The Journal of Arthroplasty xxx (2016) 1–6

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Multiple Revision Surgeries and Acetabular Bone Defect Size May Predict Daily Activity After Revision Total Hip Arthroplasty

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ARTICLE INFO

Article history:
Received 15 June 2016
Received in revised form
29 November 2016
Accepted 5 December 2016
Available online xxx

Keywords:
total hip arthroplasty
revision
daily activity
acetabular bone defect
predictormultiple operations

ABSTRACT

Background: We identified preoperative predictors and size of acetabular bone defects for poor return to daily activity after revision total hip arthroplasty.
Methods: Our analysis was based on outcomes of 140 cases of revision total hip arthroplasty, performed for any reason between May 2001 and March 2013. The Japanese Orthopaedic Association (JOA) score and body mass index (BMI) measured preoperatively, and the University of California Los Angeles (UCLA) activity score and JOA score measured at the 2-year follow-up were evaluated. Acetabular bone defects were classified according to the American Academy of Orthopaedic Surgeons grading system, with further classification of the location and severity of each acetabular bone defect. We compared preoperative clinical factors and postoperative clinical outcomes statistically.
Results: We found a significant association between the number of revision surgeries and worse postoperative JOA scores and UCLA activity scores. There were significant differences in postoperative JOA scores and UCLA activity scores between patients with partial and global acetabular bone defects.
Conclusion: Multiple revision surgeries and the size of the acetabular bone defect were predictors of both poorer clinical outcome and greater restriction in postoperative daily activities. Closer attention to the postoperative management of patients with a lower preoperative status is warranted.

Outcomes of primary total hip arthroplasty (THA) have significantly improved due to innovation in prosthesis technology and new surgical procedures [1,2]. Generally, the long-term outcomes of primary THA are expected to be acceptable, with good and excellent results [2]. However, 10%-18% of all THAs are revision surgeries performed as treatment for aseptic loosening, multiple dislocations, or septic loosening [3,4]. The clinical and radiographic outcomes of THA have been evaluated in various studies, including re-revision rate, rate of complications, and radiological evidence of failure [5-7]. Revision THA is associated with a higher mortality rate and poor functional outcome when compared to primary THA [3,8-11].

Patients' activities of daily living (ADLs) are an important outcome of THA as they directly affect quality of life. However, studies evaluating functional outcomes following revision THA have been limited to the use of the clinician-based Harris hip score or Merle d'Aubigné score [12,13]. In fact, to our knowledge, only a few studies have investigated functional results from the perspective of the patient, rather than clinician-based function scores, after revision THA [14,15]. Davis et al [14] reported that the Western Ontario and McMaster Universities Osteoarthritis pain scores, measured preoperatively, and the number of comorbidities were predictive of functional outcomes after revision THA. Therefore, factors specific to patients' preoperative status may be predictive of poorer functional outcomes after revision THA, compared to primary THA. Therefore, the aim of our study was to identify preoperative predictors and severity of acetabular bone loss for postoperative function.

Patients and Methods

Patients and Surgery

A total of 156 revision THAs were performed, for any reason, between May 2001 and March 2003 (Table 1). We excluded 16 revisions (10.3%) because these patients were lost to follow-up.

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.12.005.

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http://dx.doi.org/10.1016/j.arth.2016.12.005
0883-5403/

Table 1
Patients Background.

Age (y)	66.2 ± 10.6
Male/female (number)	27/113
BMI (kg/m^2)	22.8 ± 4.0
Preoperative JOA score (points)	52.4 ± 16.6
Postoperative JOA score (points)	71.9 ± 15.2
UCLA activity score (points)	4.2 ± 1.6
Revision no.	
1	115
2	19
3	3
>3	3
Reason (number)	
Loosening	122
Dislocation	4
Infection	14
Revision type (number)	
Acetabular only	101
Femoral only	14
Both	25

Therefore, the data from 140 hips, contributed by 140 patients (17 men and 123 women), were included in the analysis. Among the patients forming our study group, 25 underwent both acetabular and femur-side revision, with a cemented stem used in 11 patients and cementless stem in 14; 14 underwent only femur-side revision, with a cemented stem used in all 14 patients; and 101 underwent only acetabular-side revision. All revision surgeries were performed using a direct lateral approach. The majority of acetabular revision surgeries (105/126 cases) were reconstructed using a Kerboull-type acetabular reinforcement device (KT plate; KYOCERA Medical Corporation, Kyoto, Japan), with the other acetabular revisions performed using cementless sockets (21/126 cases). A polyethylene liner was used for all acetabular revision cases, with the femoral head component changed in all revision cases, with a 28- or 32-mm CoCr head used in 101 cases and a 28-, 32-, or 36-mm alumina head used in 39 cases.

Acetabular defects were classified according to the American Academy of Orthopaedic Surgeons (AAOS) grading system [16]. Type II defects (cavitary bone loss) were identified in 15 hips, type III defects (cavitary and segmental bone loss) in 78 hips, and type IV defects (pelvic discontinuity) in 8 hips. The AAOS provides a descriptive classification of the type of acetabular bone loss without quantifying the severity of loss. As an example, a type I (segmental) defect is defined by a partial-to-global defect. Therefore, we further classified acetabular bone defect by its location (superior rim, superior-anterior rim, and superior-posterior/anterior-superior-posterior) and severity (partial or global defect); our classification is summarized in Table 2. Based on this enhanced classification system, an AAOS type IV defect was defined as an anterior-superior-posterior and global bone defect.

The degree of acetabular bone defect was assessed after removal of the loosened implant, and the acetabular bone defect was augmented with beta tricalcium phosphate granules (OSferion; Olympus, Tokyo, Japan) in 31 patients, hydroxyapatite block (Osteograft, Apaceram; KYOCERA Medical Corporation) in 27 patients, and femoral head bulk allograft in 31 patients. HA block or bulk allograft was mainly used in the 52 cases with global rim defects or pelvic discontinuities to achieve implant stability. In these 52 cases, implant stability was either partially or completely reliant on augmentation. We also used bulk allograft for the 6 cases with partial rim and global cavity defects. In 37 patients, the acetabular bone defect was small and bone grafting was not used.

The KT plate was fixed firmly using an inferior hook to the teardrop and a superior flange, with at least 2 screws to the ilium. The polyethylene component was then cemented into the dome of the plate. In the case of pelvic discontinuity, the posterior column was initially fixed with the reconstruction plate (Synthes, West Chester, PA). After stabilization of the posterior column, the KT plate was implanted with structural bone grafting. When fixation of the inferior hook to the teardrop was not possible due to the loss of host bone, the inferior hook of the KT plate was fixed to the ischium, inferior acetabular dome, or directly to the allograft. For cases of THA revision due to septic arthritis, a 2-stage revision surgery was performed. Postoperatively, full weight bearing was tolerated by all patients within 3 days of surgery and patients were discharged from hospital with a T-cane gait at 3 weeks postsurgery. The weight-bearing protocol was not changed over the course of the study period.

Clinical Evaluation

Relevant background characteristics of patients forming our study group are summarized in Table 1. Hip function was evaluated using the Japanese Orthopaedic Association (JOA) score, which allocates 40 points for pain, 20 points for range of motion (ROM), 20 points for walking ability, and 20 points for ADLs, with a maximum total score of 100 points [17]. The JOA score was evaluated preoperatively and at the 2-year follow-up. Body mass index (BMI) and the University of California Los Angeles (UCLA) activity score were also evaluated at the 2-year follow-up assessment. Several papers have dichotomized the UCLA activity score into either a low-to-moderate activity (UCLA score 1-6) or a high activity (UCLA score 7-10), and used the dichotomized score to evaluate associations with preoperative variables, such as age and gender [18,19]. In our study group, all patients who underwent revision THA had a low activity level. Therefore, we dichotomized the UCLA activity score as low activity

Table 2
Classification of Bone Defect.

AAOS Type		Location of Bone Defect		Severity of Bone Defect			
Case Number		Case Number		Case Number		Case Number	
Type I (segmental)	26	Superior	12	Partial	12	Global	0
		Superior + anterior	13	Partial	10	Global	3
		Superior + posterior	1	Partial	0	Global	1
Type II (cavitary)	15		15	Partial	6	Global	9
Type III (segmental + cavitary)	77	Superior	26	Partial rim + partial cavity	18	Global rim + partial cavity	3
				Partial rim + global cavity	3	Global rim + global cavity	2
		Superior + anterior	36	Partial rim + partial cavity	13	Global rim + partial cavity	7
				Partial rim + global cavity	3	Global rim + global cavity	13
		Superior + posterior	15	Partial rim + partial cavity	0	Global rim + partial cavity	2
				Partial rim + global cavity	0	Global rim + global cavity	13
Type IV (pelvic discontinuity)	8			Global 8			