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Surgical technique

A Simple Technique to Remove an Incarcerated Ceramic Liner in Revision Hip Arthroplasty

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ABSTRACT

Extraction of a well-fixed ceramic liner during revision total hip arthroplasty can be technically challenging, particularly when acetabular fixation screws prevent en bloc removal of the shell and insert without causing collateral damage to the adjacent pelvic bone. It is also important to remove the ceramic liner intact, as ceramic debris left in the joint may cause third body wear with premature articular wear of the revised implants. We describe a novel technique to extract an incarcerated ceramic liner when previously described strategies prove ineffective. Knowledge of this technique will help surgeons avoid unnecessary damage to the acetabular bone and optimize prospects for stable implantation of revision components.

Introduction

Extraction of an osseointegrated acetabular component may be required to manage cases of infection, suboptimal cup orientation, or when a new polyethylene insert is not available to replace a worn component. The introduction of the Explant Acetabular Cup Removal System (Zimmer, Warsaw, IN), in the early 2000s [1], enabled surgeons to extract well-fixed acetabular shells more quickly and to minimize damage to periprosthetic bone. Such tools work best on components that have been implanted without screws or after screw removal.

The removal of polyethylene inserts to access fixation screws is seldom difficult or time consuming. In contrast, the extraction of a ceramic or solid metal insert may be challenging. Several strategies have been described to address firmly fixed ceramic inserts. All depend upon the generation of local tensile dynamic stresses at the tapered interface between the metal shell and the ceramic insert. When these stresses exceed the local contact stresses, component separation will occur [2].

The simplest technique is that described by Pitto [2]. The surgeon places an impactor tip on the metal rim of the acetabular component and hits the impactor with a hammer. A variant of this technique is to attach an inverted acetabular trial component to the impaction or extraction rod and place the free margin of the acetabular trial against the metal rim of the acetabular component. Hammer blows usually achieve the desired component dissociation.

For cases resistant to these maneuvers, a technique described by Whiting and Lewis [3] can be used. This involves the application of a high-frequency drill against the outer diameter of the acetabular shell. The resulting vibrations are transmitted through the shell, causing dissociation of the tapered metal-ceramic interface.

We describe a novel technique that proved successful after all the above strategies proved ineffective.

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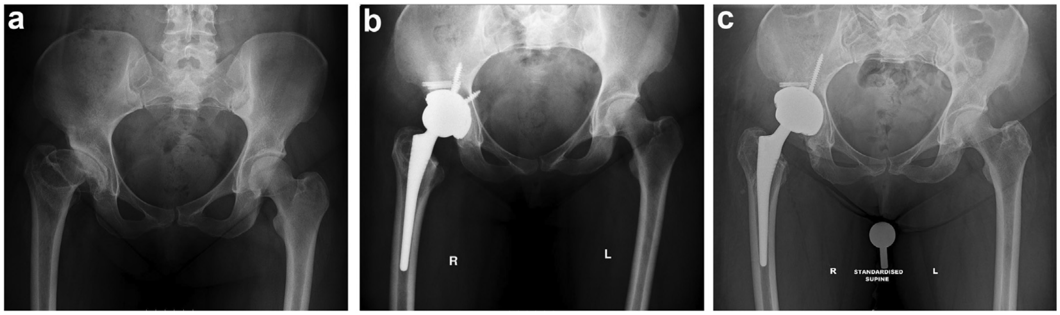

Figure 1. Preoperative and postoperative anteroposterior radiographs for the patient. (a) Preoperative radiograph showing severe congenital dysplasia of the right hip. (b) Immediate postoperative images following primary total hip replacement using Depuy Pinnacle multihole metal cup secured with 4 screws and a shelf osteotomy impacted with a femoral head graft secured with 2 Acutrak headless compression screws. (c) Immediate postoperative images following revision total hip replacement showing the revised acetabular component.

Surgical technique

A 55-year-old female with no relevant past medical history had a complex right primary THA performed in December 2007 for osteoarthritis secondary to severe congenital dysplasia (Fig. 1a). This surgery was performed using a lateral approach, and the components implanted were: a cementless 52 mm PINNACLE acetabular multihole titanium cup (DePuy Synthes, Warsaw, Indiana, USA) secured with 4 screws, with a 36 mm BIOLOX *delta* ceramic liner (CeramTec, Plochingen, Germany), a cementless CORAIL femoral stem size 9 with standard offset (DePuy Synthes, Warsaw, Indiana, USA), and a short neck BIOLOX *delta* ceramic head (CeramTec, Plochingen, Germany). To address the acetabular bony deficiency, a wedge graft was simultaneously performed utilizing a segment of the harvested femoral head. The graft was secured with 2 Acutrak (Acumed, Hillsboro, Oregon, USA) headless screws (Fig. 1b). The patient enjoyed an uneventful postoperative recovery and remained asymptomatic for 12 years. However, in 2018, she suffered deterioration with progressive loss of movement and increasing pain.

An Magnetic Resonance Imaging scan revealed atrophy of the iliopsoas muscle, and a single-photon emission computed tomography bone scan revealed increased uptake in the right ischial tuberosity, suggesting possible abutment from the implant. Ultrasound-guided steroid injections around the iliopsoas and adductor tendons provided minimal improvement. A repeat single-photon emission computed tomography scan showed no evidence of periprosthetic lucency, implant migration, or osteolysis. However, the scan demonstrated 2 screws protruding into the pelvis, with 1 in the belly of the iliacus muscle. The scan also showed that the acetabular component was positioned in 25° anteversion and 61° of inclination. The case was presented at the regional orthopedic multidisciplinary team meeting. It was agreed that acetabular component revision, to remove the protruding screws and improve acetabular component orientation, should be undertaken.

The revision was undertaken in December 2021 via the direct anterior approach, using a traction table. As the femoral component remained well fixed, the femoral head was removed using a technique advocated by Dr. Frederic Laude (Clinique du Sport, Paris). Longitudinal traction was applied until a few millimeters of separation were achieved between the femoral head and acetabular bearing surface. A blow to the distal aspect of the ceramic head using a punch achieved separation of the head from the femoral stem. After release of the pubofemoral ligament and incision of the capsule distal to the base of the cotyloid fossa, further traction with internal rotation allowed the trunnion of the femoral component to be positioned in a pocket, inferomedial to the acetabular component. The ceramic head was then extracted from the socket.

This strategy provided good acetabular exposure, Figure 3a. Following failure of the ceramic insert extraction techniques previously described, a 1 mm Legend Ball burr (Midas Rex) was used to create a small rectangular wedge at the cup or liner interface by cutting into the metal cup. This provided a contact point for the metal impactor and enabled the dissociation of the ceramic liner from the cup (Figs. 2 and 3). The acetabular shell was removed after the extraction of the 4 cancellous bone screws. The acetabulum was reamed and prepared. One of the 2 headless screws used to stabilize the femoral head graft was visible in the bone bed and was

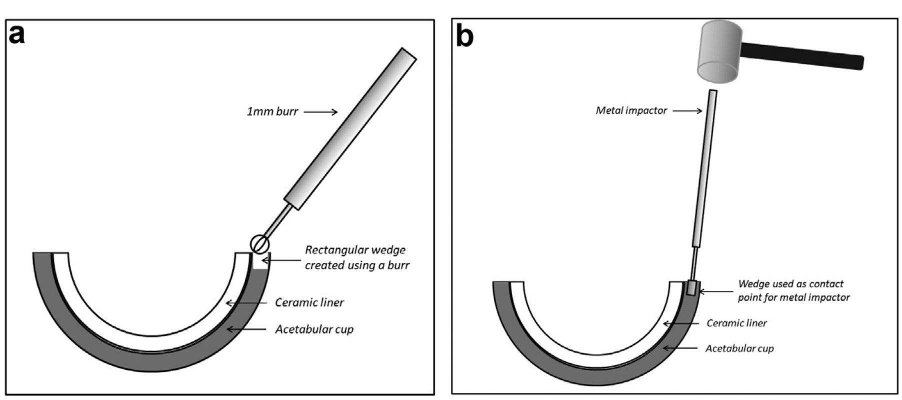

Figure 2. Schematic diagram depicting the technique for extraction of ceramic liner. (a) Use a 1 mm burr (Midas Rex) to create a small, rectangular wedge on the metal cup at the cup or liner interface. (b) Use the rectangular wedge as a contact point for the metal impactor and use a mallet to dissociate the liner.

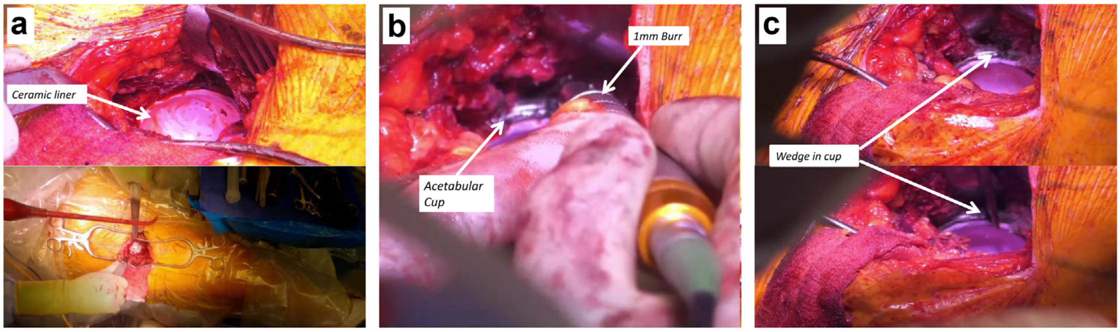

Figure 3. Intraoperative images of the surgical technique. (a) Exposure achieved using a direct anterior approach. (b) 1 mm Burr (Midas Rex) in use to create a wedge in the acetabular cup. (c) Rectangular wedge in the acetabular cup created is shown.

removed. The second headless screw was left in situ. A new 56 mm PINNACLE acetabular GRIPTION coated shell (DePuy Synthes, Warsaw, Indiana, USA) was implanted and secured with 1 40 × 6.5 mm cancellous bone screw. A 36 mm BIOLOX delta ceramic liner (CeramTec, Plochingen, Germany) was inserted. Intraoperative image intensifier was used to confirm satisfactory orientation of the new acetabular component and appropriate positioning of the acetabular screw. A BIOLOX delta ceramic head of 12/14 standard (CeramTec, Plochingen, Germany) was applied, the joint was reduced, and the wound was closed.

Postoperatively, the patient was instructed to mobilize 50% weight bearing through her right leg for 6 weeks. She enjoyed an uncomplicated early recovery and was discharged on day 2 postoperatively to continue rehabilitation in the community. Her postoperative x-rays are shown (Fig. 1c). Written informed consent was obtained from the patient for the publication of this article.

Discussion

This report demonstrates 2 learning points.

Firstly, we report a simple and novel technique to extract a well-fixed ceramic acetabular insert that proves resistant to previously described strategies. Unlike previously described methods [2,3], this technique provided a contact point on the external surface of the tapered section of the ceramic acetabular insert, and application of hammer blows through a metal punch resulted in separation of the insert from the acetabular shell. While our technique avoids damage to the ceramic insert and the generation of ceramic debris, it does create some titanium debris. This problem can be mitigated by the careful positioning of small wet swabs to minimize debris deposition on the surrounding soft tissues. Also important are the prompt removal of the swabs after burring the metal, the debridement of any surface contaminated by particulate metal debris, and the thorough lavage of the tissues prior to shell extraction.

Secondly, we have described Dr. Laude's elegant technique for separation of a ceramic or metal head from a well-fixed femoral component. However, we do note that this technique is only possible for anterior approach revision with a traction table extension. The potential benefit of this approach is a less extensile exposure with minimal soft tissue disturbance and a rapid postoperative recovery.

One of the limitations of this report is that the technique has only been used for 1 patient. It is rare for other techniques, including those described by Pitto [2] and Whiting and Lewis [3], to prove ineffective. Our technique was undertaken as a last resort to avoid the need for en bloc removal of the acetabular component (metal cup and ceramic liner) along with the fixation screws. This would have caused additional bone loss between and around the fixation screws. The technique that we report is not approach dependent and could be used for revision surgery via the lateral or posterior approach.

While we have demonstrated the success of a novel method to extract a well-fixed ceramic liner from a PINNACLE acetabular multihole titanium cup, the technique remains untested in cases of an incarcerated ceramic acetabular insert in other brands of acetabular component. Nevertheless, we would encourage its consideration for cases with acetabular fixation screws that have proven resistant to other strategies for ceramic acetabular liner extraction in other acetabular designs. Future case reports or case series will establish the safety and efficacy of this novel technique with other surgical approaches and other implant brands.

Summary

We describe a strategy for the extraction of ceramic inserts that proves resistant to previously described extraction techniques. Knowledge of this technique avoids unnecessary damage to the acetabular bone that is otherwise inevitable if a surgeon is obliged to remove an acetabular component and fixation screws en bloc.

Conflicts of interest

The authors declare there are no conflicts of interest.
For full disclosure statements refer to https://doi.org/10.1016/j.artd.2023.101142.

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