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Low Early and Late Dislocation Rates with 36- and 40-mm Heads in Patients at High Risk for Dislocation

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Abstract

Background Large (36- and 40-mm) femoral heads with highly crosslinked polyethylene liners were introduced to reduce the risk of dislocation after primary total hip arthroplasty (THA), but it is unclear whether the risk is reduced and whether there is osteolysis or liner fracture.

Questions/Purposes We therefore determined (1) the incidence of early and late (> 5 years) dislocation; (2) the rate of femoral and acetabular component loosening and revision; and (3) the rate of liner fracture and pelvic osteolysis.

Methods We retrospectively reviewed 112 patients presumed at high risk for dislocation who had 122 primary THAs: 108 with 36-mm and 14 with 40-mm femoral heads. The risk factors were: age > 75 years (80 hips); proximal femur fracture (18); history of contralateral dislocation (two); history of alcohol abuse (two); large acetabulum > 60 mm (six); and other (14). Patients were evaluated for early (< 1 year) and late (> 5 years) dislocation; rate of reoperation; clinical result with Harris hip score; and standard radiographic analysis for radiolucent lines and osteolysis.

Results The rate of early dislocation was 4% (five of 122 hips), all with a 36-mm head. There were no late dislocations in 74 hips followed for 5 to 10 years, no revision for acetabular or femoral loosening, and no liner fractured. There were no hips with pelvic osteolysis and seven hips with an acetabular radiolucent line.

Conclusions The 36- and 40-mm femoral heads were associated with a low risk of dislocation in high-risk patients undergoing primary THA with no osteolysis or liner fracture.

Level of Evidence Level IV, therapeutic study. See the Guidelines for Authors for a complete description of level of evidence.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Introduction

Early dislocation remains a serious and frequent complication after primary THA. One study reported that hip instability was the single most common cause of revision [1]. In addition, late dislocation, occurring many years after THA, is also an increasing problem with a multifactorial etiology, including acetabular component loosening, polyethylene wear, and patient-related factors [22]. One strategy to reduce the risk of early dislocation is the use of large femoral heads, either with a metal-on-metal articulation [15, 19] or a metal-on-highly crosslinked polyethylene [9, 14, 20]. In vitro, femoral head sizes greater than 32 mm provide for a greater ROM and a greater jump distance and thus theoretically decrease the risk of dislocation [3–5]. With at least one type of highly crosslinked polyethylene, the linear wear of these larger femoral heads was similar to that with standard sized heads [2, 7]. However, one study suggested there was increased volumetric wear at 5 years with 36- and 40-mm femoral heads [12]. The implication of greater volumetric wear may be an increased rate of osteolysis and acetabular component loosening with these larger heads. In addition, fracture of the rim of highly crosslinked polyethylene liners articulating with these large heads has been reported with malposition of the acetabular component [5, 21].

We previously reported the clinical results of early dislocation (minimum 1-year followup) of a small series of 65 hips with 36- or 40-mm femoral heads in 61 patients considered at high risk for dislocation [14]. Three hips (4.6%) had at least one early dislocation. However, the mean followup time was only 2 years, certainly not long enough to determine if component loosening or osteolysis was associated with these larger heads.

We therefore asked the following questions: (1) What is the incidence of early (within 1 year) and late (after minimum 5 years) dislocation using 36- and 40-mm heads in patients at high risk for dislocation? (2) What is the risk of revision for recurrent dislocation or acetabular component loosening? (3) What is the rate of liner fracture, acetabular radiolucent lines, and pelvic osteolysis?

Patients and Methods

We prospectively followed all 112 patients (122 hips) considered at high risk of dislocation treated with large heads between September 2001 and July 1, 2006. Of this cohort, 65 hips in 61 patients have been previously reported in a study of early dislocation [14]. The indications for the use of 36- and 40-mm femoral heads in primary THA were in patients considered at high risk for dislocation [11, 13–15, 18]: patient age 75 years or older (80 hips); preoperative diagnosis of acute femoral neck fracture or proximal femur fracture nonunion (18 hips); history of alcohol abuse (two hips); history of dislocation of a contralateral hip (two hips); use of an extra large acetabular component, $\geq$ 62 mm in women and $\geq$ 66 mm in men (six hips); and a chronic neurologic disorder or severe visual problems (14 hips). In addition, the implanted acetabular component required a minimum outer diameter of 50 mm or larger to accept a 36-mm liner and 58 mm or larger to accept a 40-mm liner. All other patients who did not meet these criteria received a 26-, 28-, or 32-mm femoral head based on the graduated acetabular-femoral head sizing system previously reported [10]. Within the time period of the study, a total of 293 primary THAs were performed and thus 42% (122 hips) had a large head. Of the initial cohort of 112 patients (122 hips), there were 77 female patients (83 hips) and 35 male patients (39 hips). The mean patient age was 78 years (range, 44–98 years). The mean patient weight was 75 kg (range, 41–121 kg) and the mean patient body mass index was 28 kg/m^2 (range, 17–42 kg/m^2). In 108 hips, a 36-mm femoral head was implanted (97 standard and 11 elevated rim liners), and in 14 hips, a 40-mm femoral head was implanted (three standard and 11 elevated rim liners). Of the initial cohort of 112 patients, six (six hips) died and one (one hip) refused to return before 1-year followup. None of these patients was known to have had a dislocation at last followup. In 2011 and 2012, for the purpose of this study, we attempted to recall for examination and radiographs, or contact by telephone, all patients who could have a minimum followup of 5 years. Nineteen patients (20 hips) had died between 1.5 and 4 years followup. Of the 22 patients (22 hips) lost to followup between 1 and 4 years, we had telephone followup only on 12 patients (12 hips) and the telephone had been disconnected for 10 patients (10 hips).

For the incidence of late (defined as > 5 years) dislocation, component loosening, osteolysis, and revision, there were 74 remaining hips in 65 patients with complete clinical and radiographic followup. In this cohort, there were 46 hips in 40 female patients and 28 hips in 25 male patients. The mean patient age was 76 years (range, 44–92 years). The mean patient weight was 78 kg (range, 45–121 kg) and the mean body mass index was 28 kg/m^2 (range, 17–42 kg/m^2). The minimum followup for this cohort was 5 years (mean, 6.5 years; range, 5–10 years). The preoperative diagnosis was osteoarthritis for 53 hips, osteonecrosis in five, rheumatoid arthritis in two, and fracture-related diagnoses in 14 hips. The femoral head was 36 mm in 65 hips (58 standard and seven elevated rim liners) and 40 mm in nine hips (two standard and seven elevated rim liners). The mean acetabular abduction angle was 42.6° (range, 29°–57°). The acetabular anteversion angle was not measured.

The senior author (PFL) performed all 122 primary THAs using an uncemented porous-coated acetabular component with screw fixation (Trilogy multihole; Zimmer, Warsaw, IN, USA) and one electron-beam irradiated remelted highly crosslinked polyethylene liner (Longevity; Zimmer). All procedures were performed using the posterior approach with repair of the posterior capsule, external rotators, and gluteus maximus tendon with nonabsorbable sutures. At the time of trial reduction, all hips were stable through the ROM with flexion past 90° and internal rotation of at least 60°. No constrained liners were implanted for primary THA. There were 98 cemented and 24 uncemented femoral components implanted. The choice of 36-mm versus 40-mm liner was based on the size of the shell with 58-mm or larger required for a 40-mm liner. An elevated rim liner was used if there was a greater concern for dislocation. In addition, the manufacturer removed the 40-mm elevated rim liners from the market in October 2004.

Patients were mobilized on the first or second postoperative day and were allowed immediate full weightbearing with a walker or crutches recommended for 6 weeks. No formal physiotherapy was prescribed. Because the surgeon was confident in the stability of these larger heads, no postoperative precautions were given to these patients in terms of early or late bending or activities.

Patients were requested to return for examination and radiographs at 6 weeks, 6 months, 1 year, and annually (or biannually) to two outpatient facilities. The patients were clinically prospectively evaluated using the Harris hip score [8] by one experienced clinical research nurse. Standardized supine AP radiographs centered over the pubis and frog-lateral radiographs were performed at each followup visit by technicians specifically trained for these radiographs with similar patient and tube positioning. The radiographs were reviewed (by both authors at the same time) for radiolucent lines, pelvis osteolysis, and component shift or migration using the method described by Massin et al. [17]. Acetabular radiolucent line thickness and location were described using the method of DeLee and Charnley [6]. Pelvic osteolysis was described using the method of Maloney et al. [16]. Oblique pelvic radiographs and computerized axial tomography were not performed. All reoperations were noted, including revision for loosening, wear, and dislocation.

Results

During the period of observation, five hips (five patients [4%]) of the entire cohort of 122 hips with large femoral heads had at least one dislocation. All patients were women with a 36-mm head and all occurred during the first 12 weeks after surgery. Four were posterior and one was anterior. One patient (with osteoarthritis and a seizure disorder on medication) had two anterior dislocations at night in bed at 2 and 4 weeks, respectively. She was treated with a hip spica cast for 6 weeks and has not had a recurrence at 7 years followup. The second patient (with osteoarthritis and a gluteus medius tendon tear repaired at time of THA) had a posterior dislocation at 12 weeks during an exercise class and was treated in a hip spica cast for 6 weeks without recurrence. This patient died of a myocardial infarction after the 1-year followup. The third patient (with rheumatoid arthritis and osteonecrosis) had two posterior dislocations at 3 and 8 weeks after surgery. The latter was related to nonprescribed hip stretching by a physical therapist. A hip orthosis was worn for 6 weeks and there has not been a recurrence at 6 years followup. The fourth patient (with osteoarthritis) had two posterior dislocations: the first when she placed her foot to her head during a yoga exercise at 12 weeks and the second at 20 weeks. She wore a hip orthosis for 6 weeks and there was no recurrence at 7 years followup. The fifth patient (with femoral neck fracture) had a single posterior dislocation at 8 weeks. She wore a hip orthosis for 6 weeks and there was no recurrence at 6 years followup. The mean abduction angle for these five patients was 42° (range, 40°–45°). There has been no reoperation or late dislocation in the four living patients. There was no late first dislocation in the 74 hips (65 patients) with minimum 5 years followup.

There have been no revisions for component loosening, wear, or dislocation. There were two patients who had a reoperation for open reduction and plating of a femur fracture distal to a cemented femoral component after a fall. One of these patients required a second plating and bone grafting to obtain union. The mean preoperative Harris hip score for the minimum 5-year followup cohort was 48 points (range, 0–76 points) and the mean postoperative score was 86 points (range, 65–100 points) at the most recent followup.

No patient had obvious liner fracture or dislodgement. There was no pelvic osteolysis or radiographic loosening of the acetabular or femoral components. Acetabular radiolucent lines were seen in seven hips (9%) with six hips having a less than 1-mm radiolucent line in one zone, and one hip had a nonprogressive radiolucent line in two zones measuring 1 to 2 mm. There were no radiolucent lines around the screws.

Discussion

Dislocation remains a serious and frequent problem after primary THA and the most frequent single cause for revision. The etiology of dislocation is multifactorial and includes surgeon experience, surgical approach, patient factors, and femoral head size [9–11, 13, 18, 20]. Large (36- and 40-mm) femoral heads articulating with highly crosslinked polyethylene were introduced to reduce the incidence of dislocation after primary THA, but the results at > 5 years are not known. In our previous report of 65 hips (61 patients) with large heads, there were three (4.6%) dislocations with a minimum followup of 1 year [14]. We asked the following questions: (1) What is the incidence of early (within 1 year) and late (after minimum 5 years) dislocation using 36- and 40-mm heads in patients at high risk for dislocation? (2) What is the risk of revision for recurrent dislocation or acetabular component loosening? (3) What is the rate of liner fracture, acetabular radiolucent lines, and pelvic osteolysis?

This study has several limitations. First, we had no control group of similar patients at high risk for dislocation with 28- and 32-mm femoral heads. However, our previous studies have shown higher rates of dislocation of 6% to 23% with standard head sizes [10, 13, 18]. Second, the definition of patients at high risk for dislocation is somewhat subjective. However, our definition was similar to that published in other studies [11, 15, 19, 20]. Third, there were large numbers of patients who died, were lost, or refused to return for followup after a minimum of 5 years. However, this is to be expected considering the mean age and diagnoses of these patients presumably at high risk. Fourth, we did not perform oblique pelvic radiographs or computerized axial tomography and the rate of pelvic osteolysis might be underestimated. Fifth, we did not perform cross-table lateral radiographs to measure acetabular anteversion angle nor did we measure femoral offset or leg lengths and it is possible that these factors were related to the five dislocations. Sixth, we had a single observation of our radiographic findings and had no way to assess the reliability of our findings. A final limitation is that we did not perform polyethylene wear measurements on this cohort, because that was beyond the scope of this study. However, we have previously reported a study of linear and volumetric wear of this highly crosslinked polyethylene with a variety of head sizes including a small cohort of 36- and 40-mm heads [12].

One strategy that surgeons have used to decrease the incidence of dislocation in high-risk patients has been the use of large-diameter metal-on-metal bearing THA. Sykes et al. [20] reported no dislocation with a minimum followup time of 24 months in 52 hips (41 patients) using 38- to 54-mm diameter metal heads. Thirty-two hips (27 patients [61%]) were placed in patients considered at high risk for dislocation. Peters et al. [19] reported two dislocations in 469 hips (469 patients [0.4%]) with a metal-on-metal hip with femoral heads measuring 38 to 56 mm. However, in another part of that study, these authors reported no difference in the incidence of dislocation comparing 136 patients with a 38-mm metal-on-metal hip (no dislocations) with 160 patients with a 28-mm metal-on-polyethylene hip (four dislocations [2.5%]) [19]. These patients were not selected for their risk of dislocation. Lombardi et al. [15] reported one dislocation (0.05%) in a retrospective review of 2020 large (> 36 mm) femoral heads, of which 1635 were metal on metal, 337 were metal on polyethylene, and 48 were ceramic on polyethylene. However, only 379 (18.8%) of these hips were deemed at high risk for dislocation and a minimum followup time of 1 year was available for only 1469 hips (73%). There was one revision for dislocation and 65 hips (3.2%) underwent revision, predominantly for aseptic loosening of the metal acetabular component or metal-related complications [15].

In patients we considered at high risk for dislocation, 4% of patients had dislocation at 1-year minimum followup, no late first dislocations, no late recurrences in the four living patients who had experienced early dislocation in the first year after surgery, and no revisions for component loosening or wear using this acetabular component with screw fixation and one type of highly crosslinked polyethylene. We have previously reported increased volumetric wear in a small cohort of 36- and 40-mm femoral heads compared with 26-, 28-, and 32-mm heads using the same highly crosslinked polyethylene [12]. This greater volumetric wear could be implicated in a higher rate of pelvic osteolysis, radiolucent lines, and component loosening. However, we did not have any hip with pelvic osteolysis or component loosening. The followup time may still be too short to see these potential complications from the use of large femoral heads articulating with this highly crosslinked polyethylene and we continue to recommend biannual followup to these patients.

The senior author continues to use this acetabular component with screw fixation and, until further long-term data are available, restricts the use of 36- and 40-mm heads to those patients who are considered at high risk for dislocation.

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