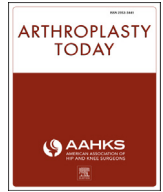




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## Original research

## Ceramic-on-ceramic bearings total hip arthroplasty in young patients

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## ABSTRACT

**Background:** The results of ceramic-on-ceramic (CoC) total hip arthroplasty (THA) in younger patients were not univocal. This study aims to evaluate the results of CoC bearing THA in patients younger than 50 years.

**Methods:** A total of 90 younger patients performed CoC THAs during March 2003 and May 2008 were included in this study. Hip function and activity were evaluated with Harris hip score and University of California Los Angeles activity score. We had discussed survival rates, radiological findings of component loosening or osteolysis, and ceramic-related complications in these patients.

**Results:** The mean Harris hip score increased from  $46.3 \pm 12.0$  points (range, 28–70 points) before surgery to  $92.5 \pm 5.6$  points (range, 78–100 points) at the final follow-up. The mean preoperative University of California Los Angeles activity score was  $4.2 \pm 1.1$  points (range, 2–6 points), which improved to a mean of  $7.2 \pm 1.3$  points (range, 4–10 points). At the time of the last follow-up, there was found to be 1 occurrence of hip dislocation, 1 squeaking, and 2 “sandwich” ceramic liners fractured during normal activity of daily living. No hips showed osteolysis or required revision for aseptic loosening. Kaplan-Meier survivorship with revision due to loosening or osteolysis was 100% and with revision due to ceramic fracture was 97.3% (95% confidence interval, 93.7%–100%) at a mean of 9.4 years.

**Conclusions:** This study with the use of CoC bearings THAs in younger patients have shown promising results and higher rate of survivorship without evidence of osteolysis.

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## Introduction

Total hip arthroplasty (THA) is among the most successful surgical operations because it relieves pain and restores hip function and mobility for various end-stage degenerative conditions of the hip joint [1,2]. Although THA was initially designed for elderly low-demanding patients, the benefit of this procedure in younger populations has also been well documented; thus, long-term results have increasingly improved over the last decades [3–5]. However, the consequences of bearing surface wear, including osteolysis and aseptic loosening, have been a leading reason of late revision THA, especially in younger and more active patients. Therefore, extended longevity of bearing can meet the increasing demand among

younger and more active patients requiring hip replacement; such demand is increasingly becoming an important issue.

Hard-on-hard bearing couples, including metal-on-metal (MoM) and ceramic-on-ceramic (CoC), which are regarded as the optimal choice for the younger and more active patients [6–8], offer the potential to decrease the prevalence of revision THA caused by bearing surface-related failures. However, concerns on the use of MoM bearings exist because they are associated with elevated metal ion levels and adverse local tissue reactions [9]. Conversely, the advantage of CoC bearing is not only the complete avoidance of metal debris but also the reduced risk of wear-induced osteolysis over ultrahigh molecular weight polyethylene. Many studies have reported that the long-term clinical and radiographic results of CoC bearings were promising. However, the long-term results of CoC THAs in younger patients have not been univocal [10,11]. Therefore, the purposes of this study were to summarize the following: (1) the clinical results with CoC cementless THA in younger and more active patients; (2) the survival rate of the CoC bearing THAs; and (3) the results of the activity level, work experience, and career choice.

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## Material and methods

We retrospectively reviewed the medical records of patients who underwent THA from March 2003 to March 2008. Inclusion criteria consisted of patients aged <50 years undergoing primary THAs without cement. A total of 100 primary THAs performed in 93 patients qualified for this study. Of these, 3 patients (3 hips) were lost to follow-up. The remaining 90 patients (97 hips) were available for a complete analysis. The mean patient age at surgery was  $39.0 \pm 8.2$  years (range, 19–50 years old). Forty (44.4%) patients were male and 50 (55.6%) were female. The mean body weight (and standard deviation) was  $64.5 \pm 9.9$  kg (range, 40–89 kg), and the mean body mass index was  $23.25 \pm 2.95$  kg/m<sup>2</sup> (range, 16.65–30.44 kg/m<sup>2</sup>). The preoperative diagnostic reasons were avascular necrosis of femoral head in 36 hips, developmental dysplasia of the hip in 23 hips, ankylosing spondylitis in 5 hips, posttraumatic arthritis in 6 hips, primary degenerative arthritis in 15 hips, femoral neck fracture in 7 hips, and rheumatologic disease in 5 hips (Table 1). This study was approved by our institute's ethics committee.

All recorded cementless THAs were performed by the same surgeon through a modified Harding approach. The acetabular component were the SPH Contact acetabular component (Lima-Lto, Italy; n = 57) or Duraloc (DePuy, Warsaw, IN, USA; n = 40). The acetabular cup was fixed with an inclination angle at 40°–45° and anteversion at 15°–25° after the acetabular had been reamed. On the femoral side, the femoral components were the C2 stem (Lima-LTO, Italy) or Corail stem (DePuy) in 57 and 40 hips, respectively. Sizes of femoral heads were 28 mm in all hips. The third-generation CoC bearing THAs, including the “sandwich” (Lima-Lto) and the BIOLOX Forte ceramic (BioloX Forte, CeramTec, Germany), were 57 and 40 hips, respectively.

The patients received antibiotic prophylaxis at 0.5 hours before surgery and continued for 48 hours after surgery. Patients were instructed to walk with crutches for toe-touch partial weight bearing for 3 weeks after surgery, except for developmental dysplasia of the hip patients who had femoral shortening osteotomy. Afterward, they were allowed to bear their weight as tolerated using 2 crutches for the next 4–6 weeks.

Clinical and radiographic evaluations were performed at 6 weeks, 3 and 6 months, and 1 year after surgery and annually thereafter. Patients were clinically evaluated for pain, walking, and range of motion using the Harris hip scores (HHSs) system [12]. The level of activity of the patients after THA was assessed with the University of California Los Angeles (UCLA) activity score [13] and Devane activity level scale [14]. Job and occupational choice was assessed by a questionnaire [15] (Table 2).

Radiographic postoperative evaluation consisted of anteroposterior and lateral views of the hip and pelvis and a true lateral view of the hip for cup position, osteolysis, implant loosening, and

**Table 1**  
Demographic patient data and preoperative diagnosis for this study.

Characteristic	Number
Number of patients (hips)	90 (97)
Gender (male/female)	36/54
Age ( $\bar{x} \pm s$ , y)	$39.0 \pm 8.2$ (17–45)
Weight ( $\bar{x} \pm s$ , kg)	$64.5 \pm 9.9$ (40–89)
BMI ( $\bar{x} \pm s$ , kg/m <sup>2</sup> )	$23.25 \pm 2.95$ (16.65–30.44)
Preoperative diagnosis (number of patients/hips)	
Avascular necrosis of femoral head	33/36
DDH	21/23
Posttraumatic arthritis	6/6
Ankylosing spondylitis	4/5
Femoral neck fracture	7/7
Primary degenerative arthritis	15/15
Rheumatoid arthritis	4/5

DDH, developmental dysplasia of the hip.

**Table 2**  
A questionnaire regarding job and occupation choice.

<p>AQ1 What was your occupation before THA?  Student ( ) Housewife ( ) Sales marketing or service worker ( ) Factory worker ( ) Farmer, fisherman, or Construction worker ( ) Other ( )</p> <p>AQ2 Did you change your job after THA? YES ( ) ; NO ( )</p> <p>AQ3 If you changed your job, what occupation did you choose after THA?  Student ( ) Housewife ( ) Sales marketing or service worker ( ) Factory worker ( ) Farmer, fisherman, or Construction worker ( ) Other ( )</p> <p>AQ4 When did you change your occupation? ( ) month(s) or ( ) year(s) after THA</p> <p>AQ5 What was the main reason for the change of occupation? Was it because of the THA you underwent?</p>
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ceramic fracture. Cup position was assessed according to the acetabular abduction angle and the anteversion angle on the picture archiving and communication system, digital radiograph system with use of the method of Murray [16] and Levinnek et al. [17]. Osteolysis was recorded at the acetabulum according to the zone described by DeLee and Charnley [18] and at the femoral component as described by Gruen et al. [19]. Loosening of the acetabular and femoral components was categorized according to previously accepted criteria [20,21]. Bony ingrowth was described according to the criteria of Engh et al. [21]. Heterotopic ossification was classified according to the system of Brooker et al. [22].

## Statistical methods

The statistical analysis was performed using the SPSS19.0 (Chicago, Illinois, USA) statistical software system. Survivorship analysis was performed with the Kaplan-Meier method. Revision for osteolysis and loosening was regarded as one end point, and revision due to ceramic fracture at the time of follow-up was regarded as another end point. We determined differences in continuous variances between the preoperative and postoperative scores using a *t*-test for independent samples. The level of significance was set at  $P < .05$ .

## Results

Ninety patients (100 hips) were available for analysis. The mean patient follow-up was  $9.4 \pm 1.6$  years (range, 7–12 years). All wounds healed uneventfully. No postoperative incisional infections and nerve and vascular injuries were observed. Two “sandwich” ceramic liners were fractured during normal activity of daily living after 7 and 9 years, respectively. One patient reported postoperative falling events at their bedside. A squeaking noise was heard in the left hip of a bilateral THA after 18 months, and it disappeared after 4 days. Acetabular abduction and anteversion were 37° and 17°, respectively. Heterotopic ossification developed in 10 hips by the time of the last follow-up. Six hips had grade I ossification, whereas 4 hips had grade II ossification.

A significant improvement in function was observed as measured with the HHS and UCLA scores. Mean preoperative HHS was  $46.3 \pm 12.0$  points (range, 28–70 points) and improved to  $92.5 \pm 5.6$  points (range, 78–100 points) at the final follow-up ( $P = .00 < .05$ ). Of the patients, 83 showed excellent results (80–100), whereas 7 had fair result (70–79). Mean preoperative UCLA scores were  $4.2 \pm 1.1$  points (range, 2–6 points) and this improved to  $7.2 \pm 1.3$  points (range, 4–10 points) at the last follow-up ( $P = .00 < .05$ ). According to the activity level scale of Devane et al., 13 patients were graded as level 5, 53 were graded as level 4, 20 were graded as level 3, and 4 were graded as level 2 in our series. About 95.6% of patients were able to participate regularly in leisure activities, such as gardening, swimming, and daily routines; 14.4% of them could perform strenuous manual labor. Eight patients had changed their work involving heavy labor before the operation to light manual work after it. Twelve patients

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