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Revision Rate and Patient-Reported Outcome After Hip Resurfacing Arthroplasty: A Concise Follow-Up of 1064 Cases

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ABSTRACT

We investigated survival and outcomes in 1064 HRA hips operated on between 1998 and 2009. After a mean of 7.8 years, 771 patients (72.4%) completed questionnaires, with a further 160 (15.0%) contacted by phone and 18 (1.7%) had died. There were 54 revisions. Overall implant survival at 10 years was 94.4%. Independent predictors of lower survival were female gender ($P = 0.015$) and cup inclination ≥55° ($P < 0.001$). Woman with cup inclination ≥55° had the highest failure rate with 10-year survival of 69.3%. Vertical cup inclination ≥55° did worse than cups <55° in both men and women. Overall men did better than women, and men with cups <55 degrees did best. Men had significantly better patient-reported outcome scores than woman.

Hip resurfacing arthroplasty (HRA) gained in popularity during the first decade of this century. Benefits such as low dislocation rates, femoral bone sparing, improved proprioception, and promising early clinical results have been reported [1–3]. HRA has been used particularly in younger and active patients, as conventional total hip arthroplasty (THA) has achieved inferior results in these patients, with shorter implant survival compared with the overall patient cohort [4]. While designer-based and single-surgeon series show good implant survival with HRA ranging from 93.5% to 97% at 10 years [5–7], arthroplasty registries indicate that HRA implants have higher overall failure rates versus conventional THA arthroplasty [4,8]. In the National Joint Registry of England, Wales and Northern Ireland, the cumulative probability of revision of HRA ranged from 5.0% to 13.7% after 5 years, and from 9.0% to 30.4% after 10 years [4,8]. In the Australian National Joint Replacement Registry, the revision rate of HRA for osteoarthritis was 9.5% after 10 years [4,8]. The risk factors for failure include patient-related, implant-related and surgeon-related factors, such as female gender, small implant size, implant design (small articulating arc) and increased cup inclination and anteversion [9–13]. Moreover, adverse events due to adverse reactions to metal debris (ARMD) [13], including potential soft tissue destruction, osteolysis and implant loosening, have been identified as a major reason for the increased failure rate [13,14]. These ARMD are caused by a local release of particles from metal-on-metal (MoM) bearings, and raise additional concerns about systemic toxicity and cancerogenicity due to the deposition of metal products [15,16].

While arthroplasty register data can help identify the risk factors for inferior survival rates, they do not provide information on patient-related outcomes. Several authors have postulated that HRA can achieve superior clinical function, gait kinematics and quality of life compared with conventional THA [17–22]. Most of the published investigations, however, analyze single surgeon series in selected patient groups with very short follow-up times. A recent meta-analysis underlined that potentially superior functional outcomes are largely seen in well-selected cohorts of young and active male patients [23]. To the best of our knowledge, no unselected large case series detailing patient-related outcomes over long-term follow-up has been published. We therefore evaluated implant survival, risk factors for failure, patient-reported outcomes and adverse events in a large single-center cohort.

Methods

The study protocol was approved by the local independent ethics committee. We reviewed the records of all 1064 patients who underwent HRA at our department between September 1998 and December 2009. Three different implants were used during the study period (Fig. 1): the Birmingham Hip Resurfacing system (BHR, Smith & Nephew, London, UK); the DUROM hip resurfacing system (Zimmer, Inc, Warsaw, USA); and the Articular Surface Replacement system (ASR, DePuy, Warsaw, USA). The BHR system was most frequently used (n = 712), followed by the DUROM (n = 322) and ASR (n = 30) systems.

The operations were performed by nine different surgeons, with the majority (70%) performed by two senior surgeons with special experience in HRA. A posterior approach was used in all cases. After dislocating the hip and removing any osteophytes, the minimum possible femoral head

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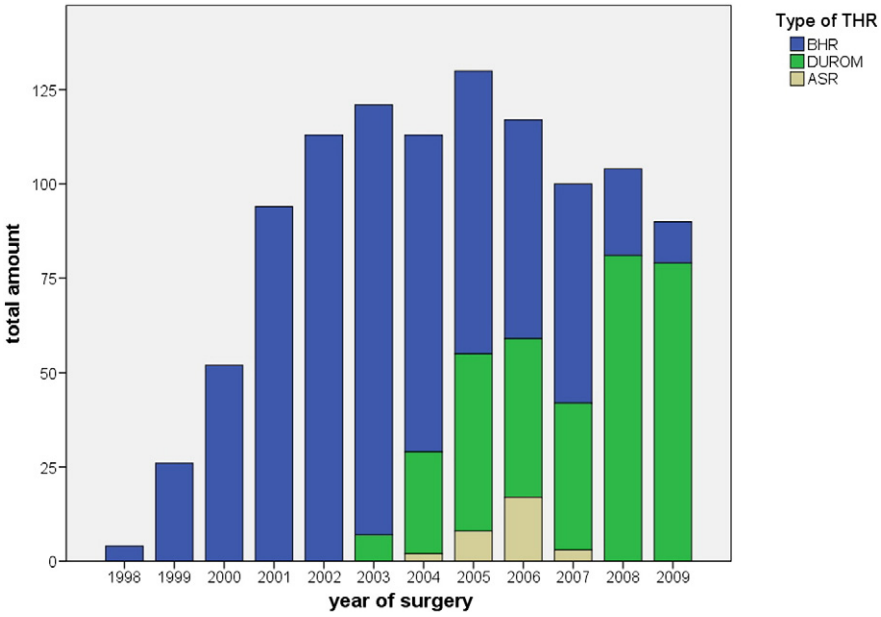

Fig. 1. Hip resurfacing arthroplasties per year and implant.

size was determined. The acetabulum was then reamed in 2 mm steps to the corresponding cup size and the cup implanted. After preparation of the femur, the head cap was cemented in line with the manufacturer's recommendations, using either high-viscosity bone cement (Palacos Bone Cement; Heraeus GmbH, Germany) for the ASR and DUROM systems or low-viscosity cement (Simplex; Howmedica International, Limerick, Ireland) for the BHR system. A bone marrow suction device was used to dry the femoral head. Finally, range of motion (ROM) and stability were checked before the wound was closed in stages. Postoperatively, patients were allowed pain-adjusted full weight-bearing from the first day and advised to use crutches for 4–6 weeks.

Patient and surgery associated data, including gender, age at surgery, body mass index (BMI), co-morbidities, surgical time, implant type and size, adverse events and details of revision surgeries, were obtained from hospital records. Cup inclination was measured on the latest available pelvic X-ray using published criteria. Implant size (<50 mm vs ≥50 mm) and cup inclination (<55° vs ≥55°), which are known risk factors for revision, were categorized [9–11,13,24,25].

In 2012 and 2013, a letter setting out the current evidence on HRA was sent to all 1064 patients. A questionnaire on revision surgeries, newly diagnosed diseases and pain was also included, alongside the Western Ontario and McMaster Universities Arthritis Index (WOMAC), the EuroQol (EQ) 5D score and the University of California Los Angeles (UCLA) activity score. All patients were offered a clinical follow-up visit. By December 2013, 771 questionnaires had been returned. The remaining patients were contacted by phone and asked to fill-in the questionnaire or give information on revision surgeries and complaints. This yielded information on a further 178 patients. By January 2014, heath status information was available for a total of 949 (89.2%) patients. Eighteen patients had died, 771 patients (72.4%) had answered the questionnaires and a further 160 (15.0%) gave information on the HRA, including 54 hips that had been revised (Fig. 2). Patients who were lost to follow-up were compared to the study group (Table 1). While they were slightly younger and had smaller implants, they were not significantly different from the study group (Table 1).

Statistical Analysis

Data description was based on means and standard deviation (SD) for continuous variables, and absolute and relative frequencies for categorical variables. The treatment groups were compared using the paired t-test and analysis of variance (more than two groups) for continuous variables, and the chi-square test for categorical variables. Implant survival was analyzed using Kaplan–Meier analysis, with differences between groups determined using the log-rank test. Survival curves are curtailed at 10 years' follow-up, as the population at risk subsequently was deemed too small, at 15.7% of the study population [26].

Multiple logistic regression analysis was performed to examine the influence of risk factors on implant survival. Significance level was set at $P < 0.05$. SPSS version 21 for Windows (IBM Corp, Armonk, NY) was used for data analysis.

Results

Data on revision were available for 931 patients, with a mean follow-up of 7.8 ± 2.9 years. There were 54 revisions, including 47 revisions to THA, three revisions of the femoral head to a stemmed large-head THA, three cup revisions and one explantation. The reasons for revision were aseptic loosening (n = 9), fracture (n = 9), ALVAL (Aseptic Lymphocytic Vasculitis Associated Lesion)/ARMD (n = 22), septic loosening (n = 6) and other (n = 8). There were additional nine reoperations without implant revision due to periarticular ossification (n = 6) and neurolysis (n = 3).

Overall 10-year implant survival was 94.4% with all-cause revision as the endpoint. There were significant differences in survival between males and females, at 96.1% versus 91.0% ($P = 0.015$) and between cups at inclinations of <55° versus ≥55°, at 95.3% versus 88.1% ($P < 0.001$). The highest revision rate was in females with a cup inclination of ≥55°, at 10, 69.3%, compared with 93.8% for females with cup inclination <55°. Survival curves are given in Figs. 3, 4 and 5. After stratification for gender, implant size and type did not have a significant impact on survival. Survival rates for each of the implants were 89.7% (ASR), 96.8% (BHR) and 97.2% (DUROM) at 5 years, and 89.7% (ASR), 94.8% (BHR) and 97.2% (DUROM) at 8 years. Follow-up was significantly longer for BHR patients ($P < 0.001$).

On multiple regression analysis, shorter implant survival was independently associated with female gender ($P = 0.010$), cup inclination >55° ($P = 0.009$) and length of follow-up ($P < 0.001$), but not implant type or size. Revisions due to ALVAL/ARMD were performed in 59.1% of females and in 45.4% of patients with cup inclination ≥55°. The only independent factor associated with ALVAL/ARMD was cup inclination ≥55° ($P = 0.01$).

Valid patient-outcome scores were available for 771 patients. The mean total WOMAC score at follow-up was 88.1 ± 15.0, while the