Reconstruction of Extensive Acetabular Wall Destruction with Protrusion of the Acetabular Component after Primary Total Hip Arthroplasty

(Case Report)

Abstract

Severe acetabular bone loss following total hip arthroplasty (THA) presents a complex reconstructive challenge. Traditional classification systems, such as Paprosky, may not fully capture the morphology of defects in the most extreme cases. Additionally, previous revision plans could not safely manage such cases. A 71-year-old man presented with pain and instability four years after a primary THA. Imaging revealed a massive acetabular defect with extensive osteolysis and metallosis, including complete loss of the posterior column, medial wall, posterior wall, inferior rim, and ischium, and only the anterior wall and column remained intact. The acetabular cup had also protruded into the pelvic cavity, approaching the bladder, and had migrated centrally. While the defect resembled a Paprosky type IIC pattern, it was markedly more severe and did not fit existing classifications. A complex two-stage reconstructive surgery was performed, involving elevation of the hip center by 2.5 to 3 cm and compensation for limb shortening through femoral stem lengthening using a long-stem prosthesis. After 2-step revision surgery, the patient experienced prosthetic dislocation, necessitating a third surgery. During this procedure, a bipolar cup was manually drilled to allow bone cement to pass through the holes for improved fixation. Additionally, bone cement was applied over the screw heads (positioned superior to the cup) to construct a scaffold that enhanced implant stability and reduced the risk of dislocation. This case may represent a novel subtype of acetabular bone defect not encompassed by current classification systems. Furthermore, the innovative approach of penetrating a bipolar cup and using cement augmentation over a screw framework presents a potential new strategy for achieving stable fixation in cases of severe bone loss. This case underscores the need for updated classification systems to account for atypical acetabular defect patterns and demonstrates a novel fixation technique that may improve outcomes in revision THA involving extensive bone loss.

Keywords: Revision surgery , Bone cement, Acetabulum.

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Introduction

Acetabular prosthetic protrusion is a rare but serious and severe complication following total hip arthroplasty (THA). This condition occurs when the acetabular component migrates into the true pelvis due to extensive osteolysis and the destruction of the acetabular walls. It is often associated with chronic mechanical stress, metallosis, and component loosening, which result in substantial loss of acetabular bone stock(1-3).

Despite being a relatively uncommon occurrence, acetabular protrusion also occurs in patients who undergo revision THA(4). Risk factors include advanced age, low bone mineral density, rheumatoid arthritis, and repeated mechanical loading, which exacerbate bone resorption and the weakening of the acetabular structure(1,2,5).

The failure of acetabular components leading to such protrusion poses significant challenges for revision surgery. Traditionally, acetabular defects are classified according to the Paprosky classification, which categorizes defects into types I, II, and III based on the extent of bone loss and the integrity of the surrounding structures(6).

However, in cases of severe bone destruction, such as in this patient, this classification system and other classification system such as Gross classification do not always adequately represent the full extent of the damage. This case demonstrates an advanced stage of acetabular failure, which requires an innovative approach for successful reconstruction[4,6,7].
Current reconstructive strategies for extensive acetabular defects include the use of cages, tantalum augments, or custom triflange implants. However, these options rely heavily on the integrity of the posterior column, medial wall, and ischium to ensure stable fixation. In cases where these structures are compromised, as seen in the patient presented here, conventional techniques are often inadequate. For example, the loss of the acetabular rim and the ischium, along with complete destruction of the medial wall, complicates the fixation of traditional components, making these solutions unfeasible and ultimately, the use of a tumor prosthesis might be considered, albeit at the cost of high morbidity and mortality[8–11]. In this case report, the patient faced with severe osteolysis and acetabular bone loss after a previous THA. The aim of this case report is not only to present a novel surgical technique to manage cases like these, but also to highlight the need for further exploration of alternative classification systems and treatment strategies for complex acetabular defects. Our goal is to contribute to the body of knowledge that will allow clinicians to better address this challenging complication and improve patient outcomes.

Case report

A 71-year-old male with a history of degenerative joint disease (DJD) of the left hip, well-controlled type 2 diabetes mellitus, and hypertension had been underwent a primary total hip arthroplasty in another center. His body mass index (BMI) was 24.2 kg/m² (70 kg, 170 cm). 2 years later, the patient started to experience progressive left-sided limp, reduced weight-bearing capacity, and limited range of motion (ROM). Over the next nine months, the condition deteriorated significantly, ultimately patient became non-ambulatory.
The initial radiographic assessment revealed severe loss of the acetabular bone, with involvement of the posterior wall and column, the medial (inner) wall, and the inferior rim of the acetabulum. The prosthetic cup had migrated into the true pelvis, abutting the urinary bladder, although there was no evidence of bladder invasion. This suggested advanced component loosening and catastrophic failure of the acetabular construct (Figure 1). The ischial erosion was attributed to chronic metalosis and altered stress transfer. No signs of periosteal reaction or soft tissue gas were observed, which would have indicated infection.
Three-dimensional CT scan (Figure 2) demonstrated extensive destruction involving the posterior column and wall, the medial wall of the acetabulum, and the inferior acetabular rim, accompanied by complete loss of the acetabular floor.

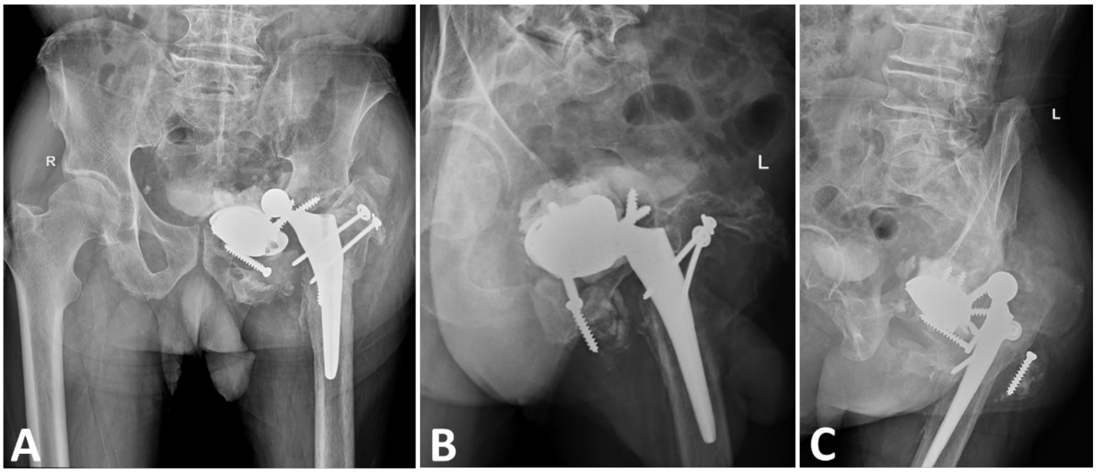

Figure 1: A) Anteroposterior pelvic radiograph demonstrating left total hip arthroplasty with its components. Notable findings include central and medial migration of the acetabular component with disruption of the medial wall and a protrusion pattern. B) Oblique view of the left hip following total hip arthroplasty. Signs of periprosthetic bone loss persist around the cup and proximal femoral stem. C) Lateral pelvic radiograph with protrusion of acetabular component and dislocation.

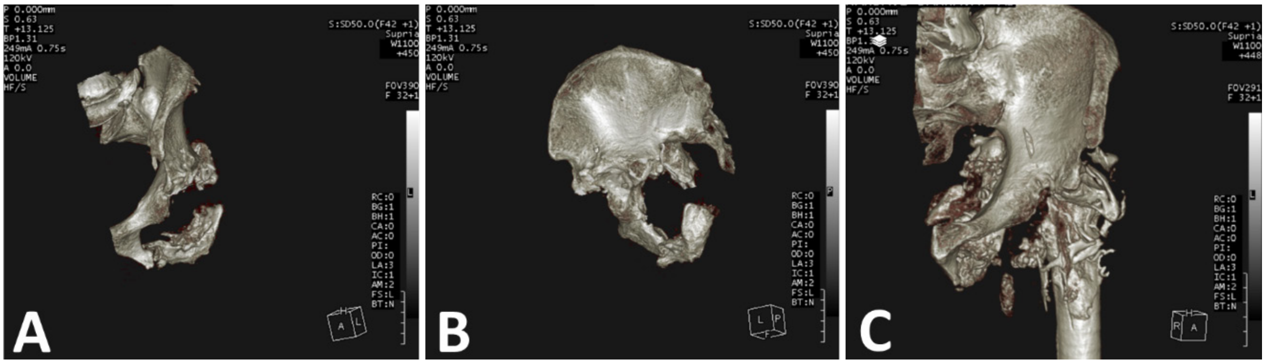

Figure 2: A) Three-dimensional CT reconstruction of the pelvis in the anterior view reveals destruction of posterior column and wall, the medial wall of the acetabulum, and the ischium, loss of the floor and rim of the left acetabulum. B) Posterior 3D CT view highlighting massive bone loss of the posterior acetabular wall and ischial segment, with clear absence of posterior column support (at left side). C) Oblique 3D CT reconstruction of the left hemipelvis.

These findings are largely consistent with a severe combined segmental and cavitary defect characteristic of Paprosky type IIC, except that in this case, in addition to the typical IIC involvement, there is complete loss of the posterior column and wall and the inferior rim. Given the degree of component migration, CT angiography was performed to assess the relationship of the intrapelvic prosthetic components to adjacent vascular structures. The external iliac, internal iliac, and obturator arteries were visualized and found intact, ruling out vascular encroachment. Clinically, the patient did not show systemic signs of infection, and laboratory work-up revealed a normal white blood cell (WBC) count. Inflammatory markers (ESR and CRP) were mildly elevated, likely as a result of chronic mechanical irritation, metallosis and osteolysis, rather than infection. Subsequently, joint aspiration was performed, which revealed a negative leukocyte esterase test, normal white blood cell count, and negative microbial cultures.

Preoperative Work-up

The patient's acetabular bone loss was classified as resembling Paprosky type IIC; however, the extent of destruction surpassed this classification, particularly regarding its severity and anatomical compromise. Given the atypical pattern of pelvic bone loss, which may represent an unclassified form of acetabular defect, revision THA was planned. Considering the potential risk of iliac artery injury during prosthesis removal, a prophylactic Fogarty catheter (size 4) was placed by the vascular surgeon for bleeding control. These evaluations confirmed the patient's suitability for surgery. Due to the extent of acetabular destruction, a two-stage surgical approach was planned:

Explantation of the Failed Prosthesis and Biopsy as the first stage

A lateral Harding- approach was used for the explantation of the prosthetic components. Tissue samples were obtained from five different anatomical sites. Intraoperatively, extensive osteolysis and metallosis was observed, with complete loss of the posterior column and wall, medial wall, inferior rim, and ischium, extending protrusion near to the bladder. After explantation, the patient was admitted to the ICU for one day under complete bed rest (CBR) and was given empiric intravenous antibiotics (vancomycin 1 g every 8 hours and meropenem 1 g every 12 hours) postoperatively.

Second Operation – Complex Revision Surgery

The second stage was performed on day three, following confirmation of negative microbial culture results .We knew that the following options are generally available for the reconstruction of extensive acetabular defects:

1. Various cages such as the GII, with or without bone grafting,
2. Tantalum cup-cage constructs, with or without bone grafting,
3. Custom designs such as tri-flange implants
4. Custom prosthesis tumor

5. Elevation of the hip center and creation of a neo acetabulum in the superior region

In this patient, extent of acetabular destruction and corrosion, specifically, absence of posterior column and wall , and missing acetabular rim and inferior margin, which are essential for the stability of an acetabular cage were concerning issues. Also, the medial wall of the acetabulum was absent (which is another prerequisite for proper cup or cage placement). Notably, the ischium had undergone complete osteolysis secondary to metallosis and prosthetic protrusion. So, in this case, the inferior rim, posterior wall and column and medial wall were missing. This precluded the use of custom triflange designs, GII cages, and cup-cage constructs. Moreover, tumor-specific reconstructions were considered high-risk due to the extensive nature of the surgery and the patient's advanced age. As a result, no standard reconstructive options were deemed viable. Therefore, the treatment strategy of “hip center elevation” was selected. Therefore, we decided to elevate the hip center (2.5-3 cm) and compensate for limb shortening and potential abductor dysfunction by using a long femoral stem with maximum tensioning.

This approach aimed to achieve a limb length discrepancy that was tolerable, and potentially correctable for the patient.

So, a high hip center reconstruction was planned to utilize superior bone stock (superior to anatomic acetabulum) and restore lower limb biomechanics. Intraoperatively, a relatively intact segment of bone was identified above the anatomic acetabulum. As a result, reaming was performed at a site superior to the anatomic acetabular cavity to create a neo-acetabulum and an elevated acetabular bed. So, a reasonably acceptable cavity was achieved, and the GAP II cage was subsequently implanted at this newly prepared site (Figure 3 and 4).

In this case, due to the bony configuration in the reconstructed area, achieving the desired and optimal inclination was not possible. Consequently, given the lack of alternative options, we proceeded with the available anatomy and accepted a slightly horizontal position for cage placement, as no other viable options were available at the time. We know that key criteria for cage fixation are: Adequate superior bone stock, acceptable inferior support at the neo-acetabular site, satisfactory inclination and anterior-posterior positioning.

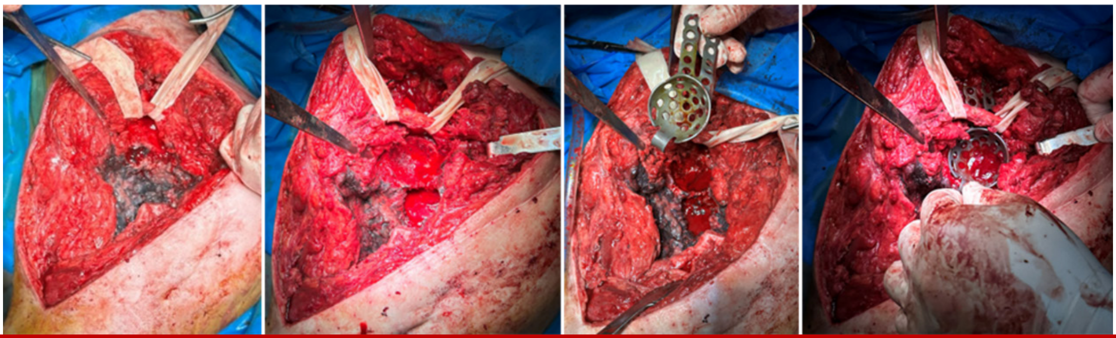

Figure 3: Procedure steps.

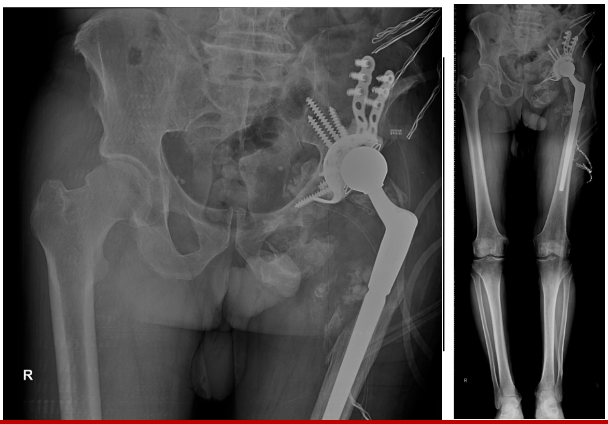

Figure 4: Pelvic radiograph demonstrating postoperative appearance of a complex acetabular reconstruction using GII cage.

Postoperatively, the patient again received empiric IV antibiotics (same regimen) and remained in the ICU for two days. Pain was mild to moderate and was managed effectively with intravenous acetaminophen and rectal diclofenac as needed. No early complications were noted, and the patient expressed satisfaction with his status.

On postoperative day 2, he was able to sit with assistance. By day 4, partial weight-bearing was initiated with the aid of a walker and one caregiver. The patient demonstrated steady early recovery and was later transferred to the general ward for further rehabilitation.

Third Operation

On postoperative day 5 ,the patient experienced a dislocation while rising from a chair, which was confirmed by radiographic imaging (Figure 5). So, third revision surgery was planned to correct the cage inclination.

Figure 5: Anteroposterior (AP) radiograph of the left hip. The radiograph demonstrates a left total hip arthroplasty with a dislocated femoral head superiorly and laterally relative to the acetabular cup t. No evidence of periprosthetic fracture is observed in the surrounding bone. Soft tissue shadows are unremarkable, without signs of hematoma or infection.

To correct the cage inclination, three screws were inserted into the outer table of the ilium above the cage. These screws were then incorporated using bone cement, effectively augmenting the superior rim of the cage. Given the patient's abductor weakness, we also opted for a constrained liner.

However, due to the inner diameter of the GAP II cage, it was not possible to accommodate even the smallest size of dual mobility or standard constrained liners.

As an alternative, we perforated the outer surface of a bipolar cup using a metal drill (Figure 6), creating multiple holes. The bipolar cup was then cemented into the cage at an appropriate version, inclination, and tension (Figure 7).

The perforations allowed the cement to interdigitate with the cup, enhancing fixation strength. Additionally, the bipolar liner itself offers a degree of constraint, making it a viable option in cases of abductor deficiency.

Through this combination of corrected inclination and the use of a bipolar liner, we successfully prevented further dislocations and achieved a stable reconstruction.

Figure 6: perforated the outer surface of a bipolar cup using a metal drill.

On the left side, the mechanical lateral distal femoral angle (LDFA) measures 88.9°, the medial proximal tibial angle (MPTA) is 88.7°, and the joint line convergence angle (JLCA) is 2.8°, suggesting near-neutral alignment. The mechanical axis angle (MAA) is 56°, and anatomical axis angle (AA) is 52°. The right side shows LDFA of 90.6°, MPTA of 87°, JLCA of 4.9°, and MAA of 56°, all within acceptable ranges. Overall, alignment is symmetrical with no significant mechanical axis deviation.

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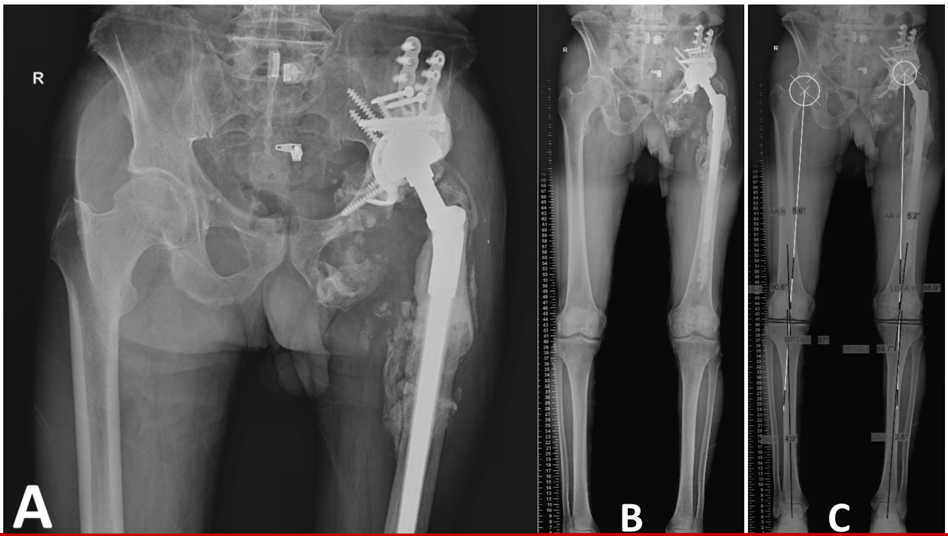

Figure 7: A-C X-ray radiographies are taken 3 months after revision surgery for follow-up. A) Anteroposterior radiograph of the pelvis and proximal femur showing a complex acetabular reconstruction on the left side using a cup-cage construct and a long femoral stem. Multiple screws are used for cage fixation into the bone. B) Full-length standing anteroposterior radiograph of both lower extremities demonstrating coronal limb alignment. The left side shows the reconstructed hip with a well-aligned long femoral stem. C) Full-length standing alignment view with mechanical axis analysis of both lower extremities.

Discussion

Acetabular revision surgery becomes particularly challenging in the presence of advanced bone loss, such as Paprosky type IIC defect. In these complex scenarios, commonly employed techniques include the use of reinforcement rings, oblong cups, porous tantalum cementless components combined with tantalum augments, and bone impaction grafting[1,8,10].

Our case introduces a novel approach for addressing severe acetabular defects in the setting of prosthetic protrusion. The technique involves the use of a perforated bipolar cup cemented inside a cage construct, a strategy not previously reported in the literature. This innovative approach provides a viable solution when conventional options are unavailable due to the extensive nature of the bone loss. By using the bipolar cup in this manner, we were able to create a stable acetabular construct despite the lack of traditional fixation points.

This technique also introduces a new perspective on managing complex acetabular defects, emphasizing the importance of customizing surgical strategies to the unique anatomical challenges of each patient. Additionally, the classification of acetabular defects has been traditionally limited to the Paprosky system[11]. While this system remains valuable for most cases, we propose an extension to the Paprosky classification, suggesting a new category for cases of extensive acetabular failure with prosthetic protrusion. This new sub-classification could help guide future management decisions for similar cases, offering a more nuanced approach to acetabular reconstruction in the face of severe bone loss.

Atypical Acetabular Bone Defect: A New Subclassification?

The presented case involves an acetabular bone defect exhibiting characteristics reminiscent of Paprosky type IIC, such as superior migration and extensive bone loss. However, the defect's specific morphology—marked by lack of anterior and posterior column—does not align precisely with existing Paprosky classifications[11]. This discrepancy suggests the potential need for a new subclassification, to encompass such unique presentations. Recognizing and categorizing these atypical defects are crucial for guiding surgical planning and implant selection. Innovative Surgical Techniques for Enhanced Fixation with drilling the Bipolar cup for better fixation was employed wherein the bipolar cup was drilled using a high-speed drill to allow for additional fixation with cement to enhance the initial stability of the implant to our knowledge, this method has not been previously documented in the literature, marking it as a significant innovation in the field of revision hip arthroplasty.

Another unique aspect of this surgical approach was the application of bone cement over the screw heads within the superior reamed area of the acetabulum. This technique served to create a scaffold-like structure, providing additional support to the implant and potentially reducing the risk of dislocation.

Recent studies have explored various techniques for managing complex acetabular defects (Table 1).

Du et al.[12] in 2020, introduced a method involving the placement of a smaller cup onto a larger tantalum shell to manage Paprosky IIIB defects. They have used Cup-on-Cup Technique. Their retrospective study was conducted on six patients (average age 59) who received acetabular reconstruction using the cup-on-cup technique. All had Paprosky type IIIB acetabular defects without pelvic discontinuity. With an average follow-up of 42 months, clinical and radiographic assessments suggest that this technique may be a viable short-term treatment option for such defects. This approach demonstrated promising short-term outcomes but did not address the specific defect morphology presented in our case.

Chen et al.[13] in 2024, have used screw-augmented cement spacers. In their study, a 52-year-old male patient with a metastatic tumor in the acetabulum underwent surgery using hollow screws and bone cement for stabilization. Screws were strategically placed in the ischium, ascending branch, and both anterior and posterior columns to secure the acetabulum. A third screw linked the anterior and posterior columns, while bone cement was applied at the fracture site to enhance stability and counteract bone loss from tumor-induced osteolysis. They demonstrated that in the context of joint stabilization, screw-augmented cement spacers have been utilized to enhance stability. While this shares conceptual similarities with our cement augmentation approach, the clinical scenarios differ significantly (this case represents the treatment of acetabular metastatic cancer with minimally invasive stabilization using screws and cement).

Wassilew et al.[14] in 2024, described the use of porous tantalum shells with augments, achieving stable fixation in challenging defects. Their retrospective study was conducted across two centers, involving 39 patients (15 men and 24 women) who underwent the 'footing' technique to treat Paprosky IIIB acetabular defects between 2007 and 2020. The median patient age was 64.4 years, and the median follow-up period was 3.9 years. The use of porous tantalum shells and two augments in this technique demonstrated excellent outcomes in the medium term, supporting its effectiveness for managing these complex defects. However, their technique (Footing Technique) did not incorporate the drilling of the bipolar cup or the specific cement augmentation strategy employed in our case.

Conclusion

The techniques employed in this case offers potential alternatives for managing complex acetabular defects, particularly those not conforming to existing classifications.

Table 1: Comparative Analysis of Similar Case Reports

Study	Year	Technique	Novel Aspects	Outcomes
Du et al.[12]	2020	Cup-on-Cup	Use of smaller cup on larger shell	Improved Harris Hip Score from 32.4 to 80.7
Chen et al.[13]	2024	Screw-Augmented Cement	Screw-augmented cement spacers utilized to enhance stability	Enhanced stability
Wassilew et al.[14]	2024	Footing Technique	Porous tantalum shells with augments	89% implant survival at medium-term follow-up
Current Case	2025	Drilled Bipolar Cup with Cement Augmentation	Drilling bipolar cup for screw fixation; cement over screw heads	Stable fixation; no dislocation at 12-month follow-up

References

1 Cursaru A, Iordache S, Costache M, Serban B, Popa M, Cretu B et al. Management of Acetabular Bone Loss in Hip Revision Arthroplasty: Case Series Presentation. Cureus. 2023;15(9):e45432. DOI: 10.7759/cureus.45432.

2 Pandey A.K, Zuke W.A, Surace P, Kamath A.F. Management of acetabular bone loss in revision total hip replacement: a narrative literature review. Ann Jt. 2024;9:21. DOI: 10.21037/aoj-23-23.

3 Sculco P.K, Wright T, Malahias M.A, Gu A, Bostrom M, Haddad F, et al. The Diagnosis and Treatment of Acetabular Bone Loss in Revision Hip Arthroplasty: An International Consensus Symposium. HSS J. 2022; 18(1):8–41. DOI: 10.1177/15563316211034850.

4 Prod'homme M, Dietrich G, Helfer L, Müller J.P, Barrera Uso M, Grasset D, et al. Major acetabular prosthetic protrusion following total hip arthroplasty: a case report of a reconstruction challenge. AME Case Rep. 2022;6:24. DOI: 10.21037/acr-22-1.

5 Ansari S, Gupta K, Gupta T, Raja B.S, J P, Kalia R.B. Total Hip Arthroplasty in Protrusio Acetabuli: A Systematic Review. Hip Pelvis. 2024;36(1):12–25. DOI: 10.5371/hp.2024.36.1.12.

6 Telleria J.J.M, Gee A.O. Classifications in brief: Paprosky classification of acetabular bone loss. Clin Orthop Relat Res. 2013; 471(11):3725–30. DOI: 10.1007/s11999-013-3264-4.

7 Driscoll D.A, Ricotti R.G, Malahias M.A, Nocon A.A, Bornes T.D, Tarity T.D, et al. Reliability and validity of the Paprosky classification for acetabular bone loss based on level of orthopedic training. Arch Orthop Trauma Surg. 2024;144(9):4267–73. DOI: 10.1007/s00402-024-05524-x.

8 Aprato A, Olivero M, Di Benedetto P, Massè A. Decision/therapeutic algorithm for acetabular revisions. Acta Biomed. 2020;91(14-S):e2020025. DOI: 10.23750/abm.v91i14-S.10999.

9 Fryhofer G.W, Ramesh S, Sheth N.P. Acetabular reconstruction in revision total hip arthroplasty. J Clin Orthop Trauma. 2020;11(1):22–8. DOI: 10.1016/j.jcot.2019.11.004.

10 Mancino F, Cacciola G, Di Matteo V, Marco D de, Greenberg A, Perisano C, et al. Reconstruction options and outcomes for acetabular bone loss in revision hip arthroplasty. Orthop Rev (Pavia). 2020;12(Suppl 1):8655. DOI: 10.4081/or.2020.8655.

11 Sanghavi S.A, Paprosky W.G, Sheth N.P. Evaluation and Management of Acetabular Bone Loss in Revision Total Hip Arthroplasty: A 10-year Update. J Am Acad Orthop Surg. 2024;32(10):e466-e475. DOI: 10.5435/JAAOS-D-23-00645.

12 Du Y.Q, Liu Y.P, Sun J.Y, Ni M, Zhou Y.G. Reconstruction of Paprosky type IIIB acetabular bone defects using a cup-on-cup technique: A surgical technique and case series. World J Clin Cases. 2020;8(7):1223–31. DOI: 10.12998/wjcc.v8.i7.1223.

13 Chen Y, Akbar Y, Xiang H, Yadikan Y, Cao G, Ju X, et al. Minimally invasive stabilization using screws and cement for acetabular metastatic tumor: a case report. J Med Case Rep. 2024;18(1):287. DOI: 10.1186/s13256-024-04604-1.

14 Wassilew GI, Zimmerer A, Fischer M, Nonnenmacher L, O'Hara L, Hube R. Reconstruction of Paprosky IIIB acetabular defects with porous tantalum shells and augments using the footing technique. Bone Joint J. 2024;106-B(5 Supple B):54–8. DOI: 10.1302/0301-620X.106B5.BJJ-2023-0523.R2.