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Is There a Benefit to Head Size Greater Than 36 mm in Total Hip Arthroplasty?

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ABSTRACT

This study compares the rate of dislocation and revision for instability between 36-mm and anatomic femoral heads (large diameter metal-on-metal THA, dual-mobility bearings, and hip resurfacing arthroplasty) in patients at high risk for dislocation. A total of 501 high-risk patients, over a 10-year period, were identified (282 36-mm THA, 24 dual-mobility bearings, 83 metal-on-metal arthroplasty, and 112 hip resurfacing arthroplasty). There were 13 dislocations in the 36-mm group compared to 1 in the anatomic group (4.6% vs 0.5%; $P = .005$). Four patients dislocated more than once in the 36-mm group (1.4% vs 0%; $P = .04$), and 2 patients in the 36-mm group required a revision for instability (0.7% vs 0%; $P = .11$). These results suggest that anatomic head sizes significantly lower the risk of dislocation in high-risk patients.

Although the demand for primary total hip arthroplasty (THA) continues to increase in the United States [1], dislocation unfortunately remains a common occurrence. Dislocation not only increases overall health care costs [2] but also negatively impacts patients' quality of life after this elective procedure [3]. Although quoted dislocation rates vary in the literature between less than 1% to greater than 5%, recent large-scale data from the Medicare database demonstrated a 3.9% rate of dislocation [4]. Furthermore, most of these dislocations have been shown to occur during the early postoperative period [5,6]. Furthermore, dislocation has been shown to be one of the most common indications for revision surgery, representing 22.5% of revision hip arthroplasties, further underscoring the impact on the health care system and the patient alike [7].

Biomechanical as well as clinical data suggest improved range of motion as well as stability with increasing femoral head sizes [8-10]. The bulk of the clinical literature, however, has compared head sizes less than or equal to 36 mm, with a paucity of data evaluating larger articulations, particularly in a high-risk patient population [11-17]. Current strategies to mitigate dislocation include "anatomic" articulations such as large (>36 mm) metal-on-metal (MOM) THA, hip resurfacing arthroplasty (HRA), and dual-mobility (DM) bearings. Although these more anatomic articulations (MOM, HRA, and DM) have shown efficacy in preventing dislocations, even in high-risk patients, unique concerns remain regarding their use [18-30]. Specific risks unique to these components include adverse local tissue reaction with MOM THA and HRA implants, as well as intraprosthetic dislocation and component disassociation in the case of DM implants.

Few clinical series to date have evaluated rates of instability with the use of 36-mm femoral heads as compared to anatomic articulations in a high-risk patient population [31]. Although little currently available evidence suggests a possible benefit to femoral heads greater than 36 mm, their relative effectiveness compared to anatomic articulations remains unknown [11,13-17]. Furthermore, the rate of revision for recurrent instability of these anatomic articulations, as compared to 36-mm heads, remains in question as well. The purpose of this study was to compare the rate of dislocation, recurrent dislocation, and revision for dislocation among patients with a 36-mm head and those with an anatomic head size among patients undergoing primary THA who possessed risk factors that made them higher risk for dislocation.

Methods

After institutional review board approval, we performed a retrospective analysis of a single fellowship trained arthroplasty surgeon's prospectively collected surgical database and identified 1068 primary THA who received a 36-mm femoral head, large head MOM THA, HRA, or DM articulation between October 2002 and April 2012 at a tertiary care center. From this cohort, we identified 501 hips (282 36-mm THA, 112 MOM hip resurfacings, 83 MOM THA, and 24 dual-mobility bearings) that had at least one of the following risk factors for dislocation: a neuromuscular disorder (eg, cerebral palsy, Parkinson disease, or stroke), dementia or cognitive impairment, substance or alcohol

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All studies must have been carried out in accordance with relevant regulations of the US Health Insurance Portability and Accountability Act. This study was granted an institutional review board approval.

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Table 1
Indication for Total Hip Arthroplasty.

Preoperative Diagnosis	Patients
36-mm head group (n = 282)	
Osteoarthritis	202 (71.6%)
Inflammatory arthritis	5 (1.8%)
Osteonecrosis	35 (12.4%)
Displaced femoral neck fracture	20 (7.1%)
Proximal femoral fracture nonunion	11 (3.9%)
Hip dysplasia	8 (2.8%)
Charcot arthropathy	1 (0.4%)
Dual-mobility group (n = 24)	
Osteoarthritis	17 (70.1%)
Displaced femoral neck fracture	5 (20.8%)
Osteonecrosis	2 (8.3%)
Large diameter MOM group (n = 83)	
Osteoarthritis	55 (66.3%)
Inflammatory arthritis	1 (1.2%)
Osteonecrosis	24 (29%)
Displaced femoral neck fracture	1 (1.2%)
Hip dysplasia	2 (2.4%)
HRA group (n = 112)	
Osteoarthritis	99 (88.4%)
Inflammatory arthritis	5 (4.5%)
Osteonecrosis	7 (6.3%)
Hip dysplasia	1 (0.9%)

abuse (>10 drinks per week), acute displaced femoral neck fracture, age 75 years or older, inflammatory arthritis, and increased preoperative range of motion (calculated as described by Krenzel et al: combined flexion, adduction, internal rotation ≥115°) [32-36]. Patients with less than 90 days of follow-up (36 patients) were excluded.

A posterior approach with capsular repair was used in all cases. The most common indication for hip arthroplasty among both groups was osteoarthritis (Table 1). When compared to each other, the patients in the 36-mm head group tended to be older and lighter and included a higher percentage of females (Table 2). The mean femoral head size in the HRA group was 49.4 mm (range, 42-56 mm), the MOM group was 47.1 mm (range, 39-56 mm), and the mean diameter of the polyethylene head in the DM group was 46.5 mm (range, 42-56 mm). High offset stems were used in a total of 193 patients. A 10° elevated rim liner was used in 38 patients (13.5%) in the 36-mm group. A complete list of components is shown in Table 3.

Posterior hip precautions were maintained for a total of 90 days postoperatively, and all patients were allowed weight bearing as tolerated postoperatively with the use of at least 1 assist device for the first 6 weeks. Patients are instructed to sleep supine with a pillow between their legs. Postoperative physical therapy included gait training and abductor strengthening. Posterior hip precautions are maintained for 6 weeks for DM, MOM, and HRA patients, whereas the 36-mm group were asked to maintain posterior precautions for a total of 12 weeks.

Patients were evaluated in the outpatient office at standard intervals (3 weeks, 6 weeks, 3 months, 1 year, and annually thereafter). At each visit, patients were assessed clinically as well as radiographically. Surgical and demographic details as well as the occurrence of dislocation were obtained from the patient's chart. Two reviewers (BH and DP) who were not involved with the index procedure reviewed the clinical records. The timing and the direction of dislocation (determined radiographically) were collected as well.

The 2 primary outcomes (dislocation and revision surgery) were compared between high-risk groups (36-mm vs anatomic femoral heads) using Fisher exact tests. Statistical significance was set at a P value less than .05. Using prior work on large head hip arthroplasty performed by Lachiewicz and Soileau [15,16], an a priori power analysis indicated that 172 patients would be needed per group to attain 90% power, with an α of .05 to detect a difference in the dislocation rates between the 2 groups.

Table 2
Demographic Information.

Variable	36-mm Head (n = 282)	HRA (n = 112)	MOM (n = 83)	Dual mobility (n = 24)
Patients (P < .0001)	282	112	83	24
No. of females	177 (63%)	14 (13%)	39 (47%)	9 (38%)
Average age (y) (P < .0001)	65.7 (25-75)	65.6 (45-83)	54.3 (22-78)	50.2 (20-65)
Average height (in) (P < .0001)	65.2	66.7	67.1	64.2
Average weight (lb) (P = .0013)	181.7	187.8	187.1	199.1

Results

A total of 14 dislocations were observed in our high-risk patient cohort, 13 in the 36-mm femoral head group vs 1 in the anatomic group (4.6% vs 0.5%; P = .005). The 36-mm group experienced 7 anterior dislocations (5 detected in the postoperative recovery room only) and 6 posterior dislocations. The singular anatomic femoral head dislocation was in a large MOM articulation. The patient was a 43-year-old man with spastic cerebral palsy who dislocated posteriorly 4 days postoperatively and was successfully closed reduced. For the entire cohort of 1068 patients (standard and high risk), there were 23 dislocations (2.2%) including 22 dislocations in the 36-mm group and the 1 dislocation in the anatomic group as described above.

Recurrent dislocations (≥2 dislocations) occurred in 4 patients, all of which were in the 36-mm head group (1.4% vs 0%; P = .04). There were 2 patients who required a revision for instability, both of which were in the 36-mm group. No patients in the anatomic group required revision for instability (0.7% vs 0%; P = .11).

Discussion

With the advent of modern highly cross-linked polyethylene, larger femoral head sizes have become used more widely. Large femoral head bearings have several advantages including a larger head-neck ratio, increased range of motion, greater jump distance, decreased impingement, and resultant increased stability [8-10,37]. Nevertheless, dislocation continues to be among the most common complications of THA [5,6]. Although much of the literature has focused on head sizes less than 36 mm, the impact of larger femoral head sizes on early dislocation remains relatively unknown, with some authors suggesting that there is little benefit to femoral head sizes greater than 36 mm in diameter [11-17,31,38-49]. We performed a retrospective review of patients at high risk for dislocation after primary THA and found a lower rate of dislocation, recurrent dislocation, and revision for dislocation in patients where an anatomically sized femoral head was used compared to patients where a 36-mm diameter head was used.

This study has a number of limitations that are important to keep in mind when interpreting our results. First, our study is retrospective and, as such, is open to inherent biases as evidenced by the demographic differences between groups. However, if any bias existed, the surgeon who performed the procedures tended to use the anatomic head sizes in patients felt to be at highest risk for instability, which would have favored the 36-mm group. Nonetheless, a randomized controlled trial may be better suited to definitely answer the questions we posed. In addition, we did not perform any radiographic assessment of component positioning. As component malpositioning has been shown to be an important risk factor for dislocation, this opens the possibility of component malpositioning as a potential confounder of our findings; however, as all of the procedures were done by the same surgeon, it is unlikely that component positioning differed drastically between the 2 groups. Furthermore, our follow-up was short, and the dislocation rates for both groups may have been higher if follow-up was longer. Nonetheless, we feel that our data are valid as most dislocations occur within