Acetabular Cages: A Ladder Across a Melting Pond

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The original premise for implanting anti-protrusio devices was based on an attempt to provide increased contact area between the implant and remaining pelvic bone to dissipate forces within the cement and decrease the likelihood of implant migration. Early devices relied on cement as the sole source of fixation and these implants were associated with a high failure rate at short-term follow-up. Although the use of these devices was quickly abandoned, new devices based on mechanical screw fixation were designed and the use of these devices became popular in the early 1990s.1

These so-called “acetabular cages” should be classified into the two categories: 1) roof rings and 2) anti-protrusio devices.2,3 This distinction is important as significant differences exist between these two device categories and they should be used to treat different conditions. This article reports on the anti-protrusio devices that are used to bridge across from the ischium to the ilium to dissipate the forces in poor or absent bone.

ANTI-PROTUSIO DEVICE USE

The majority (90%-95%) of acetabular revisions can be treated effectively with an uncemented hemisphere.4 Typically, when <50% of host bone apposition is present against the uncemented cup, most surgeons consider using anti-protrusio devices. We have challenged this concept recently due to our experience with a new device, the trabecular metal revision acetabular shell, as this device has affected the way we achieve fixation.5 The location and quality of bone is as important as the amount of bone apposition. As a result, unresolved acetabular cases requiring an acetabular cage now represent an even smaller group of patients (<5%). These unresolved acetabular cases include 1) severe, combined segmental, and cavitary bone deficiencies; 2) poor bone quality and biology, such as with a history or prior pelvic irradiation; and 3) type 4 pelvic discontinuity associated with severe bone loss.

SURVIVAL OF CAGES

The reported results of cages are only mid-term results and include a mixed group of patients with variable pathology and bone loss.2,6-9 The irrefutable fact with all of these devices is that the fixation is purely mechanical and not biologic. This is of great concern as the current mid-term results suggest higher rates of loosening with these devices.10 It is important to point out that the survival of these devices depends on whether the insertion of the device is performed in a technically adequate fashion with appropriate indications.8,10 It has been shown that

Figure 1: Graph depicting the pattern of use of mechanically fixed acetabular cages at the Mayo Clinic.
The Role of Acetabular Cages in Revision

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Revision of the failed acetabular prosthesis, when associated with significant osteolysis and destruction of the pelvic bone stock, combines the challenges of achieving reconstruction of bone and initial and long-term stability of the acetabular implant. Revision cages are an important part of the armamentarium of the hip surgeon. The long-term clinical experience with revision cages is substantial; however, limitations also exist regarding the use of these implants.

INDICATIONS

The majority of acetabular revisions can be managed with a cementless “jumbo cup.” However, initial and long-term stability of the revision cementless acetabular component requires at least 50% viable, stable host bone to support and stabilize the component. Medial wall defects >2 cm and significant peripheral rim defects also limit the use of the cementless jumbo cup. The revision ring is indicated when the above criteria cannot be fulfilled. However, extensive osteolytic destruction of the pelvis may require alternate reconstruction techniques such as hemi-pelvic allograft or custom acetabular implants.

Acetabular reconstruction cages offer the revision substantial advantage in revision surgery. Modern cage designs allow the surgeon to intraoperatively customize the ring to fit the altered pelvic anatomy. Recent design innovations include augments to aid the achievement of initial stability of the implant. The use of thicker, stronger metal decreases the likelihood of implant fracture. Plasma spray coatings of the reconstruction cages provide the opportunity for a stable biologic interface of the ring when positioned against viable host bone (Figure 1). A further advantage of the acetabular cage is the ability to independently position the polyethylene prosthesis within the cage, thus assuring proper position of the reconstruction necessary for reducing the risk of dislocation.

RESULTS OF RECONSTRUCTION RINGS

The results of reconstruction cages are well-documented, and have provided clear guidelines to the clinical use of these implants. Rosson and Schatzker reported average 5-year follow-up of 20 revision cages in 1992. They reported no revisions among any of the Burch-Schneider rings, and concluded that the use of allograft in conjunction with the ring was an essential part of the success of their technique.

Winter et al reported the results of 38 acetabular revision rings and found no failures at average 7.3-year follow-up. Saleh et al reported the results of 13 patients with severe osteolysis requiring massive allograft. At average 7.1-year follow-up, 77% of the series were considered successful.

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Acetabular cages should be implanted against good native bone for long-term survival.10 Using three different devices, the 6-year survival data revealed a 30%-40% mechanical revision or failure rate.10 These findings are concerning for surgeons who have been implanting an increasing number of acetabular cages and confirm the observations of our experience at mid-term follow-up. Fortunately, not everything is lost with cages that fail mechanically because at revision some have reconstitution of bone and allow conversion to an un cemented hemispherical shell.

PRACTICE PHILOSOPHIES

Beginning in the early 1990s, we began to use cages sparingly and then began to use these devices more frequently (Figure 1). The height of the era of acetabular cage use occurred in 1996 and since that time the use of these devices has steadily declined.11 For example, in 2002, only four of these cages were implanted at our clinic. Recently, we have used cages in combination with the trabecular metal shell, and in 2003, the use of these so-called “cup-cages” exceeded the use of mechanically fixed acetabular cages (Figures 1 and 2). The primary reason for using the “cup-cages” has been to use a device that has potential for biologic ingrowth.

Commercially available devices, such as the Triflange Cup (Depuy Orthopaedics, Warsaw, Ind), have been used for similar reasons and thus far have yielded good to excellent results for difficult acetabular reconstructive problems.12 A close look at this device reveals that it is basically a hemispherical un cemented device with flanges. Primary disadvantages of the Triflange Cup are that it must be fabricated on a custom basis, which causes manufacturing delays, and it is expensive. For these reasons, we use the “cup-cages,” and at short term follow-up are impressed. Acetabular cages will become less frequently implanted because un cemented hemispherical shells can be used for most cases. For the remaining cases, modular acetabular reconstructive systems will be developed with augments and flanges that rely on biological ingrowth for long-term fixation. Mechanically fixed acetabular cages will eventually become a part of acetabular reconstructive history.

REFERENCES

Figure 2: AP radiograph of severe acetabular protrusion, which occurred approximately 4 months following revision (A). The patient was referred for a reconstruction ring; however, a pelvic dissociation was suspected. Severe iliac and ischial osteolysis was considered a relative contraindication to the use of a reconstruction ring. Three-dimensional pelvic CT reconstruction demonstrates severe bone stock deficiency and transverse pelvic dissociation (B). This was managed with a custom acetabular component; severe bone loss, as in this case, is not appropriate for management with a reconstruction ring.

(continued from page 831) Successful. Kerboull et al² reported 92% survivorship at average 13-year follow-up of 60 reconstruction rings, all of which required massive allograft. Gill et al⁸ reported 92% success at average 7.1-year follow-up of their series of revision rings. A report from the Mayo Clinic in 1999 concluded “for most hips with IV-b and IV-C bone loss, we prefer to use particulate bone graft protected with an anti-protrusion cage.”³⁹

The revision surgeon should anticipate the possible need for a revision cage by careful examination of the preoperative radiographs. Comparison with prior radiographs will suggest the pattern of bone destruction that may be associated with the failure of the implant. Major, sudden change in position of the failed acetabular insert suggests the possibility of pelvic dissociation or posterior column fracture. In this setting, it may be necessary to place a pelvic reconstruction plate posteriorly to additionally stabilize the pelvis and reconstruction ring. Massive osteolysis of the ilium or ischium are frequent clinical problems that are appropriate for the use of the revision ring. Large medial wall defects with or without protrusion are also excellent indications for the revision cage.

Compacted cancellous allograft addresses the bone stock deficiency in the majority of reconstruction rings. However, when large peripheral rim defects (>2×2 cm) exist, corticocancellous intercalary graft will be necessary to stabilize the revision ring. The revision ring provides the additional advantage of at least partial stress protection while allograft incorporation occurs.

The revision ring is a valuable, proven technique for revision of the failed acetabular implant. Although the majority of acetabular revisions can be successfully managed with the “jumbo” ingrowth cup, reconstruction rings address the majority of cases involving more extensive bone loss. In our practice, the revision ring is used for those cases presenting with large (>2 cm) peripheral rim defects, large cavitary defects, and large medial wall defects.

REFERENCES


