Seminars in
Arthroplasty

Cup–Cage Solution for Pelvic Discontinuity

Mansour Abolghasemian, MD,* Suksan Tangsataporn, MD,* Paul R.T. Kuzyk, MD, FRCSC,* Oleg A. Safir, MD, FRCSC,* David J. Backstein, MD, FRCSC, Med,*,† and Allan E. Gross, MD, FRCSC*

The cup-cage reconstruction is indicated in massive acetabular bone loss with or without pelvic discontinuity during revision hip arthroplasty. We report the results of 26 pelvic discontinuities treated by this technique at a mean follow up of 46.6 months. The average Harris hip score was 76.6. Three constructs failed all within the first postoperative year. Complications included one deep infection, two dislocations and one peroneal neuropathy. Cup-cage construct is a reliable technique for treating pelvic discontinuity in mid-term follow-up.
Semin Arthro 23:171-175

KEYWORDS **acetabular revision, pelvic discontinuity, cup-cage**

Revision hip arthroplasty can be a challenging surgery, the complexity of which is usually related to the severity of bone loss. Pelvic discontinuity (PD) complicates the reconstruction even further. By definition, it refers to a dissociation of the proximal and distal halves of the acetabulum associated with variable amounts of bone loss.[1]

Historically, PD has been treated using a variety of techniques. Acute PD, which may occur intraoperatively or after a trauma postoperatively, can be addressed using plate fixation plus insertion of a conventional acetabular component.[1,2] More commonly, PD is secondary to chronic bone loss due to osteolysis and loosening of an acetabular component resulting in disappearance of the midportion of the acetabulum.[3] This latter category is not amenable to simple use of a regular cemented or cementless prosthesis and requires reconstruction of bone stock before insertion of the component. This usually needs a structural allograft plus internal fixation using a plate or a reconstruction cage.[4] The literature does not report a high success rate for these techniques. Failure rates of up to 50% have been reported and attributed to nonbiological fixation of the cage relying on the screws and flanges for fixation.[5]

Cup–cage reconstruction for PD is a relatively new technique that has shown promising results in short-term follow-up.[6] The theoretical logic is placing the trabecular metal (TM) cup in contact with a mixture of host bone and morselized allograft with usually suboptimal press-fit. The cage that is placed over the TM cup provides load relief for the cup over the time that the allograft incorporates to the host bone and sufficient amount of bone ingrowth surrounds the cup, taking the advantage of high affinity of TM cups for ingrowth. The cage into which the liner is cemented places the articulating hip center at the right level. After the cup achieves sufficient biological fixation, the overlying cage will be off-loaded and will not loosen.[6]

Previously, we have reported the short-term results of cup–cage reconstruction of 26 consecutive PD cases, which showed a high success rate.[7] One conflict for the validity of the aforementioned theory is that this early success may have been because of the supportive nature of the cage, which similarly has shown short-term success in treatment of PD. However, cages are known to start failing after a few years owing to fatigue, which is the characteristic of any nonbiological fixation.[8] Herein, we present the longer follow-up results of the same series of cup–cage cases.

Methods

Between March 2003 and September 2007, 26 cup–cage acetabular reconstructions for PD were performed in 24 pa-

*Division of Orthopaedics, Mount Sinai Hospital, University of Toronto, Toronto, Ontario, Canada.
†Mount Sinai Centre for MSK Disease, University of Toronto, Toronto, Ontario, Canada.
All reported work was done at Mount Sinai Hospital, University of Toronto, Toronto, Ontario, Canada.
A.E.G. is a consultant for Zimmer; D.J.B. is a consultant for Zimmer and Stryker Company.
Address reprint requests to Mansour Abolghasemian, MD, Division of Orthopaedics, Mount Sinai Hospital, University of Toronto, 600 University Avenue, Suite 476A, Toronto, Ontario M5G 1X5, Canada. E-mail: m-abolghasemian@tums.ac.ir

1045-4527/12/$-see front matter
http://dx.doi.org/10.1053/j.sart.2012.07.001

tients. The mean age of the patients at the time of surgery was 65 (44-84) years. They had an average of 2.4 (1-5) hip operations before this surgery.

Surgery consisted of total hip revision in six and acetabular revision in 20 hips, all done by the senior author (A.E.G.). The diagnosis of PD was based on the intraoperative findings, although preoperative radiological findings were diagnostic in 15 cases. At the time of surgery, after removal of the old acetabular component, the PD was diagnosed by demonstrating movement between the proximal and distal parts of the acetabulum. All required data about the condition of the acetabulum at surgery, including the amount of bone loss and the percentage of host bone coverage and also the bleeding bone in contact with the TM cup, were documented by the senior author.

The patients were evaluated using Harris hip score (HHS) preoperatively and yearly thereafter. We also obtained the ambulatory score preoperatively and at the last visit.

Radiological evaluation consisted of anteroposterior and iliac oblique views of the pelvis and lateral view of the hip. We used the criteria of Massin et al[9] for evaluating the cup and a modification of the criteria of Gill et al[10] for the cages.

Surgical Technique

Although the posterior approach can be effective, the senior author's preference is a lateral approach using a modified sliding trochanteric osteotomy.[11] An extended trochanteric osteotomy is used when an accompanied femoral revision with need to access to the femoral canal distal to the lesser trochanter is anticipated.[12] It is important that the continuity of the vastus lateralis muscle with the mobile trochanteric fragment is maintained.[11] Moreover, the short external rotators and posterior capsule are left attached to the femur. This will decrease the risk of posterior dislocation postoperatively.[12]

The trochanteric fragment and the attached glutei and vastus muscles are retracted anteriorly. After excising the pseudocapsule and dislocating the old prosthesis, the modular head or the whole femoral component is removed, depending on need for a femoral revision. The proximal femur is then pushed posteriorly using a Hohmann retractor. The acetabulum is then cleaned of any debris and fibrous tissue and all borders are exposed, allowing an accurate evaluation of the bone stock. Gentle reaming of the acetabulum is carried out. Caution should be taken not to ream the often soft and thin walls with unreasonable force. Reaming continues until either bleeding bone is obtained or it becomes clear that bony support will decrease with further reaming. If the reamer does not achieve any degree of engagement in the surrounding bone, a conventional cage rather than a cup–cage may be necessary.

The proximal 1-2 cm of the ischium should be exposed and the slot for the ischial flange created. Morselized allograft mixed with any autograft from reaming is now packed into defects, especially the discontinuity site (Fig. 1A). Uncontained defects can be reconstructed by structural allografts or TM augments. Then, a trial is performed to find the size of the cup that fits the acetabulum and the cage that fits into the cup and extends from the ischium to the ilium. The cages are specifically sized for the cup diameter. The cup should be press-fit as much as possible to distract and help to stabilize the discontinuity. Every attempt should be made to provide some contact to the bleeding bone in both the superior and inferior halves of the acetabulum, preparing the environment for the cup to stabilize the discontinuity after ingrowth occurs. Considering that the lateral dome of the acetabulum is usually the most deficient part, placing the cup in a 45° inclination does not provide it with the best host bone contact. Therefore, the cup is usually placed in a relatively vertical position. This also provides better access to the ilium for the superior flange of the cage. It should be in a fairly retroverted direction as well, so that the ischial flange of the cage can be inserted to the ischium.

Once the revision TM cup is inserted to the acetabular defect, it should be fixed with at least 2 screws. These screws maintain an important role in the preliminary stability of the cup. The direction of the screws is dictated by the location of better bone stock. Although revision TM cups come with multiple screw holes, if deemed necessary, creating more holes is technically possible using the regular bone drill bits. We cover all the holes, even those containing screws, with bone wax to make possible future removal easier and to prevent the cement from intruding to the bone–cup interface, which may impair the bone ingrowth into the cup (Fig. 1B).

Then, the slot for the ischial flange of the cage is created. The starting point is located in the inner surface of the acetabular rim, at the 7-o'clock position in the right and at the 5-o'clock position in the left hip. The direction is dictated by the exposed lateral surface of the ischium and is confirmed by drilling a hole and using a depth gauge to ensure that for a distance of 3 cm, the flange will be surrounded by bone. The slot is initiated using a special osteotome but completed by the real flange of the cage to avoid inadvertent perforation of the ischium by the sharp osteotome and endangering the sciatic nerve.

A helpful practice is to template with a trial cage and to adjust the superior and inferior flanges of the real cage before insertion. This diminishes the need to force the cage when engaged in the often deficient bone of the ischium. Usually, the upper flanges need to be bent downward to the ilium and the lower ones upward to align with the ischium. The last action before inserting the cage is to prepare the lateral ilium for the upper flange. Abductor muscles should be gently elevated from an appropriate length of the ilium. This should be performed carefully to avoid damage to the superior gluteal neurovascular bundle and resultant lurch.

Cage insertion starts with inserting the inferior flange all the way into the slot. Then, the cage is impacted into the cup so that the upper flanges lie flat on the ilium, slightly toward the posterior. The fixation depends on the distal flange and the screws through the superior flanges to the ilium (Fig. 1C). A minimum of 3 bicortical 6.5-mm screws should be used to fix the flanges to the ilium, but before that, it is recommended to insert a couple of screws in the dome of the cage through the cup and ilium. The latter screws will push the cage further