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## Increase in Benign Squeaking Rate at Five-Year Follow-Up: Results of a Large Diameter Ceramic-on-Ceramic Bearing in Total Hip Arthroplasty

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## ABSTRACT

**Background:** Squeaking is an on-going complication with a variable incidence of 0.5%–20.7%. The mechanism of squeaking has not been understood completely and is most likely multifactorial in nature. Previously, we have reported on a squeaking rate of 7.3% at 2 years. Our current results show a substantial increase in the squeaking incidence from 7.3% to 17.4% with the DeltaMotion articulation at the 5-year follow-up.

**Methods:** Two hundred six total hip arthroplasties with a large ceramic-on-ceramic bearing were performed on 195 patients by 2 senior authors. The minimum duration of follow-up was 5 years (range 5–6.2).

**Results:** The mean Harris Hip Score remained stable at 91.7 at 5 years compared to 92 after 2 years. However, we observed an increase in the squeaking rate from 7.3% after 2 years to 17.4% after 5 years. As in previous studies, we did not find significant differences between the silent and squeaking group in relation to age, height, weight, and femoral head diameter. In contrast, others reported no significant differences regarding range of motion and gender between the silent and the squeaking hip group at 2 years of follow-up, whereas at 5 years, the squeaking group showed a significantly higher combined range of motion and a higher relative risk of squeaking in women compared to the silent group.

**Conclusion:** While large diameter ceramic bearings may produce squeaking, especially in female patients, our mid-term clinical results of a large ceramic-on-ceramic bearing in total hip arthroplasty are encouraging. Nevertheless, long-term follow-up is recommended.

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Total hip arthroplasty (THA) is one of the most successful and frequent orthopedic procedures [1]. Low implant survival rates are determined mainly by early dislocation or late aseptic loosening and osteolysis [2–4]. In order to reduce these 2 causes of the need for revision, alternatives to the traditional metal-on-polyethylene bearings have been developed.

Ceramic-on-ceramic bearings (CoC) can be manufactured in large diameters and result in the lowest wear rate of any bearing

combination, thus addressing the 2 main causes of hip revision. However, squeaking seems to be an ongoing complication with a variable incidence of 0.5%–20.8% [5–7], and it occurs typically 6 months to 2 years after the index surgery [6–9]. Numerous studies investigated the cause of squeaking and concluded that squeaking is multifactorial in nature.

The DeltaMotion Hip System (DM) (DePuy Synthes, Warsaw, IN) is the first large-diameter preassembled fourth generation CeramTec BIOLOX delta ceramic liner and provides a bearing diameter close to the native femoral head.

Tai et al [10] reported on the short-term results of this cohort and observed a 7.3% squeaking rate 2 years postoperatively. McDonnell et al [11] investigated the same articulation bearing, but reported on an overall squeaking incidence of 20.7%. The aim of this study is to report the mid-term clinical and radiological results of the DM and to analyze whether the squeaking rate has or has not changed over time in our cohort.

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**Table 1**  
Patient's Demographics and Comparison of Clinical Results at 2 and 5 Years.

Criteria	2 Years	Interim Period Change	5 Years
Hips	206		206
Patients	195		195
Gender			
Male	77		77
Female	118		118
Mean age at surgery (y) (range)	69 (38.1-93)		69 (38.1-93)
Lost to follow-up	9 (5.1%)	+6 (2.2%)	15 (7.3%)
Deceased	8 (3.9%)	+22 (10.7%)	30 (14.6%)
Postoperative HHS	92 (44-100)	-0.3	91.7 (27-100)
"Excellent and good"	92.3%	-0.1%	92.2%
Revised	3	1	4
Squeaking hips	15 (7.3%)	+13	28 (17.4%)
Gender (female:male)	10:5	8:5	18:10
Head size (mm)			
36			1 (7.7%)
40			17 (24.6%)
44			11 (20.8%)
48			6 (23.1%)
Differences (squeaking hip > silent hip)			
Combined ROM	No differences		<i>P</i> = .007
Flexion	No differences		<i>P</i> = .004
Internal rotation	No differences		<i>P</i> = .041
Adduction	No differences		<i>P</i> = .025
Inside Lewinneck's safe zone	155 cups with 8 squeaking hips (5.2%)		113 cups with 26 squeaking hips (23%)
Outside Lewinneck's safe zone	51 cups with 7 squeakers (13.7%)		48 cups with 9 squeakers (18.8%)

No significant differences with regard to age, gender, weight, height, BMI, median head size, and cup alignment. BMI, body mass index.

## Patients and Methods

Between December 2008 and December 2009, a total of 206 primary cementless THAs were performed on 195 patients using a preassembled DM [12] and a Secur-Fit stem (Stryker, Kalamazoo, MI). All procedures were performed by the 2 senior authors (blinded) at one institution. Table 1 summarizes the patients' demographics. Primary osteoarthritis (98.1%) was the most common indication for surgery in our patients. Informed consent of all patients and approval from the hospital ethics committee were obtained.

### Operative Technique

All hips were approached posteriorly with the patient in a lateral decubitus position. All implants were inserted by means of a press-fit technique. The size of the cup determined the size of the femoral head. A 32-mm femoral head matches a 42 and 44 mm cup, a 36 mm head fits a 46 and 48 mm cup, a 40-mm femoral head matches a 50 and 52 mm cup, a 44 mm head fits a 54 and 56 mm cup, and a 48 mm head matches a 56 mm cup and larger. Following implantation, the capsule and short external rotators were routinely repaired.

The patients' demographic data were collected preoperatively (Table 1) and postoperatively at 6 weeks, 6 months, 2 years, and 5 years. At 2 and 5 years of follow-up, the clinical assessment included the Harris hip score (HHS), University of California, Los Angeles activity score (UCLA), the Oxford Hip Score, as well as range of motion (ROM).

Standardized anteroposterior X-rays of the pelvis and lateral radiographs of the hip were taken each time. The radiographs were evaluated by a blinded author who was not involved in any of the operations. The inclination and the anteversion of the cup was evaluated by Lewinneck's method [13], on a standard anteroposterior X-ray of the pelvis with respect to Murray's radiographic definition [14]. If a computed tomography scan of the pelvis was available, the anatomical anteversion and radiographic inclination were measured [15]. The occurrence of osteolysis and

radiolucent lines was recorded as per the 7 zones of Gruen et al [16], and the 3 zones of DeLee and Charnley [17], heterotopic ossification was recorded according to the Brooker classification. Stress shielding was assessed by comparing the periprosthetic bone density with the contralateral femoral side. Migration of the cup was evaluated by comparing the cup alignment to previous X-rays. Kaplan-Meier estimation for all components was calculated. The revision for any reason was taken as the endpoint of the term of survival of the implant.

The unpaired 2-tailed Student's t-test was used to analyze the statistical significance between 2 groups. Statistical significance was considered at  $P \leq .05$ .

## Results

One hundred fifty-one patients (161 hips, 78.2%) were available for clinical review 5 years after surgery (range 5-6.2). Thirty patients (14.6%) were deceased, deaths unrelated to the surgery, and 15 patients (7.7%) could not be tracked down for follow-up (Table 1). Patients where follow-up could not be performed were cross-checked with the Australian National Joint Replacement Registry and none required revision.

The postoperative average HHS improved from preoperative average score of 54 (16-95) to 92 (44-100) at the 2-year follow-up and slightly decreased to 91.7 (27-100) at the 5-year follow-up. At 5 years, 92.5% (149 patients) had a good or excellent HHS that is consistent with the 2 years of follow-up. Ninety-three percent had none or mild postoperative thigh or groin pain. The median implanted cup size was 52 mm (range 42-64) and the median head size was 40 mm (range 32-48).

The mean radiographic inclination of the cup was 45.6° (range 26.69°-65.39°) and the mean radiographic anteversion of the cup was 21.6° (range 6.4°-36.4°).

### Radiographic Evaluation

There were 111 hips available for radiographic assessment including all patients who reported squeaking. Forty-six patients of

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