Stability of Revision Acetabular Components Using the Rim-Fit Technique

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Abstract: Use of the rim-fit technique in revision acetabular surgery was reviewed for 20 hips in 18 patients. Defects at revision surgery included isolated medial segmental and global cavitary deficiencies with largely intact peripheral rim. A cementless acetabular component is placed to achieve a press-fit against the bony acetabular rim after morselized allograft and/or autograft was placed behind the cup. The average follow-up period was 68.3 months (5.7 years) (range, 27-112 months). Cup migration was assessed using digital radiography. Average vertical migration was 1.02 mm superiorly, and average horizontal migration was 0.8 mm medially. The abduction angle changed on average by 0.25°. Use of the rim-fit technique for treatment of cavitary acetabular defects is associated with component stability and minimal component migration. **Keywords:** revision hip arthroplasty, cementless revision acetabulum, cavitary defect, digital radiography.

The principles of acetabular reconstruction include reestablishment of the hip center of rotation and improvement in the biomechanical environment of the hip joint with stable component fixation. Ideally, bone stock should be restored, and the final construct should be stable throughout a functional range of motion.

Depending on the location and amount of bone loss, a variety of techniques have been used to address the deficiencies at the time of acetabular revision surgery. These methods have included bipolar components [1-3], oversized cups [4], bulk structural allograft augmentation [5], high hip center positioning [6], antiprotrusio cages [7], trabecular metal augmentation [8], bilobed [9] and custom prostheses [10,11], and the rim-fit technique [15]. The orthopedic surgeon has a vast armamentarium of techniques and devices to manage various acetabular reconstructions. The technique chosen is predicated on the character of the acetabular deficiency and the experience of the surgeon.

This study is designed to examine the intermediate-term stability of one method of dealing with large medial cavitary acetabular deficiencies—the rim-fit technique. Digital radiography was used to evaluate the durability of this technique in patients having undergone revision total hip arthroplasty (revTHA) with medial acetabular deficiencies at greater than 2 years of follow-up.

Materials and Methods

Institutional review board approval was obtained before the initiation of this study. We retrospectively reviewed 233 revTHA performed by the senior author during 1996 to 2002. Revision surgeries where large medial segmental or cavitary deficiencies were encountered (Paprosky classification 2A, 2B, or 2C [5]), leading to the use of the rim-fit technique, were identified. Inclusion criteria included use of the rim-fit technique at the time of revTHA (use of back-fill allograft and a large cementless acetabular cup with additional screw fixation) and digital radiographs taken in the early (3 month) postoperative period and at a minimum 2-year follow-up. Cases where the rim-fit technique was not the primary mode of reconstruction and/or requisite films were not available were excluded.

A total of 38 patients were identified as having revTHA performed where the rim-fit technique was used for acetabular component fixation (16.3% of revTHA performed during this period). Eighteen patients and 20 hips met the inclusion criteria. Patient demographics included 11 males and 7 females with an age range of 38 to 83 years (average, 63.0 years). Follow-up ranged from 27 to 112 months (average, 68.3 months).

The indications for acetabular component revision included 6 failed cemented acetabular components, 11 painful bipolar components protruded medial to Kohler's line, 1 failed cup arthroplasty, and 2 aseptically loose

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Table 1

Patient	Indication	Femur Revised	Screws
1	Aseptically loose uncemented cup	No	2 dome/2 peripheral
1	Failed bipolar	No	2 peripheral
2	Failed cup arthroplasty	Yes	4 peripheral
3	Failed bipolar	No	1 dome
4	Failed bipolar	No	3 dome
5	Failed bipolar	No	2 dome/2 peripheral
6	Failed bipolar	No	1 dome/2 peripheral
7	Failed bipolar	No	1 dome/3 peripheral
8	Failed bipolar	No	1 dome/2 peripheral
9	Aseptically loose cemented cup	Yes	2 dome
10	Aseptically loose cemented cup	No	2 dome/2 peripheral
11	Failed bipolar	Yes	1 dome/2 peripheral
12	Failed bipolar	Yes	2 dome/2 peripheral
12	Failed bipolar	No	3 dome/3 peripheral
13	Aseptically loose cemented cup	No	3 dome
14	Aseptically loose cemented cup	No	2 dome/2 peripheral
15	Aseptically loose cemented cup	No	2 dome
16	Aseptically loose cemented cup	No	2 dome/1 peripheral
17	Aseptically loose uncemented cup	No	1 dome/2 peripheral
18	Failed bipolar	No	2 dome/2 peripheral

cementless cups (Table 1). Femoral component management involved 4 revisions to a modular press-fit implant (s-ROM; Johnson & Johnson/DePuy Orthopaedics, Warsaw, IN).

Rim-Fit Technique

The rim-fit technique has been described for the management of isolated medial segmental and global cavitary deficiencies [12]. Most typically, these defects occur secondary to migrated acetabular components that have loosened and migrated both medially and superiorly. An intact rim or introitus is present, which is smaller than the medially directed, patulous cavity. The operative technique involves identification of the equator of the rim and reaming to, but not through, this equator. The cavitary defect is back filled with morselized autograft and/or allograft of varying particle size.

In the surgeries included in this study, frozen femoral or humeral heads were ground in a bone mill to provide morselized allograft. This material was then placed in the base of the acetabulum. If the defect was classified as Paprosky type 2C with medial wall compromise, a wafer cut from the apex of the allograft femoral head was used to plug the defect before placing the morselized allograft. Next, a reamer slightly smaller than the final reamer was used to contour the allograft against the host bone by reaming in the reverse direction. All graft material was cleared from the peripheral host osseous rim, and a press-fit is obtained on the rim only when impacting the acetabular implant. Unicortical supplemental screw fixation was then performed. Bicortical screw fixation was attempted if the unicortical fixation was felt to provide inadequate support to the rim purchase.

Radiographic Measurement

Digital radiography was used to perform all measurements in this study. Preoperative or outside radiographs that were obtained before the digital network at our institution were converted to a digital format. Digital templating software (IMPAX; Agfa-Gevaert NV, Mortsel, Belgium) was used to standardize magnification scale differences.

Acetabular component position was assessed using postoperative digital radiographs. The antero-posterior (AP) pelvis film taken at the 6-week follow-up visit was chosen for use as "time zero." (Immediate postoperative film was used with one patient because the 6-week film was not available.) Acetabular component positioning on this early postoperative film was compared with the AP pelvis film taken at the most recent follow-up clinic visit.

Displacement of the acetabular component in the horizontal and vertical planes was measured, as well as changes in the abduction angle of the cup (Figs. 1 and 2) similar to the method of Dorr and Wan [12]. Medial displacement was assessed by measuring the distance between the most medial portion of the cup and Kohler's line. Vertical displacement was assessed by measuring the distance between the most inferior portion of the cup and a line drawn between the inferior margin of the obturator foramina. This interforamina line was also used as the

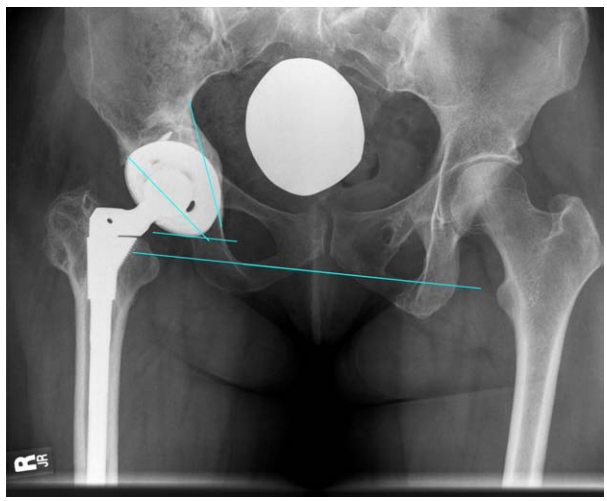

Fig. 1. Postoperative anteroposterior radiograph of the pelvis of a 48-year-old man demonstrating the horizontal axis across the inferior aspect of the obturator foramina and Kohler's line.