

Prospective study comparing functional outcomes and revision rates between hip resurfacing and total hip arthroplasty: preliminary results for 2 years

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Abstract

There is a need of independent prospective studies about modern generation of hip resurfacing implants. The aim of this prospective observational study was to compare the functional outcomes and revision rates with hip resurfacing arthroplasty and total hip arthroplasty and to present the preliminary results at 2 years. Patients included were recruited prospectively in the *Partial Pelvic Replacement Hip Project* by a single surgeon between January 2007 and January 2010. Patients were assessed with the Harris Hip Score (HHS) and Postel-Merle d'Aubigné (MDA) score and Devane Score. The end point of the study was reoperation for any cause related to the prosthesis. At a mean follow up of 38.6 months there were a total of 142 patients with hip resurfacing (group 1) [100 Durom® (Zimmer Inc., Warsaw, IN, USA) and 42 Birmingham Hip Resurfacing® (Smith & Nephew, Memphis, TN, USA)] and 278 patients with total hip arthroplasty (group 2). The results showed significantly greater gain of HHS, MDA and Devane score with hip resurfacing procedures. However, considering all the complications, the rate was significantly higher in group 1 (16.4% vs 1.79% in group 2 ($P < 0.0001$)). In group 1 we observed 6 complications only concerned males with Durom® implants. The follow up of this cohort is still on going and may deliver more information on the evolution of these results in time.

Introduction

After a recent period of increasing, the number of hip resurfacing (HRA) procedure

seems to stabilize.¹⁻³ Indeed after the publications of many papers outstanding the high rate of complications with HRA, the best candidates for HRA seem to be males under 65 years old with osteoarthritis and near to normal bone morphology.¹ All national registers report that elderly and females are more concerned by femoral neck fractures, component loosening, metal hypersensitivity, femoral impingement and pseudotumors.²⁻⁴ Smith *et al.*,⁵ in a recent meta analysis reported that HRA had twice the failure rate of total hip arthroplasty (THA). Despite these results, the functional outcomes in this meta-analysis were better with RHA than with THA. Unfortunately, there are few studies comparing outcomes after HRA and THA and their evidence levels are usually very low. Most of the prospective studies comparing HRA and THA reported only functional outcomes.^{6,7} Moreover, the findings of these studies are unclear and sometimes contradictory.

The aim of this study was to compare functional reported outcomes, complications and revision rates of HRA on 2-year follow-up with a THA control cohort. This 2-year report is the first of an ongoing prospective study that will continue to follow patients for 10 years. Our null hypothesis was that HRA had the same functional and survival outcomes as THA.

Materials and Methods

Study design

The PPR Hip Project was designed as a prospective observational cohort of all patients receiving a primary hip arthroplasty at the Toulouse University Hospital (France). Institutional review board approval was previously obtained. Patients included were recruited in the PPR Hip project by a single surgeon (PC) between January 2007 and January 2010 in order to compare functional outcomes and early revision rates after hip resurfacing (group 1) and total hip arthroplasty (group 2). Inclusion criteria were patients under 70 years old for males and under 60 years old for females, with primary osteoarthritis or avascular necrosis with a volume inferior to 30% of the femoral head. The difference in age restrictions for male and female patients are caused by discrepancies in bone mineral density and subsequent fracture risks and are related to femoral bone anatomy and quality.^{8,9} The decision of performing a resurfacing arthroplasty or a THA was left to the discretion of the surgeon. Device selection was determined by the surgeon and his patients and was based on the published evidence, clinical criteria, and personal preferences.

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Baseline information and perioperative information

For PPR Hip project, baseline information was collected from consenting patients at the time of their preoperative visit the day before surgery. Information collected included age, sex, employment, body mass index (BMI), medications, medical conditions, the Harris Hip Score, Postel Merle d'Aubigné score (MDA) and Devane Score. All the surgical details were collected the day of the surgery. They included the surgeon's identity, the type of surgical approach, the devices and sizes of the implant, the type of fixation, and any perioperative complications. Data were stored in an online secure, central database: Orthowave V6 Database (Aria Software Ltd, France) with the patient's agreement.

Follow-up

For PPR Hip Project typical follow-up of patients included a review at baseline, 3 months, 1 year and 2 years postoperatively. Thereafter patients are being followed yearly for 10 years. This study reports on 2-year follow-up data.

Outcome measures

Patients were evaluated by an independent observer, with the Harris Hip Score (HHS) and Postel-Merle d'Aubigné (MDA) score and Devane Score.¹⁰⁻¹² Complications and radiographic findings were recorded. The end point of the study was reoperation for any cause related to the prosthesis.

Statistical analyses

All data was extracted from the PPR Hip Project online database thanks to the Orthowave Software®. All statistical analysis was carried out by an independent statistician using Excel® (Microsoft Inc, Redmond, WA, USA) and SPSS software® (SPSS Inc, Chicago, IL, USA). Descriptive data analysis was performed using student t test. The difference between the preoperative and follow-up hip scores was analyzed with paired Student t tests. Comparisons between the two groups were assessed by Fisher-Student tests for parametric data and with χ^2 test for non parametric data. Significance was determined to be $P < 0.05$. Kaplan and Meier survivorship analyses were performed using the time to revision for any reason as an end point.

Results

Population

At a mean follow up of 38.6 months there were a total of 142 patients with HRA (group 1) and 278 patients with THA (group 2) and no patient lost to follow-up and no patient dead. In group 1, the mean age was 45.5 years (range, 17-69 years) the mean BMI was 24.85 (range, 19.26-35.1) and there were 124 males and 18 females. In group 2, the mean age was 55.9 years (range, 25-70 years), mean BMI was 25.97 (range, 17.3-45.72) and there were 182 males and 96 females. A comparison of

the baseline characteristics of all patients with HRA and THA shows that these 2 groups differ in terms of age and sex distribution. All the resurfacing were performed by minimal invasive antero-lateral approach as described by Rottinger *et al.*¹³ All the THA were implanted using a minimal invasive posterior approach. While performing this approach, the surgeons took care of preserving the quadratus femoris muscle and the capsule was systematically repaired at the end of the procedure. The resurfacing prostheses used were Durom® (Zimmer Inc., Warsaw, IN, USA) in 100 cases and Birmingham Hip Resurfacing, BHR® (Smith & Nephew, Memphis, TN, USA) in 42 cases. The THA prostheses used were Omnica® (Zimmer Inc., Warsaw, IN, USA) which are cementless anatomic stems recovered with hydroxy-apatite. The acetabular components used were RM® (Robert Mathys, Bettlach, Switzerland) which are cementless full polyethylene cups covered with titanium allowing osteointegration. The femoral head components were 32 mm ceramic heads. There was a statistically significant difference between HRA and THA for type of bearing surface, mean head size, and fixation method (data not shown). However, there was not statistically significant difference between HRA and THA for the cup size.

Functional scores

The mean preoperative HHS score was 55.13 in group 1 *versus* 53.18 in group 2. The difference between the 2 groups was not statistically significant. The improvement of HHS score

was greater in group 1: 39.46 *versus* 27.47 in group 2 with $P < 0.001$ (Figure 1A). The results are the same as considering each part of the HHS score except the gain of deformity HHS part (Table 1).

The mean preoperative MDA score was 11.83 in group 1 *versus* 11.63 in group 2 ($P > 0.05$). The mean 2 year-post-operative MDA score was 17.41 in the group 1 *versus* 17.07 in the group 2 ($P > 0.05$). The gain of MDA score was greater in group 1 5.55 *versus* 3.27 in group 2 ($P < 0.001$) (Figure 1B).

There was no statistical difference in the distribution of preoperative Devane score between the two groups. The rate of patients who increased Devane score was more important in group 1 with 65.6% against 45.5% in group 2 $P < 0.01$ (Table 2).

Complications and revisions

In group 1 we had one per operative complication due to a technical error concerning the preparation of cement and having insufficiently impacted the femoral component. This patient presented a femoral neck fracture in the next three weeks following surgery. In group 2 we had one peroperative complication: a femoral fracture which was treated by cable osteosynthesis and weight discharge during 6 weeks. At 2 years post-operative, in group 1 we have recorded 6 femoral neck fractures with 2 stem fractures (both Durom® implants), 2 aseptic loosening of the acetabular implant, 1 gluteus medius enthesopathy. Only male patients with Durom® implant were concerned by these complications and revision rate's differences between the two resurfacing devices

Table 1. Comparison of HHS score between RHA and THA.

Functional score	Group 1: RHA	Group 2: THA	P
HHS preop	55.13±14.99	53.18±16	0.28
HHS 2 year postop	94.67±10.11	91.47±10.9	<0.01
Gain total HHS	39.46±18	27.47±20.88	<0.01
Gain pain HHS	24.78±11.61	17.76±14.05	<0.001
Gain function HHS	12.58±9.12	8.57±7.93	<0.001
Gain motion HHS	1.52±1.11	1.03±0.97	<0.001
Gain deformity HHS	0.48±1.31	0.43±1.25	0.80

RHA, hip resurfacing; THA, total hip arthroplasty; HHS, Harris Hip Score.

Table 2. Comparison of Devane score between RHA and THA.

Devane	Preop count %		2 years count %	
	RHA	THA	RHA	THA
Strenuous labor/contact sports	19.01	6.47	39.43	5.03
Light jobs/non contact sport	35.21	35.61	55.63	37.76
Leisure activities/gardening	35.91	28.42	2.81	44.60
Semisedentary/household chores	9.17	22.66	0	8.99
Sedentary/dependent	0.70	6.84	2.13	3.62
Unknown	0	0	0	0

RHA, hip resurfacing; THA, total hip arthroplasty.

were statistically significant with $P < 0.01$. In 3 cases, neck fractures were secondary to a high-energy trauma. In the other cases including the two stem femoral implant fractures, no precipitating factor was found. Femoral fractures were treated by bipolar revision with uncemented Omnicase stem and RM cup, while acetabular aseptic loosening were treated by unipolar revision. In the group 2, we had 5 complications with 2 femoral fractures Vancouver B2, one aseptic loosening of the cup, one deep infection and one psoas enthesopathy that required a surgical treatment. They were treated respectively by unipolar revision with reconstructive femoral stem, unipolar revision with cemented cup, two stages bipolar revision and surgical debridement. Considering all the complications, the rate was significantly higher in group 1 6.34% vs 1.79% in group 2 ($P < 0.0001$) (Figure 1C). The rate of implant failure was also higher in

group 1 3.52% vs 0.36% in group 2 ($P < 0.031$). The rate of revision was 5.63% in group 1 and 1.79% in group 2 with a significant difference ($P < 0.014$).

Survivorship study

The Kaplan and Meier 2-year survivorship was 94.4% for HRA against 98.2% for THA with a Log-rank P value < 0.05 (Figure 1D).

Discussion

The results of this study clearly show that hip resurfacing offers better functional results than THA but with a higher risk of complications and revisions.

A certain number of points should nonetheless be stressed on: first of all it is important

to take into account that the two studied groups are quite different. Indeed group 1 is composed of younger patients and more males than group 2. This could bias the better functional results found in hip resurfacing. A solution to reduce this limitation could have been to match the patients on baseline characteristics or to use a propensity score matching method. Nonetheless, the results would require a cautious interpretation as patients selected for HRA and THA procedures may differ in ways that would not appear in the baseline characteristics measured in this study.⁵

The use of two different surgical approaches (postero-lateral or lateral approach) must be taken into account. Many authors have in fact shown that there was no difference in functional results for hip resurfacing performed by different approaches.¹⁴⁻¹⁷ Myers *et al.*¹⁵ did not find any differences between postero-lateral and lateral approach; Mc Bryde *et al.*¹⁶ studied

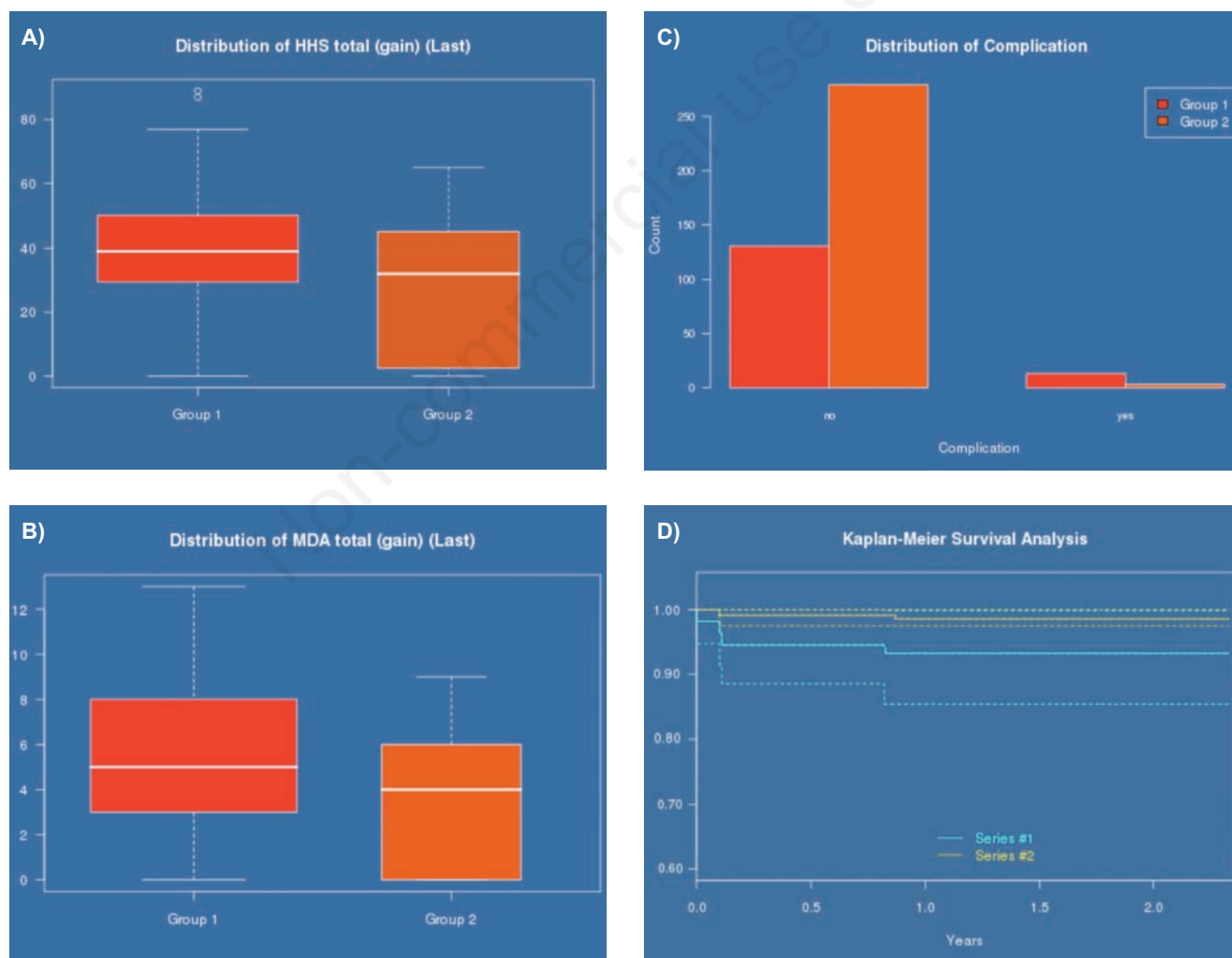


Figure 1. A) Comparison of gain of Harris Hip Score (HHS) between hip resurfacing (RHA) (group 1) and total hip arthroplasty (THA) (group 2); B) comparison of gain of Postel-Merle d'Aubigné score between RHA (group 1) and THA (group 2); C) distribution of complications between RHA (group 1) and THA (group 2); D) Kaplan-Meier survival analysis of RHA (series 1) and THA (series 2).

the influence of surgical approach on outcome in Birmingham Hip Resurfacing® and compared 135 resurfacing procedures performed by antero-lateral approach with 774 hip resurfacings performed by postero-lateral approach. They concluded that both approaches offered excellent function scores with no difference in survival or in the incidence of complications after 8 years of follow-up.

Several authors reported better results in rehabilitation and return to higher sport level with hip resurfacing. Swank *et al.*¹⁸ compared minimally invasive hip resurfacing to minimally invasive THA and found better functional outcomes with hip resurfacing at 2 years post-surgery. Smith *et al.*,⁵ in a meta analysis and systematic review, concluded, on the basis of the current evidence base that hip resurfacing has better functional outcomes than THA. Only Stulberg *et al.*⁷ reported better early results in hip resurfacing than THA but these differences had disappeared by 24 months.

Despite these good functional results, the rate of complications and revisions is higher for hip resurfacing than THA. For instance, we observed 6 femoral neck fractures with 2 stem fractures of the femoral implant (Durom® in the both cases). Three of the femoral neck fractures were due to high-energy trauma. Concerning the 2 stem femoral implant fractures, there were only two cases described in literature at our knowledge.^{19,20} One hypothesis may be that the fracture was due to avascular necrosis of the femoral head leading to its collapse.²⁰ The unsupported femoral component may have caused overloading of the stem leading to fatigue fracture.^{9,20,21} Of a more general point of view, the Australian National Registry and the Nordic Arthroplasty Register Association report the increased risks of revision surgery following hip resurfacing and thus indicate THA is superior in terms of implant survival.^{2,3,22} Smith *et al.*⁵ found significantly greater incidences of heterotopic ossification, aseptic loosening and revision surgery with hip resurfacing compared to THA. According to the Australian Registry the cumulative percentage of revision at 8 years the cumulative percentage of revision in the Australian Registry was 5.3 (4.6-6.2) for hip resurfacing, compared to 4.0 (3.8-4.2) for total hip replacement and at 3 years was 2.5 (2.2-2.9) for BHR® implant and 4.7 (3.4-6.7) with Durom® compared to 5.63 in our study.²² These results persuaded us to transitioned from Durom® implants to BHR system®. Recently, McMinn *et al.*²³ analyzed the National Joint Registry for England and Wales (275 000 patients) and reported no difference between THA and HRA (with BHR® implant) in males under 50 years old. What's more, the adjusted mortality rate, in this population showed that the BHR outperformed cemented and uncemented THA, while revision rate for cemented

THA was the lowest. The epidemiological impact is such that by performing a cemented total hip replacement instead of resurfacing, their analysis predicted that an extra death occurred within six years for every 23 (17 to 35) procedures.²³ All these results highlight the importance of prosthesis selection in optimizing the outcome of hip resurfacing.¹

Conclusions

In conclusion, our study reported greater rates of complications and revisions with HRA with nonetheless better clinical outcomes than with THA. This study should of course be considered as an early interim review, as our intention is to report on the longer-term follow-up.

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