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Alumina Delta-on-Alumina Delta Bearing in Cementless Total Hip Arthroplasty in Patients Aged <50 Years

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ABSTRACT

Background: There are limited studies to evaluate long-term clinical and radiographic outcomes of alumina delta ceramic-on-ceramic bearings in cementless total hip arthroplasty (THA). The purpose of this study was to evaluate the clinical and radiographic results, prevalence of osteolysis, squeaking, and fracture of ceramic material associated with the use of the alumina delta ceramic-on-alumina delta ceramic bearing in cementless THA in patients aged <50 years.

Methods: We reviewed the cases of 277 patients (334 hips) who underwent a cementless THA using alumina delta ceramic-on-alumina delta ceramic when they were 50 years or younger at the time of surgery. Demographic data; Harris Hip Score; Western Ontario McMaster Universities Osteoarthritis Index; and University of California, Los Angeles activity score were recorded. Radiographic and computerized tomographic evaluations were used to evaluate implant fixation and osteolysis. Squeaking sound and ceramic fracture were documented. The mean follow-up was 13.1 years (range, 10–14).

Results: The mean postoperative Harris Hip Score, Western Ontario McMaster Universities Osteoarthritis Index score, University of California, Los Angeles activity score were 93 points, 15 points, and 8.6 points, respectively. Two patients had thigh pain (grade 7 points). All acetabular components and all but 2 femoral components were well fixed. Thirty-three hips (10%) exhibited clicking sound, and 2 hips (0.6%) exhibited squeaking sound. No hip had osteolysis or ceramic head or liner fracture.

Conclusion: Our minimum 10-year follow-up results with the use of alumina delta ceramic-on-alumina delta ceramic bearings in patients aged <50 years suggest that cementless THA provides a high rate of survivorship without evidence of osteolysis or fracture of ceramic material.

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Although total hip arthroplasties (THAs) have provided durable long-term results, periprosthetic osteolysis related to particulate polyethylene wear debris is considered an important cause of aseptic loosening and late implant failure [1,2]. Concern regarding development of osteolysis attributable to polyethylene wear, particularly in young patients, prompted the introduction of ceramic-on-ceramic bearings to prevent or minimize wear-related osteolysis. Furthermore, to combat the problem of hip instability in THA, larger diameter ceramic, metal, or highly cross-linked polyethylene femoral heads were transitioned [3–7].

Recent studies of the alumina forte ceramic-on-alumina forte ceramic bearings with smaller femoral heads (28 or 32 mm) found little or no osteolysis [8–13]. Concerns with alumina forte ceramic bearing remain, including ceramic head [14–16] and, more significantly, liner fracture [17–19]. Therefore, alumina delta ceramic-on-alumina delta ceramic (BILOX Delta; CeramTec AG, Plochingen, Germany) was developed to address some of the concerns raised with the alumina forte ceramic-on-alumina forte ceramic bearing. The material has a smaller grain size (<0.8 μm) compared with the grain size of alumina forte ceramic (1–5 μm). The mechanical properties of this combination result in a bearing that has improved toughness and wear characteristics when measured in a laboratory setting [20].

There are few studies of alumina delta ceramic-on-alumina delta ceramic bearing, but these are limited by small number of patients aged <50 years and short-term follow-up [18,21]. To our knowledge, there are limited studies to evaluate long-term clinical and radiographic outcomes of alumina delta ceramic-on-alumina

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delta ceramic bearings in cementless THA in large cohorts of patients of age <50 years.

The purpose of this study was to evaluate the clinical and radiographic outcomes associated with the use of the alumina delta ceramic-on-alumina delta ceramic bearing in cementless THA in patients aged <50 years. In addition, we determined the prevalence of osteolysis, squeaking, and fracture of ceramic femoral head or acetabular ceramic liner.

Materials and Methods

A consecutive 313 patients (384 hips) underwent THAs from October 2001 to October 2004. Of these, 286 patients (347 hips) met the inclusion criteria and were recruited to participate in the study. All operations were performed by the senior surgeon. The indications for surgery were hip diseases that were severe enough to warrant THA after an adequate trial of nonoperative therapy. Twenty-five patients (34 hips) were excluded because they were older than 50 years (the age limit was chosen arbitrarily), one patient (2 hips) was excluded because the patient had a foot or ankle disorder that limited walking, and one patient (one hip) was excluded because the patient had marked proximal femoral deformity. Contraindications for this ultrashort cementless stem were the patients with high dislocation of the femoral head, severe osteoporosis, or intertrochanteric fracture. The study protocol, including the consent form, was approved by the institutional review board at our institution. A detailed informed consent form was signed by each patient. Nine patients were lost to follow-up, leaving 277 patients (334 hips) available for study with a minimum duration of follow-up of 10 years (mean, 13.1 years; range, 10–14 years; Fig. 1).

There were 143 men and 134 women with a mean age (standard deviation) of 48.2 (11.3) years (range, 21–49 years) at the time of surgery. The mean height (standard deviation) was 165.7 (10.2) cm (range, 157–186 cm), and the mean body weight (standard deviation) was 78 (9.7) kg (range, 68–121 kg). The mean body mass index (standard deviation) was 28.9 (10.1) kg/m² (range, 27.2–34.6 kg/m²). The diagnosis was osteonecrosis of the femoral head in 124 patients (45%), osteoarthritis secondary to developmental dysplastic hip in 115 (42%), osteoarthritis secondary to childhood pyogenic arthritis in 15 (5%), traumatic arthritis in 13 (5%), femoral neck fracture in 6 (2%), and rheumatoid arthritis in 4 (1%; Table 1). On the contrary to westerners, the predominant diagnosis was osteonecrosis related to excessive alcohol consumption and very low incidence of osteoarthritis of the hip joint in the current patient cohorts.

All operations were performed by the senior author using a posterolateral approach. The ultrashort anatomic cementless stem (Proxima; DePuy, Leeds, United Kingdom) was used in all hips. The ultrashort anatomic cementless stem is made of titanium alloy and is entirely porous-coated with sintered titanium beads having a mean pore size of 250 μm, to which a 30-μm-thick hydroxyapatite coating is applied, except at the distal tip. The femoral neck was cut horizontally at the head-neck juncture. The broach was inserted into the divided femoral neck and driven distally in a varus direction by hammer blows and then steadily tilted in the correct alignment while advancing into the femoral metaphysis. We refer to this technique as the “round-the-corner” technique [22–25]. The size of the femoral component was selected not by a canal fill but by the torsional stability of the stem as dictated by bone quality. The real component was 0.5 mm larger than that of the prepared metaphysis. We used a 36-mm-diameter Biolox delta ceramic liner when a cup size was >52 mm, and a 32-mm Biolox delta ceramic liner was used when a cup size was <52 mm. A 36-mm-diameter Biolox delta ceramic femoral head (CeramTec) was used in 283 hips

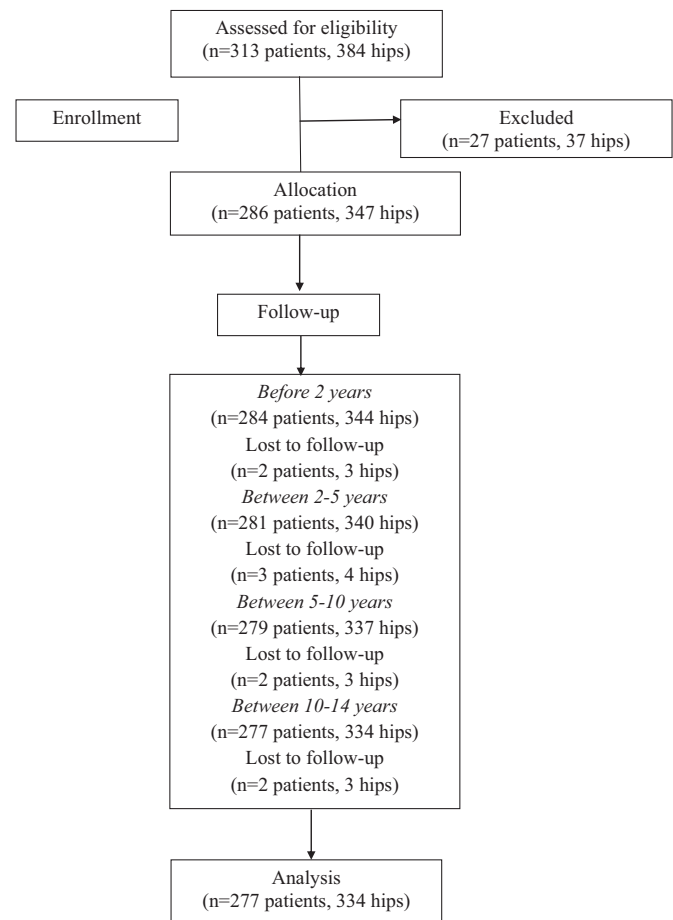


Fig. 1. CONSORT flow diagram.

(85%), and a 32-mm-diameter Biolox delta ceramic femoral head was used in the remaining 51 hips (15%). A cementless Pinnacle cup (DePuy, Warsaw, IN) and a 36-mm-internal-diameter Biolox delta ceramic liner were used in 283 hips (85%), and a 32-mm-internal-diameter Biolox delta ceramic liner was used in the remaining 51 hips (15%). In 304 hips (91%), the solid acetabular component was fixed with use of a press-fit technique only; in the remaining 30 hips (9%), 1 or 2 screws were inserted for fixation of the cups via the screw holes.

Table 1
Demographic Data of Patients.

Number of Patients (Hips)	277 (334)
Male:female	143:134
Mean age (range, SD), y	48.2 (21–49, 11.3)
Mean weight (range, SD), kg	78 (68–121, 9.7)
Mean height (range, SD), cm	165.7 (157–186, 10.2)
Mean BMI (kg/m ²)	28.9 (27.2–34.6, 10.1)
Diagnosis, n (%)	
Osteonecrosis	124 (45)
Ethanol associated	69 (56)
Idiopathic steroid use	44 (35)
Osteoarthritis secondary to developmental dysplastic hip	115 (42)
Osteoarthritis secondary to childhood pyogenic arthritis	15 (5)
Traumatic arthritis	13 (5)
Femoral neck fracture	6 (2)
Rheumatoid arthritis	4 (1)
Duration of follow-up (y)	13.1 (10–14)

SD, standard deviation; BMI, body mass index.

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