Annals of Case Reports

Wessling M, et al. Ann Case Report 6: 695.

DOI: 10.29011/2574-7754.100695

Case Report

New Approach to the Anchoring of Macroporous Revision Cups in Large Acetabular Defects a Case Report

Wessling M, Usama Dib*, Gebert C

Department of Revision Arthroplasty and Tumor Orthopedics, Wetter (Ruhr), Germany

***Corresponding author:** Usama Dib, Department of Revision Arthroplasty and Tumor Orthopedics, Wetter (Ruhr), Germany

Citation: Wessling M, Dib U, Gebert C. (2021) New Approach to the Anchoring of Macroporous Revision Cups in Large Acetabular Defects a Case Report. Ann Case Report 6: 695. DOI: 10.29011/2574-7754.100695

Received Date: 17 August, 2021; **Accepted Date:** 20 August, 2021; **Published Date:** 25 August, 2021

Abstract

Revision hip arthroplasty has become more common and will probably continue to give rise to significant controversies in treatment management. Many different surgical techniques for the procedure have been published, with a wide range of options, depending on the size and location of the acetabular defect. This report describes a case of a Paprosky type IIC-IIIB defect due to aseptic loosening of a total hip arthroplasty, which was treated with allograft augmentation and a high-porosity titanium laser-manufactured acetabular shell with an inverse anchoring technique (Implantcast GmbH, Buxtehude, Germany). The 1-year follow-up showed a 40 point improvement in the Harris-Hip score.

Introduction

Kurtz and colleagues predicted in 2007 that the rate of revision hip arthroplasty would double by 2026 [1]. Many different surgical techniques and solutions, depending on the acetabular defect involved, have since been published [2]. However, treating large bone defects in the acetabulum continues to be challenging, particularly in Paprosky type II and III defects [3]. Secure fixation of the implant in a biomechanically promising zone is critical to achieving good functional results. The diameters of the screws used in cup fixation vary from 4.5 mm to 6.5 mm [4]. Some authors have described the use of a bolt or peg to secure the implant [5-10]. In almost all recently used pressfit revision cups, the cup is implanted first with a 1-2mm press-fit, while screws or bolts are used to secure the position of the implant [11,12].

In addition to screw diameter and length, the number of screws also has an effect on primary stability [13]. When three screws are used, three-dimensional angular stability can be achieved, without using the locking screw fixation technique. The new implant used in the present case report combines both fixation strategies. An 8-mm dome screw provides a high degree of primary stability in the weightbearing area without the well-known disadvantages of the pedestal cup. In addition, the advantages of a modern high-porosity titanium cup can create better preconditions for long-term osseointegration (Figure 1).

This report describes the case of a 62-year-old man in whom a borderline Paprosky type IIC-IIIB defect was treated with this implant, and reports on the outcome after 1 year.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the author.

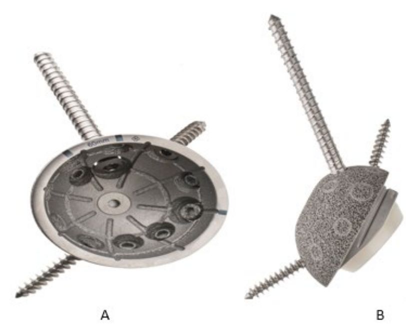


Figure 1 a, b: The PRS Cup (Implantcast GmbH, Buxtehude, Germany).

Case history

The patient presented in our department with pain in the left hip, having undergone a hip arthroplasty 25 years previously in a different institution. The initial examination showed a range of motion in the hip with extension/flexion of 0 to 90°, abduction/adduction of 10 to 10°, and internal/external rotation of 10 to 0°. The Harris Hip Score (HHS) estimated at the time of admission was 50 [14]. Pelvic radiographs showed loosening of the primary cup and mediocranial migration of the center of rotation, with no signs of loosening of the stem (Figure 2). Computed tomography of the pelvis showed an oval acetabular defect (Paprosky type IIC-IIIB), with no pelvic discontinuity and with a central and anterior wall defect and superior osteolysis (Figure 3). The patient's body mass index was 27 kg/m2. With the exception of high blood pressure, a paralyzed right foot due to poliomyelitis in childhood and hip arthroplasty to the right side, no other conditions were noted. Preoperative blood tests showed a C-reactive protein (CRP) level of 0.3 mg/dL (normal range < 1.0 mg/dL) and a white blood cell count of 5.06 10^3/µL. The preoperative joint aspiration was dry, and intraoperative aspiration showed a Leukocyte count 0,410 Tsd/µl and 32,7% Neutrophils.

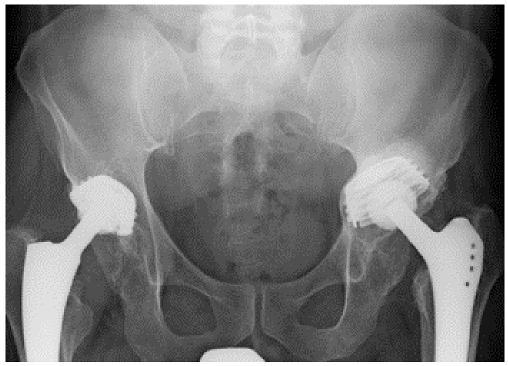


Figure 2: Anteroposterior radiograph of the pelvic, showing cranial migration and loosening of the cup.

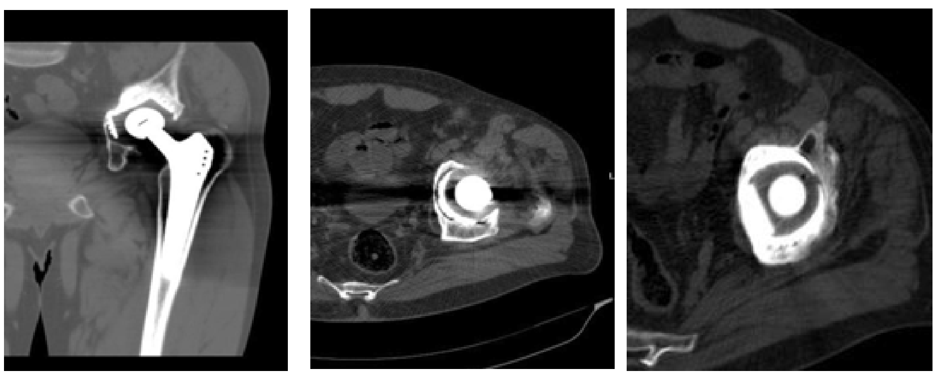
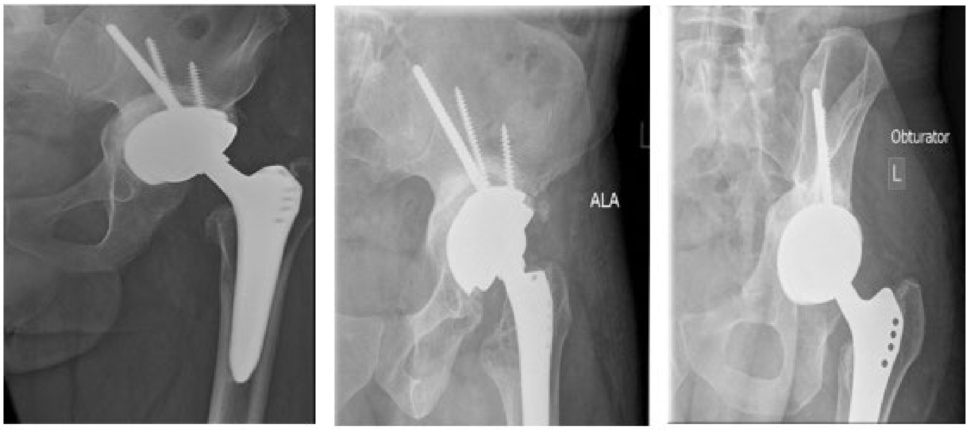


Figure 3: Computed tomography of the left hip (a, coronal; b, transverse), showing loosening of the cup and an acetabular defect. C Transverse image, showing supra-acetabular osteolysis.

Surgical technique

With the patient under general anesthesia in the supine position and through the previous scar, the hip was then dislocated in a typical manner. The stem proved to be well fixed. The cup was extracted and after clearance of the debris, the acetabulum showed a central cranial defect with anterior and superior acetabular rim loss. To restore the COR and fill the acetabular defect, morcellized allograft was packed into the defect and a K-wire was fixed through the dome of the defect along the trajectory of the posterior superior iliac spine under radiographic guidance. The K-wire was overreamed and replaced with a guide wire for the PRS Cup (Implantcast GmbH, Buxtehude, Germany).This modification (screw first) of the standard implantation technique (implantation of the cup first, than screw fixation) is needed to obtain the longest possible lever arm of the dome screw. A trial implant was threaded and placed in the acetabulum. Intraoperative radiographs showed good coverage of the defect and restoration of the COR. The original PRS Cup (with a diameter of 64 mm) was then threaded and pressed into the acetabulum. The guide wire was removed, and an 8-mm wide, 90-mm long screw was placed. The cup was then hammered into position, achieving press-fit fixation. Two 6.4-mm screws were placed in rudimentary fashion in the ilium. The 8-mm wide screw was tightened. A dual-mobility hip cup (Implantcast EcoFit 2M, 54 mm outer diameter) was cemented into the PRS Cup shell. The cemented 2M implant was then angulated to re-establish the inclination and anteversion. Postoperatively, full-body weightbearing was allowed after radiography of the pelvis (Figure 4). The radiographs showed satisfactory restoration of the COR and proper placement of the pelvic screws.

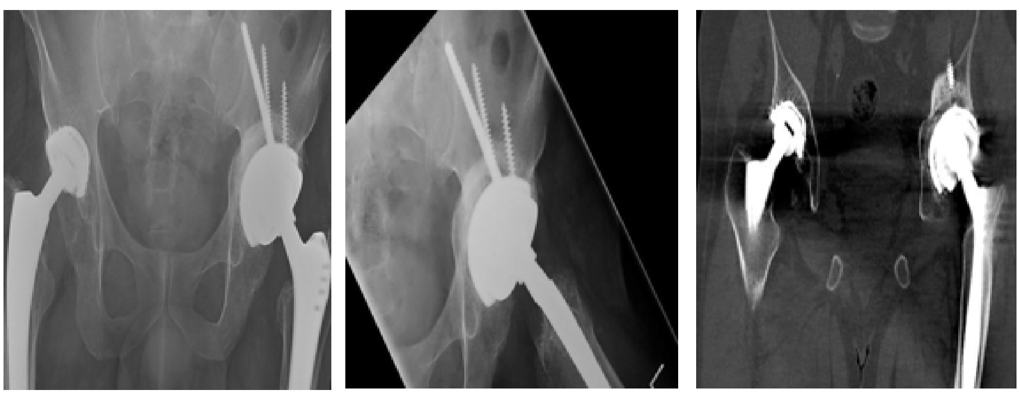
ISSN: 2574-7754



A B C

Figure 4: Radiographs of the left hip after revision, showing screw placement in the ilium. a, Anteroposterior view; b, ala radiograph of the ilium; c, obturator radiograph.

The patient was discharged 10 days after the procedure. A follow-up examination after 6 weeks showed good functionality in the hip, with no need for crutches. The 1-year follow-up examination showed no signs of loosening, remodeling of the allograft that was used, and osseointegration of the PRS Cup, in addition to restoration of the COR, achieved by the allograft filling the acetabular cavity (Figure 5). The Harris Hip Score measured was 90 [14].



A B C

Figure 5: One year after revision of the left hip. pelvic (a), lateral (b) radiographs and coronal (c) computed tomography scan.

Discussion

The main goal of revision total hip arthroplasty (THA) is to achieve long term stable fixation, restore the centre of rotation [15], or at least to restore good functioning. This is made by packing allograft into the acetabular defect, using sustainable implants that allow bone ingrowth, filling the acetabular wall defect with wedges, and using cages and 3D-printed implants [2,11,16,17]. Porous implants such as trabecular metal (Trabecular Metal; Zimmer Biomet, Warsaw, Indiana, USA), which are commonly used in revision THA, have already shown good results in relation to osseointegration and functionality [18]. Porous titanium has been found to have a low modulus of elasticity, excellent bioactivity and biocompatibility, and allows bone regeneration as reported by Wen et al. [19], Trabecular Titanium showed encouraging results in revision hip arthroplasty in short and medium terms[20,21].

The LUMIC pedestal cup which has a similar anchoring principle by anchoring in the weight bearing area (supra acetabular area) [22]. This concept was then modified by Dijkstra’s tumor research group in order to reconstruct pelvic defects after tumor surgery [23]. However the pedestal cup has a conical shaped stem which has to be hammered in the ileum which could lead to Fissures and loosening. The study by Schoellner and Schoellner reported a complication rate of 20% the results in tumour operations show an implant failure rate for the modular cup of 2.1% after two years and 17.3% after five years [22]. These results must be regarded critically as a tumour operation which is not compatible with the revision operation [23]. The philosophy behind the 8-mm screw and its placement is based on the weightbearing axis in the pelvis [24]. This gives the PRS Cup an advantage over similar designs. In Hip Revision surgery it is well known, that an anatomic reconstruction with biological defect augmentation such as solid bone transplants or cancellous bone restores bone stock and downgrades the defect while providing good component stability [25,26]. Using allograft in combination with metal augments such as Trabecular Metal™ (Zimmer Biomet, Warsaw, Indiana, USA) is also possible to insure ingrowth of the implants and restore the centre of rotation [27].

The acetabular shell used is a hemispherical porous titanium implant with a range of optional screw fixation. Additionally the presented implant has an option for an 8-mm wide dome screw (70–100 mm in length) that allows stable anchoring in the main weight bearing area. The 8-mm screw is inserted through the upper dome of the acetabular defect and directed along the trajectory of the posterior superior iliac spine to achieve the longest possible lever arm comparable to the stem of a pedestal cup [22]. To the best of our knowledge, this is the only implant with these specifications. Other screw fixations are possible, with 6.5-mm screws for additional rotational stability as they were used in other implants regularly. Main goal of this material combination is to achieve maximum primary stability in the weight bearing area and reduce forces at the implanted allograft in the less weight loaded areas allowing good osteointegration. The principles of this type of defect reconstruction had been used by other authors successful in the past. But in contrast to the standard combination of trabecular metal with 6.5mm or smaller screws, an early mobilization with full weight bearing could be achieved by using the 8mm dome screw.

This procedure is combined with a tripolar cemented revision cup, which allows correction of any mis-angulation that may occur after defect reconstruction [2,22,28]. The cement ensures locking fixation of the screws. The 1-year follow-up examination showed excellent radiographic and functional results (Video 1). However, more cases will need to be collected in order to verify the efficacy of the procedure and short-term and long-term outcomes. This case shows the biological potential of the combination of materials presented and may suggest that it can also be used in larger uncontained defects, such as Paprosky type IIIA-IIIB cases.

Disclosure

The authors C. Gebert and M. Wessling received grants from Implantcast GmbH as scientific and orthopedic advisors.

References

1. Kurtz S, Ong K, Lau E, Mowat F, Halpern M, "Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030," J. Bone Jt. Surg.
2. Baauw M, Van Hooff ML, Spruit M. (2016) "Current construct options for revision of large acetabular defects: A systematic review," JBJS Rev., 4: e2, 2016.
3. Paprosky WG, Perona PG, Lawrence JM, "Acetabular defect classification and surgical reconstruction in revision arthroplasty. A 6-year follow-up evaluation," J. Arthroplasty, 1994.
4. Theil C, Schmidt-Braekling T, Gosheger G, Moellenbeck B, Schwarze, et al, (2019) "A single centre study of 41 cases on the use of porous tantalum metal implants in acetabular revision surgery," BMC Musculoskelet. Disord. 20: 1-9. 2019.
5. McMinn D, Grigoris P, Roberts P, (1993) "A stemmed acetabular cup for complex hip arthroplasty," J. Bone Jt. Surg., 75: 123.
6. C. Perka, F. Schneider, and K. Labs, "Revision acetabular arthroplasty using a pedestal cup in patients with previous congenital dislocation of the hip - Four case reports and review of treatment," Arch. Orthop. Trauma Surg., 2002, doi: 10.1007/s004020100332.
7. P. Desbonnet, H. Connes, P. Escare, J. L. Tricoire, and J. Trouillas, "Total hip revision using a cup design with a peg to treat severe pelvic bone defects," Orthop. Traumatol. Surg. Res., vol. 98, no. 3, pp. 346–351, May 2012, doi: 10.1016/j.otsr.2012.01.006.
8. D. Nunn, "The Ring uncemented plastic-on-metal total hip replacement. Five-year results," J. Bone Joint Surg. Br., vol. 70-B, no. 1, pp. 40–44, 1988, doi: 10.1302/0301-620X.70B1.3339058.
9. Badhe NP, Howard PW, "Partially hydroxyapatite-coated stemmed acetabular cup and nonstructural bone-graft in the management of severe acetabular deficiency," J. Arthroplasty, 15: 63-68.
10. Santori FS, Vitullo A, Fredella N, Santori N, (2004) "O2003 STEMMED CUP IN REVISION ARTHROPLASTY AND CDH: EXPERIENCE IN 168 CASES," Orthop. Proc., 86: 275.
11. Roessler PP. (2019) "The augment-and-modular-cage revision system for reconstruction of severe acetabular defects—two-year clinical and radiographic results," Int. Orthop., 43:2269–2278.
12. Steno B, Kokavec M, and Necas L, "Acetabular revision arthroplasty using trabecular titanium implants," Int. Orthop., 39: 389-395.
13. Tabata T, Kaku N, Hara K, and Tsumura H, "Initial stability of cementless acetabular cups: press-fit and screw fixation interaction—an in vitro biomechanical study," Eur. J. Orthop. Surg. Traumatol., vol. 25, no. 3, pp. 497–502, 2015, doi: 10.1007/s00590-014-1571-4.
14. Söderman P and Malchau H, (2001) "Is the Harris hip score system useful to study the outcome of total hip replacement?," Clin. Orthop. Relat. Res., 2001.
15. Kim DH, Cho SH, Jeong ST, Park HB, Hwang SC, and Park JS, (2010) "Restoration of the center of rotation in revision total hip arthroplasty," J. Arthroplasty, 25: 1041–1046.
16. Krishnan KM, Longstaff L, and Partington P, "Acetabular reconstruction using morcellised bone with ring support - Medium term results at three to nine years," Acta Orthop. Belg., 2011.
17. Chiarlone F, Zanirato A, Cavagnaro L, Alessio-Mazzola M, Felli L, and Burastero G, "Acetabular custom-made implants for severe acetabular bone defect in revision total hip arthroplasty: a systematic review of the literature," Archives of Orthopaedic and Trauma Surgery. 2020, doi: 10.1007/s00402-020-03334-5.

18. Löchel J, Janz V, Hipfl C, Perka C, and Wassilew GI, "Reconstruction of acetabular defects with porous tantalum shells and augments in revision total hip arthroplasty at ten-year follow-up," Bone Joint J., 2019.

19. C. E. Wen, Y. Yamada, A. Nouri, and P. D. Hodgson, "Porous titanium with porosity gradients for biomedical applications," Mater. Sci. Forum, 539-543.

20. Gallart X. (2016) "Trabecular TitaniumTM cups and augments in revision total hip arthroplasty: Clinical results, radiology and survival outcomes," HIP Int.

21. De Meo F, Cacciola G, Bellotti V, Bruschetta A, and Cavaliere P, (2018) "Trabecular Titanium acetabular cups in hip revision surgery: mid-term clinical and radiological outcomes," HIP Int., 28: 61-65.

22. Schoellner C, Schoellner D. (2018) "[Pedestal cup operation in acetabular defects after hip cup loosening. A progress report]," Z. Orthop. Ihre Grenzgeb., 138: 215-221.

23. Bus MPA et al., (2017) "LUMiC ® Endoprosthetic Reconstruction After Periacetabular Tumor Resection: Short-term Results," Clin. Orthop. Relat. Res.

24. Mahadevan V. (2018) "Anatomy of the pelvis," Surgery (United Kingdom).

25. Schmolders J. (2015) "Acetabular defect reconstruction in revision hip arthroplasty with a modular revision system and biological defect augmentation," Int. Orthop., 39: 623-630.

26. Prieto HA, Kralovec ME, Berry DJ, Trousdale RT, Sierra RJ, et al. (2017) Cabanela, "Structural Allograft Supporting a Trabecular Metal Cup Provides Durable Results in Complex Revision Arthroplasty," J. Arthroplasty, 32: 3488-3494.

27. Whitehouse MR, Masri BA, Duncan CP, Garbuz DS. (2015) "Continued Good Results With Modular Trabecular Metal Augments for Acetabular Defects in Hip Arthroplasty at 7 to 11 Years," Clin. Orthop. Relat. Res., 473: 521-527.

28. Sculco PK, Ledford CK, Hanssen AD, Abdel MP, Lewallen DG. (2017) "The evolution of the cup–cage technique for major acetabular defects: full and half cup–cage reconstruction," J. Bone Jt. Surg.,13: 1104-1110.