Cup-on-cup technique to manage severe protrusio acetabular defects

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ABSTRACT

Previous studies have demonstrated that revision of total hip arthroplasty consumes considerably more resources than the primary procedure. Worse, patients who need revision procedures are more likely to have radiographic evidence of acetabular and femoral bone loss than those undergone primary total hip arthroplasty. Many techniques have been introduced to manage different conditions of acetabular deficiencies. We describe a rare case of a 67-year-old man with severe acetabular bone loss, which was caused by a long-term loose acetabular component and was successfully managed by cup-on-cup technique. We also discuss the similarities and differences between cup-on-cup and cup-in-cup techniques in the management of protrusio acetabular defects, with a case-based approach.

KEYWORDS

Total hip arthroplasty – Revision – Acetabular defect

Accepted 17 April 2018

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Introduction

With the increasing life span of patients with total hip arthroplasty (THA) and a trend towards surgery at younger ages, the volume and complexity of revision surgery should increase.¹ Although technological advances in prosthetics have shown improved long-term survival, aseptic loosening of the prosthesis remains one of the most common intermediate and long-term complications of THA. Some patients decline revision, mainly because the cost and resource use for a revision are substantially higher than those of primary procedures. Loose acetabular components with no timely revision are usually accompanied by displacements, proximal and intrapelvic migration and, finally, acetabular protrusio defects. Severe protrusio defects in THA revision present several challenges for the reconstruction. We report a rare case of severe acetabular bone loss caused by long-term loose acetabular components, which was successfully managed by a cup-on-cup technique.

Case history

A 67-year-old man presented with a 4-month history of unbearable pain in the left hip. He had been diagnosed with an intertrochanteric fracture of left femur 9 years ago, but he discounted this diagnosis and chose nonoperative care. He underwent THA 6 years ago when persistent and increased severe pain was present with restriction of his

activities. Postoperative rehabilitation performance was unsatisfactory and inward displacement of the acetabular components were discovered six months after surgery. Advice about hip revision was refused.

Clinical examination showed that the left lower extremity was shortened, adducted and internally rotated. Radiography revealed central prosthetic dislocation (Figs 1–3). Computed tomography confirmed acetabular protrusio, proximal and intrapelvic migration of acetabular components (Figs 4 and 5). Preoperative Paprosky classification of the acetabular defects was type IIIB.²

Previous standard posterior–lateral approach had been applied for the revision. The loosening acetabular components were completely displaced and migrated into the pelvic cavity. After removal of the acetabular prosthesis, a 4.0 × 4.0 cm defect in the medial acetabular wall was revealed. After long-term progressive wear and tear of the failed acetabular components, the protrusio acetabular defect was deep and the hip centre of rotation migrated medially and vertically (Figs 1–5). Porous tantalum augmentation models were selected and installed repeatedly, but could not restore the vertical and horizontal offset effectively.

To obtain initial stability and immediate secure fixation to host bone, while also for the restoration of horizontal and ventral offset, we applied a cup-on-cup technique in which a porous tantalum acetabular cup (50 mm diameter) was impacted into supportive medial host bone and fixed with two cancellous screws. The acetabular cup was filled

Figure 1 Radiography revealed central prosthetic dislocation. Preoperative Paprosky classification of the acetabular defects was type IIIB

Figure 3 Lateral radiograph of the central prosthetic dislocation

Figure 2 Anteroposterior radiograph demonstrating a dislocated total hip arthroplasty, with the acetabular component vertical and medial migration into pelvic

with autologous cancellous bone and vancomycin to promote faster and better bone ingrowth, then covered with bone cement to avoid micromotion and wear between the cups; a second tantalum cup (56 mm diameter) was then cemented below to obtain stability and to achieve restoration of horizontal and vertical defects, two more cancellous screws were used to strengthen the fixation and increase the initial stability (Figs 6 and 7).

Postoperative physical therapy was not recommended and limited weight-bearing was allowed 2 months after revision. At 6 months of follow-up, the patient was able to walk freely with a cane and at 1 year of follow-up, there was no evidence of loosening or migration and the prostheses remained stable. This novel technique saved the patient more than US\$3000.

Discussion

Acetabular revision arthroplasty in the face of large, complex, protrusio acetabular defects or pelvic discontinuity, such as Paprosky type III, are challenging for even the most seasoned surgeons. The goals of revision arthroplasty are to achieve adequate initial stability with sufficient anchoring area and to restore offset and limb length. Previously published studies have reported the application of cup-in-cup technique in the management of severe protrusio acetabular defects.³⁻⁵ In comparison, the cup-on-cup

Figure 4 Computed tomography three-dimensional reconstruction confirmed acetabular protrusio, proximal and intrapelvic migration of acetabular components

Figure 5 Computed tomography three-dimensional reconstruction revealed central prosthetic dislocation, acetabular defect with acetabular components proximal and intrapelvic migration

technique appears to be similar but is actually quite different.

Figure 6 Anteroposterior radiograph of the cup-on-cup technique. A porous tantalum acetabular cup (50mm Diameter) was impacted into supportive medial host bone and a second tantalum cup (56mm Diameter) was then cemented below to achieve restoration of horizontal and vertical defects.

First, the creation of initial stability and the anchoring concepts are different. Cup-in-cup technique using two porous tantalum acetabular cups: one larger medial cup is placed on to supportive host bone in a cementless fashion to buttress large defects, establish the initial stability, increase the horizontal offset and restore the vertical offset. One smaller (by 6–10 mm diameter) lateral cup is cemented in to restore horizontal and vertical offset and bring the hip centre of rotation to an anatomic position.⁵ In our case, the loosening acetabular components induced bone resorption and periprosthetic osteolysis, and weight-bearing activities aggravated the acetabular erosion, which finally led to proximal and intrapelvic migration and central prosthetic dislocation. After reaming, the inside diameter of the acetabulum was smaller than the outside and the larger-diameter reamer was not applied to optimise acetabular bone preservation. We therefore developed the cup-on-cup technique: one smaller medial cup is placed to buttress large defects, to establish partial initial stability

Figure 7 Lateral radiograph of the cup-on-cup technique after the hip revision

and anchoring area for the lateral cup and to increase the horizontal and vertical offset substantially. One larger lateral cup is cemented below to improve the horizontal and vertical offset and achieve initial stability. The anchoring area and initial stability of cup-in-cup technique mainly depend on the medial cup rather than the lateral cup, while in the cup-on-cup technique, both medial and lateral

cups are of considerable importance for the anchoring area and initial stability. Thus, the stability of the cup-in-cup structure appears to be better than the cup-on-cup structure.

Second, the effectiveness of the restoration of horizontal and vertical offset between the two techniques is distinct. The cup-on-cup technique is therefore more effective in increasing the vertical and horizontal offset, which had also weakened the initial stability.

Finally, both techniques should be used sparingly in limited situations. All the previous treated cases are representative severe protrusio defects, which were consensually classified as Paprosky type IIC or III.^{3,4} Most of the acetabular defects occurred either medially or both medially and vertically, and accurate preoperative measurement and design are imperative in choosing the optimal management.

Conclusion

The cup-on-cup technique is an alternative choice for the management of severe protrusio acetabular defects, to obtain stable fixation and to restore offset when traditional reconstructive methods fail to meet the requirements. Although we have observed excellent initial acetabular fixation with no evidence of failure for loosening, long-term follow-up is warrant to determine the durability of the stability.

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