



A prospective comparative study of hip resurfacing arthroplasty and large-diameter head metal-on-metal total hip arthroplasty in younger patients—a minimum of five year follow-up

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Received: 29 December 2017 / Accepted: 29 January 2018 / Published online: 18 February 2018
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Abstract

Introduction Both hip resurfacing arthroplasty (HRA) and large-diameter head metal-on-metal total hip arthroplasty (LDH MoM THA) are generally used for young and active patients. A number of comparative studies of HRA and total hip arthroplasty have been published in the literature. However, studies that have compared HRA with LDH MoM THA are rare. The purpose of this study is to compare the mid-term results of HRA with those of LDH MoM THA in young patients.

Patients and methods Between 2007 and 2011, 68 patients were enrolled in the study and randomized into two groups: HRA group (28 hips) and LDH MoM THA group (40 hips). Peri-operative data including blood loss, surgery duration, size of the implant, and post-operative complications were recorded. All patients were assessed clinically and radiologically at six weeks; one, three and five years; and at the time of final review. Functional outcome were assessed using Harris hip (HHS), University of California Los Angeles (UCLA) and Oxford hip (OHS) scores. The mean follow-up for all patients was 7.4 years (5 to 9).

Results Patient groups matched similarly in age, percent female, body mass index, preoperative HHS, and follow-up time. No differences were observed between the two groups in blood loss or in head size or acetabular inclination angle. HRA group had significantly longer surgery duration but less blood loss. The two groups had comparable HHS, UCLA, and OHS at the latest follow-up. Major complications, such as fracture, dislocation, infection, and adverse reactions to the metal debris (ARMD) were not found in the two groups. Only one case in LDH MoM THA group underwent revision surgery due to unexplained pain.

Conclusion Comparison of HRA and LDH MoM THA shows similar mid-term clinical results. HRA may be preferable due to the well-preserved bone stock and restoration of the native anatomy. LDH MoM THA may be used with caution due to the excessive metal ion release.

Keywords Hip · Arthroplasty · Large diameter head · Resurfacing

Introduction

Total hip arthroplasty (THR) is the treatment of choice for many patients with end-stage hip diseases. However, conventional THR using metal-on-polyethylene bearings has had a common problem of high incidence of revision due to wear debris [2, 14]. Metal-on-metal bearings were subsequently introduced to reduce wear and osteolysis and were thought to be suitable for young and active patients.

Hip resurfacing arthroplasty (HRA) and large-diameter head metal-on-metal total hip arthroplasty (LDH MoM THA) are the mainly used implants with these bearings and have been popular during the last decade. Recently, a number of published literatures have reported adverse reaction to metal debris (ARMD) which may, at least in part, result in early failure of large-diameter MoM implants [11, 12, 18]. Some large-diameter MoM devices have been recalled, and the use of these devices has dramatically decreased. Yet, the fact is surgeons differ in their use of HRA and LDH MoM THA. Favorable short- to long-term clinical results make many surgeons consider HRA as an effective surgical intervention in a selected population of young patients [3, 8, 13, 16, 23–25]. On the other hand, the use of LDH MoM THA is discontinued because of high incidence of early failure due to the taper wear [10].

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The purpose of this study is to compare the mid-term results of HRA with those of LDH in young patients. As we know, few authors reported prospective study concerning comparison of these large-diameter MoM implants.

Materials and methods

Between 2007 and 2011, 100 young patients (≤ 65 years) who were considered eligible for both HRA and LDH MoM THA were randomized into two groups. Each group consisted of 50 patients. Randomization was undertaken using sealed envelopes which were opened on the day of admission. Selection criteria were avascular necrosis involving less than one-half of the femoral head on a plain radiograph, primary osteoarthritis, developmental dysplasia of hip (DDH) with relatively normal hip morphology, and rheumatoid arthritis. We excluded patients who expressed that they had intention of becoming pregnant, who had renal function insufficiency or bilateral hip replaced. We excluded patients who had bilateral hip replaced. These patients were informed about HRA and LDH MoM THA and willing to participate in the study. However, only 75 patients signed an informed consent on the day before operation. Seventeen patients in HRA group and eight patients in LDH MoM THA group refused to undergo metal-on-metal arthroplasty and chose ceramic-on-polyethylene or ceramic-on-ceramic bearings. Five patients in HRA

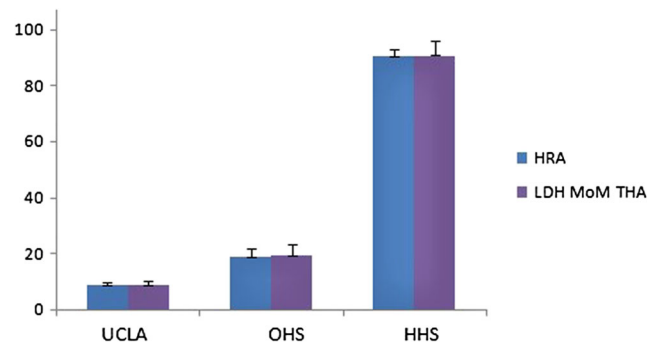
group and two patients in LDH MoM THA group were lost to a minimum of five year follow-up, respectively. Finally, 68 patients made up the present study. Our institutional review board approved the study.

The implant used was Conserve Plus (Wright Medical Technology, Arlington, TN, USA) in HRA group and Cocr (Wright Medical Technology, Arlington, TN, USA) in LDH MoM THA group, respectively. A uniform posterolateral approach was used in all cases. Good exposure is essential for satisfactory component alignment. The intention was to achieve 45° of acetabular component inclination, a 5° to 10° more anteversion aligned with the native acetabulum, and slight femoral valgus. When HRA was performed, care was taken to avoid notching and excessive load of the femoral neck. All operations were performed by a single surgeon (Fan L). Peri-operative data including blood loss, surgery duration, size of the implant, and post-operative complications were recorded. All patients were assessed clinically and radiologically at six weeks; one, three and five years, and at the time of final review. Computed tomography (CT) scanning was performed at five years and at the time of final review. Functional outcome were assessed using Harris hip (HHS), University of California Los Angeles (UCLA) and Oxford hip (OHS) scores. The mean follow-up for all patients was 7.4 years (5 to 10). All statistical analysis was performed using SPSS 17.0. A p value < 0.05 was used as a threshold for significance. The patient demographics are listed in Table 1.

Table 1 Demographic information

	HRA group (28hips) <i>P</i> value	LDH MoM THA group (40 hips)
Gender 0.955		
Male	19 (67.9%)	28 (70.0%)
Female	9 (32.1%)	12 (30.0%)
Age 0.156		
Mean (range) in years	43 (21 to 65)	47 (24 to 65)
Body mass index 0.725		
Mean (range)	21.5 (17.8 to 25.7)	21.8 (17.2 to 26.2)
Diagnosis 0.328		
Avascular necrosis	18 (64.3%)	32 (80.0%)
Primary osteoarthritis	7 (25.0%)	5 (12.5%)
Developmental dysplasia	2 (7.1%)	3 (7.5%)
Rheumatoid arthritis	1 (3.6%)	
Harris hip score before surgery 0.257		
Mean (range)	50.5 (41 to 62)	49.2 (42 to 59)
Follow-up time		
Mean (range) in years 0.321	7.7 (5.0 to 10.0)	7.3 (5.3 to 9.6)

Fig. 1. The two groups had comparable HHS, UCLA, and OHS at the latest follow-up



Results

Patient groups matched similarly in age, percent female, body mass index, preoperative HHS, and follow-up time. No differences were observed between the two groups in blood loss or in head size or acetabular inclination angle. HRA group had significantly longer surgery duration but less blood loss. The two groups had comparable HHS, UCLA, and OHS at the latest follow-up (Fig. 1). Comparison of clinical outcomes between the two groups was seen in Table 2. Good exposure is essential for satisfactory component alignment. The intention was to achieve 45° of acetabular component inclination, a 5° to 10° more anteversion aligned with the native acetabulum, and slight femoral valgus. When HRA was performed, care was taken to avoid notching and excessive load of the femoral neck. Major complications, such as fracture, dislocation, infection, and ARMD were not found in the two groups. Only one case in LDH MoM THA group underwent revision surgery five years after

primary surgery due to unexplained pain. The 65-year-old gentleman complained of persistent hip pain five years after the index procedure, without any sign of ARMD or another major complication. He underwent revision surgery in another hospital and was unwilling to keep in touch with us because of the poor outcome (Figs. 2 and 3).

Discussion

We find comparable functional results between the groups in a minimum of five year follow-up, except for the revision case in LDH MoM THA group. Garbuz et al. [6] also compared the two metal-on-metal bearings and reported similar short-term results. The authors further warned against the use of LDH MoM THA due to the excessive metal ion release. ARMD is the major complication following large-diameter head metal-on-metal hip arthroplasty. The clinical findings of ARMD may include periarticular fluid collections, soft tissue masses,

Table 2 Comparison of clinical outcomes in the two groups

(28 hips) <i>P</i> value	HRA group	LDH MoM THA group (40 hips)
Blood loss (ml) 0.002	353 ± 79	429 ± 109
Surgery duration (min) 0.00	98 ± 12	79 ± 9
Head size (mm) 0.531	46.4 ± 2.5	46.4 ± 2.5
42 mm	1 (3.6%)	2 (5.0%)
44 mm	9 (32.1%)	11 (27.5%)
46 mm	7 (25.0%)	12 (30.0%)
48 mm	6 (21.4%)	11 (27.5%)
50 mm	4 (14.3%)	1 (2.5%)
52 mm	1 (3.6%)	3 (7.5%)
Acetabular inclination angle (AIA) 0.274	50 ± 6	48 ± 5
Functional outcome at latest follow-up		
HHS 0.708	90.4 ± 2.4	90.8 ± 5.1
UCLA 0.479	8.5 ± 1.0	8.7 ± 1.3
OHS 0.714	18.7 ± 3.0	19.1 ± 4.4

HHS, Harris hip score; UCLA, University of California, Los Angeles; OHS, Oxford Hip score

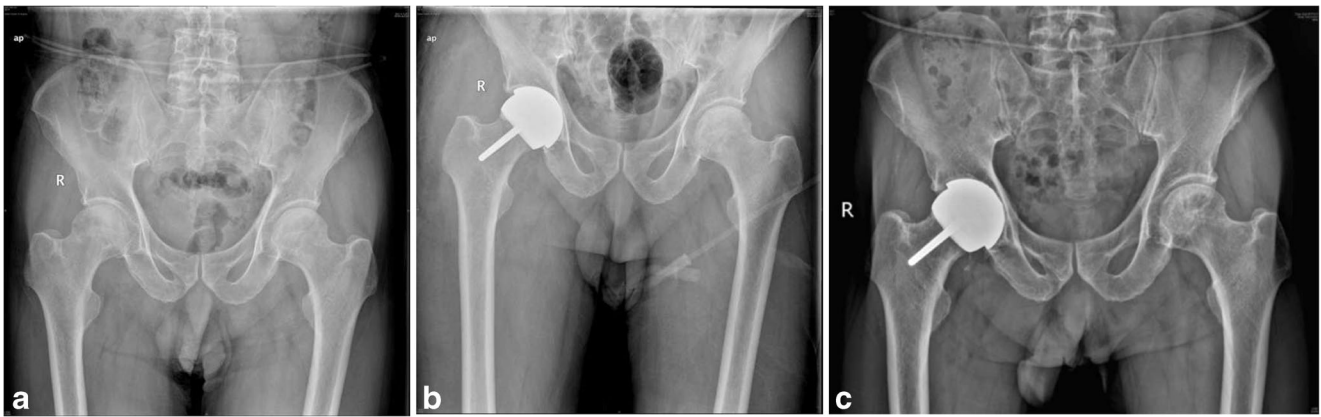


Fig. 2 A 65-year-old gentleman with bilateral femoral head necrosis underwent HRA on the right side in 2008. Pelvic radiographs: **a** preoperation, **b** 5 days post operation, **c** 9 years post operation. Notice that the left femoral head did not collapse over time

and gluteal muscle necrosis [18]. Some authors suspected that clicking and a sensation of subluxation was correlated to the later failure of the devices. In the present study, however, both patients experienced such symptoms obtained good results with negative CT findings. In the present study, ARMD was not observed in the two groups. Magnetic resonance imaging (MRI), especially metal artifact reduction sequence magnetic resonance imaging (MARS MRI), and slice encoding for metal artifact correction (SEMAC MRI) is effective in detecting patients with ARMD [24]. However, such techniques are unavailable in our center. This is one of the limitations of this study.

Numerous published literatures [5, 9, 16, 22, 25] reported excellent short- to mid-term outcomes in HRA. The significantly longer surgical time in HRA group can be explained by more complexity and higher technique demanding of this procedure. The significantly less blood loss may be attributed to the intact femur medullary cavity. Sereshon et al. [24] summarized femoral neck fracture and aseptic loosening as the two most common modes of failure in FDA-approved HRA. We

do not have cases of failure mainly due to meticulous protection of femoral neck during surgery and relatively short-term follow-up. On the other hand, the clinical outcomes following LDH MoM THA are discouraging. Many authors reported early failures of LDH MoM THA [11, 12, 19]. Extensive corrosion on the taper and trunnion was observed in LDH MoM THA revisions. This probably contributed to excessive metal debris releasing and ARMD [17]. In the present study, however, all hips functioned well except the revision one at five year follow-up. Longer follow-up is needed for these cases. Both HRA and LDH MoM THA are large-diameter head metal-on-metal arthroplasty. The latter one appears to release more metal ions [10]. We did not measure serum levels of cobalt and chromium ions. This is another limitation of this study.

The main subjects of many comparative studies between HRA and total hip arthroplasty are patients with osteoarthritis. In this study cohort, the majority are patients with avascular necrosis of femoral head (64.3% in HRA group and 80% in LDH MoM THA group, respectively). Some authors do not

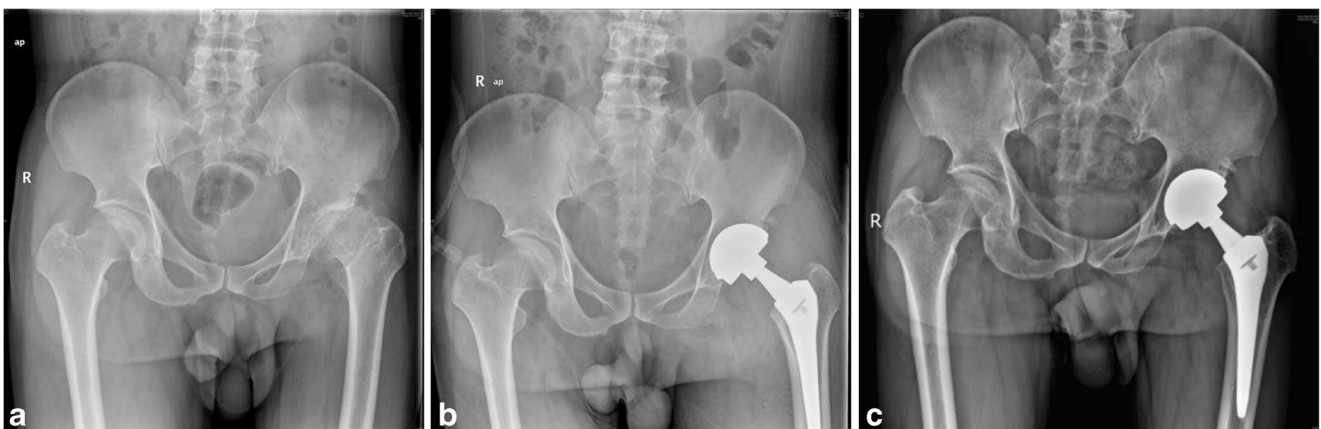


Fig. 3 A 46-year-old farmer sustained left hip osteoarthritis secondary to DDH. LDH MoM THA was performed in 2008. Pelvic radiographs: **a** preoperation, **b** 5 days post operation, **c** 8.5 years post operation

think avascular necrosis of femoral head is indicated for HRA [7]. Our study demonstrated good mid-term results. We believe it a good indication for HRA and this is in accordance with other authors' opinion [1, 15, 21, 23, 24]. DDH may be an independent risk factor for failure following HRA, since the vertical, anteverted nature of the dysplastic hip results in significant cup uncoverage at the anterosuperior edge when the cup is placed in the recommended 40° of abduction. In the present study, the only two dysplastic hips we selected had relatively normal hip morphology. The cup coverage was acceptable and the hips functioned well.

The strengths of this study are twofold. First, it is a randomized prospective study. Haddad et al. [8] emphasized on the difficulties in randomized comparative study between HRA and THA. In their study, only 24 patients were randomized, and we have 68 randomized patients. Second, we followed patients at a minimum of five years, while many comparative studies between HRA and THA are short-term studies [4, 6, 20].

In conclusion, comparison of HRA and LDH MoM THA shows similar mid-term clinical results. HRA may be preferable due to the well-preserved bone stock and restoration of the native anatomy. However, patient selection, surgical technique, as well as implant design should be taken into consideration. LDH MoM THA may be used carefully due to the excessive metal ion releasing.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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