Operative Technique: Acetabular Distraction for Severe Acetabular Bone Loss with Associated Chronic Pelvic Discontinuity

Christopher M. Melnic, MD
Neil P. Sheth, MD

Introduction

Revision total hip arthroplasty (THA) coupled with severe bone loss is a challenging problem to address especially when associated with a pelvic discontinuity. The overall goal should be to restore hip biomechanics, achieve biologic fixation of a cementless device, implant a construct which yields adequate hip stability, and preserve limb function. The burden of revision THA is expected to increase over the next several years and with it the number of complex acetabular revisions will also rise.[1]

A pelvic discontinuity defines a clinical situation where the inferior and superior hemipelvis is no longer in continuity (Figure 1). Numerous techniques have been described to address this problem including the use of a custom triflanged component, cup-cage construct, acetabular allograft with a cage, jumbo cup in conjunction with posterior column plating (in the case of an acute discontinuity), as well as acetabular distraction with porous tantalum augments. Each method intends to restore continuity between the ischium and the ilium by way of bridging the defect. In this technique guide, we describe the acetabular distraction technique using a jumbo cup and modular porous metal acetabular augments.

Background

Several classification systems have been described throughout the literature to categorize the pattern of bone loss that is present at the time of revision surgery. They include the Paprosky, Gross, and American Academy of Orthopaedic Surgeons.[2,3,4] We advocate the use of the Paprosky classification, which is based on four radiographic factors: the integrity of Kohler's line (ilioischial line), osteolysis of the tear drop and ischium, and the location of the hip center in relation to the superior obturator line.[2]

The incidence of pelvic discontinuity is very low. Berry et al., determined that the incidence at one high volume institution was 0.9%.[5] Pelvic discontinuities can be present with IIC, IIIA, or IIIB defects; however, the highest association with chronic discontinuity is seen with IIIB defects. An "up and in" pattern is demonstrated in IIIB defects (i.e. the acetabular columns are not supportive and the hip center has migrated greater than 3cm superomedially).

The three key factors that influence the treatment of pelvic discontinuity are the amount of residual host bone stock available for reconstruction, the potential for biological ingrowth, and the potential for healing.[6] In the setting of chronic pelvic discontinuity, the discontinuity is often thought of as a fibrous non-union, and the healing potential is significantly decreased as compared to an acute pelvic discontinuity.[6] As a result, we do not recommend routine plating of the posterior column in the setting of chronic pelvic discontinuity.

Pre-operative Evaluation and Indications

Patients typically present with pain and often a leg-length discrepancy due to superior migration of the hip center. A thorough pre-operative history and physical exam should be performed. All operative reports should be acquired so that the treating surgeon has an understanding of all previously performed procedures as well as the implants that are currently in place. Infection must always be ruled out prior to performing a revision THA.[7,8] An elevated erythrocyte

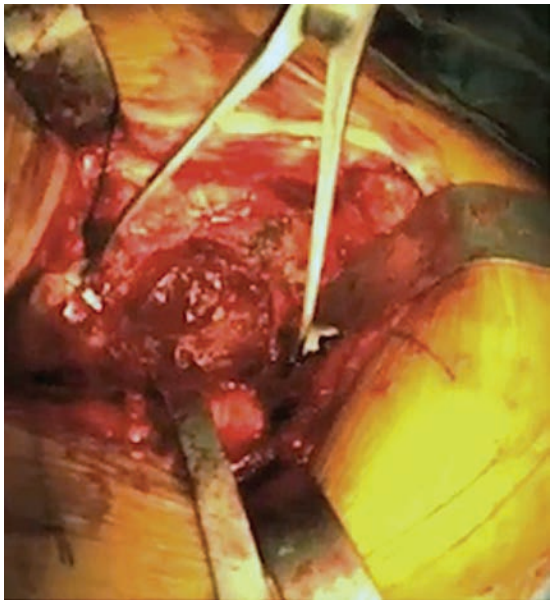

Figure 1. Demonstration of chronic pelvic discontinuity prior to distraction.

Corresponding author:
Christopher Melnic MD
Penn Medicine University City
3737 Market Street, 6th Floor
Philadelphia, PA 19107
christopher.melnic@uphs.upenn.edu

sedimentation rate and C-reactive protein should prompt a pre-operative hip aspiration. Radiographs as well as a fine-cut computed tomographic (CT) scan of the pelvis may help to evaluate the pattern of bone loss and the amount of residual bone stock. A detailed surgical plan should be constructed prior to proceeding to the operating room.

Surgical Technique

Acetabular distraction was first described by Sporer and Paprosky.[9] A posterolateral approach is typically utilized to allow for extensile exposure of the pelvis and femur. Care must be taken when removing the acetabular component already in place making sure to debride all overlying fibrous tissue in order to prevent additional iatrogenic bone loss. If a discontinuity is not grossly visualized, a Cobb elevator should be used to stress the pelvis and any discordant motion between the superior and interior hemi-pelvis signifies the presence of a discontinuity. The entire discontinuity must be defined; however, Paprosky has previously suggested that the entire chronic fibrous nonunion not be completely débrided.[6]

Prior to performing acetabular distraction, the integrity of the anterosuperior and posteroinferior columns must be evaluated. Defects of either column may require tantalum augment reconstruction; this requires securing the augment in the appropriate position prior to cup insertion. The augment in this scenario is used for primary stability of the final construct.

Once the discontinuity is defined, a distractor (Figure 2) is placed within the confines of the acetabulum, and the mobility of the discontinuity is assessed (Figure 3). Next, a 2.4mm Kirschner (K) wire is placed into the superior dome and a second K-wire is placed into the ischium. The distractor is then placed over each of the wires allowing for distraction of the discontinuity from an extra-acetabular position. This technique allows for peripheral distraction while simultaneously creating compression medially at the discontinuity.

In the distracted position, acetabular reaming is performed on reverse to avoid excessive removal of host bone. Prior to reaming, the native hip center should be identified either by using the transverse acetabular ligament or the superior aspect of the obturator foramen.[6] Once the appropriate size

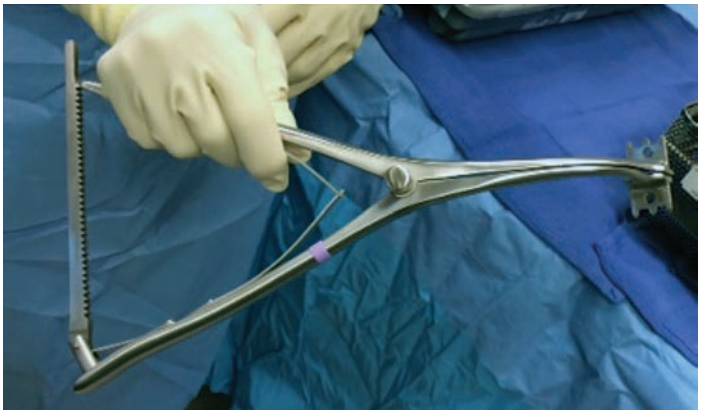

Figure 2. Acetabular distractor.

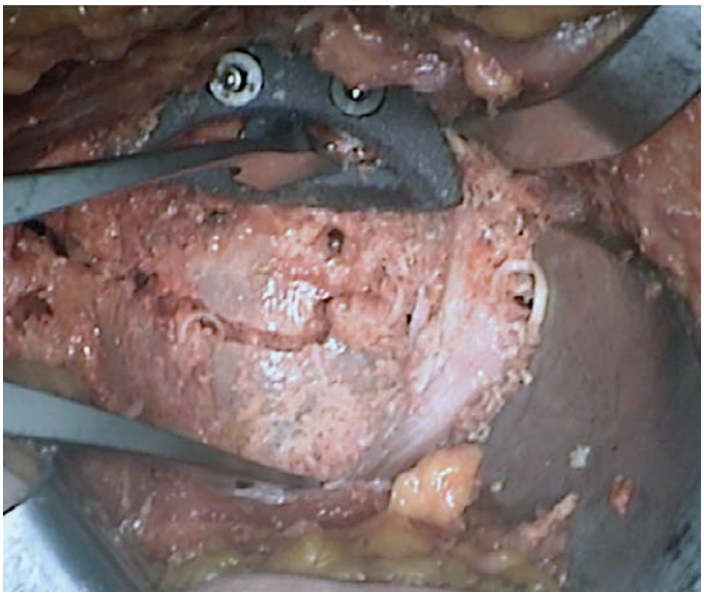

Figure 3. Demonstration of a chronic pelvic discontinuity after intra-acetabular distraction has been applied to check the mobility of the discontinuity. Note the presence of a tantalum augment in the anterosuperior column used for primary stability.

reamer is reached, the reamer typically disengages from the reamer handle and is used as a surrogate for the acetabular shell. At the correct size, the reamer will pinch between the anterosuperior and posteroinferior columns. Bone graft should be placed in the discontinuity prior to implanting the cementless shell.

A cementless trabecular metal™ revision acetabular (Zimmer, Warsaw, IN) shell is the implant of choice for treatment of pelvic discontinuity (Figure 4). A minimum of four screws should be placed through the cup into host bone, ensuring that at least one screw is placed inferiorly in the ischium or the superior pubic ramus (kickstand screw). At least 50% of the cup should be in contact with host bone; a cup placed against allograft alone will not achieve biologic fixation. The liner is then cemented in place with the proper version and abduction. If screw fixation through the cup is inadequate (e.g. less than four screws or screws with poor purchase), then a tantalum augment should be placed posterosuperiorly for supplemental fixation.

Post-operative Protocol

As previously described, our protocol following acetabular distraction includes touchdown weight bearing (10%) for 6 to 12 weeks to facilitate bone ingrowth. At three months, assuming there is no change in the position of the components, the patient is allowed to progress to weight-bearing as tolerated with a cane. Finally, no active abduction should be allowed for six weeks if an extended trochanteric osteotomy was performed to aid in femoral revision.[6]

Discussion

Revision THA with an associated chronic pelvic discontinuity is a difficult problem to treat. Results with an acetabular cage

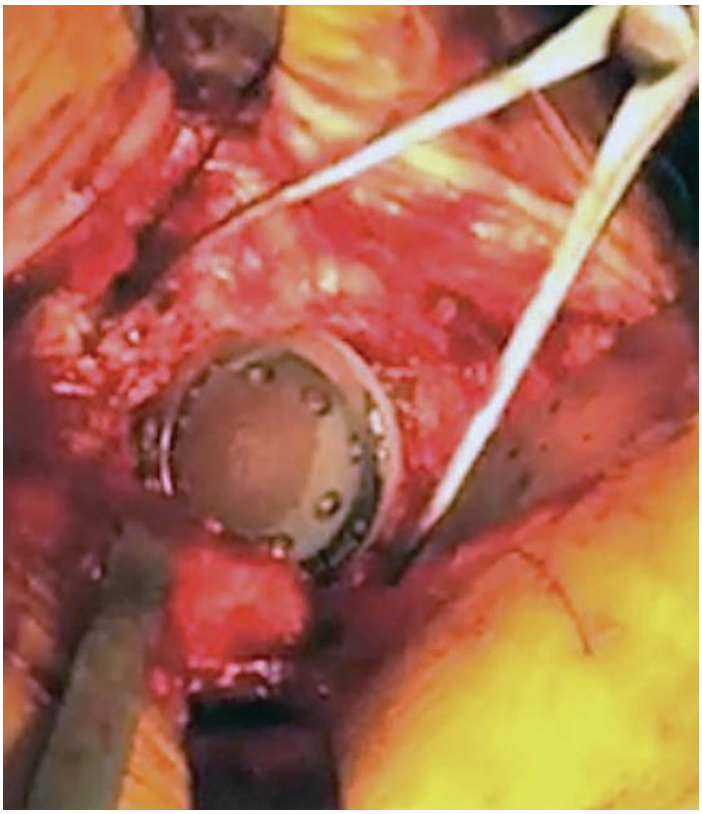

Figure 4. Final acetabular component in place after achieving a fit between the anterosuperior and posteroinferior columns.

alone, structural allograft with a cage and cemented liner, cup-cage construct,[17,18] customized triflange have been mix ed.[2,10,11,12,13,14,15,16,19,20,21] To date, there has only been one study reviewing the results of acetabular distraction. Sporer et al. demonstrated excellent results with only one out of 20 patients being revised for aseptic loosening.[9] Given the mixed results to date and the promising results reported by Sporer, acetabular distraction with a jumbo cup and modular porous metal acetabular augments appears to be a practical treatment option.

References

1. Kurtz, S, Ong, K, Lau, E, et al. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. *J Bone Joint Surg Am*, 89(4):780 (2007).

2. Paprosky, WG, Perona, PG ,Lawrence, JM. Acetabular defect classification and surgical reconstruction in revision arthroplasty. A 6-year follow-up evaluation. *J Arthroplasty*, 9(1):33 (1994).

3. Gross, AE. Revision arthroplasty of the acetabulum with restoration of bone stock. *Clin Orthop Relat Res*(369):198 (1999).

4. D'Antonio, JA, Capello, WN, Borden, LS, et al. Classification and management of acetabular abnormalities in total hip arthroplasty. *Clin Orthop Relat Res*(243):126 (1989).

5. Berry, DJ, Lewallen, DG, Hanssen, AD, et al. Pelvic discontinuity in revision total hip arthroplasty. *J Bone Joint Surg Am*, 81(12):1692 (1999).

6. Sheth, NP, Melnic, CM ,Paprosky, WG. Acetabular distraction: an alternative for severe acetabular bone loss and chronic pelvic discontinuity. *Bone Joint J*, 96-B(11 Supple A):36 (2014).

7. Della Valle, CJ, Scher, DM, Kim, YH, et al. The role of intraoperative Gram stain in revision total joint arthroplasty. *J Arthroplasty*, 14(4):500 (1999).

8. Johnson, AJ, Zywiel, MG, Stroh, DA, et al. Should Gram stains have a role in diagnosing hip arthroplasty infections? *Clin Orthop Relat Res*, 468(9):2387 (2010).

9. Sporer, SM, Bottros, JJ, Hulst, JB, et al. Acetabular distraction: an alternative for severe defects with chronic pelvic discontinuity? *Clin Orthop Relat Res*, 470(11):3156 (2012).

10. Goodman, S, Saastamoinen, H, Shasha, N, et al. Complications of ilioischial reconstruction rings in revision total hip arthroplasty. *J Arthroplasty*, 19(4):436 (2004).

11. Paprosky, W, Sporer, S ,O'Rourke, MR. The treatment of pelvic discontinuity with acetabular cages. *Clin Orthop Relat Res*, 453:183 (2006).

12. Sembrano, JN ,Cheng, EY. Acetabular cage survival and analysis of factors related to failure. *Clin Orthop Relat Res*, 466(7):1657 (2008).

13. Gross, AE ,Goodman, S. The current role of structural grafts and cages in revision arthroplasty of the hip. *Clin Orthop Relat Res*(429):193 (2004).

14. Abolghasemian, M, Sadeghi Naini, M, Tangsataporn, S, et al. Reconstruction of massive uncontained acetabular defects using allograft with cage or ring reinforcement: an assessment of the graft's ability to restore bone stock and its impact on the outcome of re-revision. *Bone Joint J*, 96-B(3):319 (2014).

15. Dewal, H, Chen, F, Su, E, et al. Use of structural bone graft with cementless acetabular cups in total hip arthroplasty. *J Arthroplasty*, 18(1):23 (2003).

16. Lee, PT, Raz, G, Safir, OA, et al. Long-term results for minor column allografts in revision hip arthroplasty. *Clin Orthop Relat Res*, 468(12):3295 (2010).

17. Ballester Alfaro, JJ ,Sueiro Fernandez, J. Trabecular Metal buttress augment and the Trabecular Metal cup-cage construct in revision hip arthroplasty for severe acetabular bone loss and pelvic discontinuity. *Hip Int*, 20 Suppl 7:S119 (2010).

18. Kosashvili, Y, Backstein, D, Safir, O, et al. Acetabular revision using an anti-protrusion (ilio-ischial) cage and trabecular metal acetabular component for severe acetabular bone loss associated with pelvic discontinuity. *J Bone Joint Surg Br*, 91(7):870 (2009).

19. Dennis, DA. Management of massive acetabular defects in revision total hip arthroplasty. *J Arthroplasty*, 18(3 Suppl 1):121 (2003).

20. DeBoer, DK, Christie, MJ, Brinson, MF, et al. Revision total hip arthroplasty for pelvic discontinuity. *J Bone Joint Surg Am*, 89(4):835 (2007).

21. Taunton, MJ, Fehring, TK, Edwards, P, et al. Pelvic discontinuity treated with custom triflange component: a reliable option. *Clin Orthop Relat Res*, 470(2):428 (2012).