust fixation, making removal difficult.

Figure 4. Example of a cemented dual mobility cup (PolarCup, Smith and Nephew, Memphis, TN) as it may be cemented into a standard acetabular component (REDAPT Fully Porous Shell, Smith and Nephew, Memphis, TN). Note the lack of access to the intercomponent interface due to peripheral ridges for fixation. Please also note that no cement is pictured for easier visualization.

In the absence of supplemental screw fixation, consideration could be given to removal of the entire acetabular construct en bloc. However, this is rarely the case, as cemented DM cups are most useful in complex revision THA. Therefore, herein we propose a technique for removal of these components. While this technique requires the tedious cutting of either a stainless steel or cobalt-chromium DM cup, in our experience, this does reliably allow for the safe removal of the cemented DM cup.

We recommend using this technique when there is poor access to the intercomponent interface. Early commitment to cutting the cup is recommended prior to using undue manual force to remove the cemented DM cup to avoid catastrophic complications. This is especially the case when removing a cemented component with circumferential peripheral rings. We feel that this technique, which removes a central portion of the cup from the kerf of the burr, is necessary to allow these peripheral ridges to 'disengage' from their cement mantle, allowing removal. Caution should be taken to avoid overly forceful hitting of the components, as pelvic fractures could result. If this is felt to be necessary, we recommend proceeding with removal via the technique contained within.

Summary

Removal of a cemented dual mobility component in revision THA represents a clinical challenge, particularly when the component being removed has peripheral ridges limiting access to the intracomponent interface. In this circumstance, we recommend cutting the cemented DM component in half, after which the relief provided by the burr kerf allows each hemi-component to be disengaged and removed.

Conflicts of interest

J. Martin is a paid consultant for Depuy Synthes; all other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2023.101211.

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