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Our Midterm Results of the Birmingham Hip Resurfacing With and Without Navigation

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ABSTRACT

We reviewed 148 consecutive hip resurfacings in order to assess the clinical outcomes of the BHR at midterm follow-up and to compare the accuracy of the navigation in the positioning of femoral component. We retrospectively analyzed 85 hips using the conventional jig to implant the femoral component and we prospectively followed 63 hips operated on by navigation. At a mean follow-up of 50.54 months, the Harris hip score improved significantly from 44.66 preoperatively to 98.45 postoperatively without any differences between the groups. Radiologically, we classic navigated group. Our clinical outcomes are excellent at midterm follow-up and the navigation definitely improves the implant position in both planes.

Total hip arthroplasty has shown excellent long-term results for the last-stage symptomatic osteoarthritis, especially for old and less active patients [1]. During the last decade, hip resurfacing has gained in interest as a femoral bone conserving arthroplasty procedure. It has been proposed for young and more active patients with very good short- and midterm results [2,3]. Technically, hip resurfacing procedure is more challenging than conventional hip arthroplasty. The resurfacing technique's learning curve is long before the surgeon can accurately perform hip resurfacing [4]. The correct placement of the femoral component is the more critical factor to avoid short-term and midterm failures. Especially, the placement in varus or femoral neck notching is associated with very poor results at short-term follow-up [5]. To improve the placement of the femoral component, firms had developed special jigs as a notch checking device and to put the implant in valgus. Some surgeons use the fluoroscopy during the procedure to check the accurate placement of the guide pin inserted in the femoral neck. Recently, the navigation appeared to be one of these intraoperative aids that can help the surgeon to put the femoral implant in the planned position [6–10]. The purpose of our study is to analyze the clinical outcome of a single independent surgeon hip resurfacings at midterm follow-up and to analyze whether the navigation could improve the placement of the femoral implant.

Materials and Methods

Between January 2004 and December 2009, we consecutively performed 151 hip resurfacings in 141 patients. We excluded patients operated on who died ($n = 1$) of reasons not related to the procedure or not responding to the follow-up ($n = 2$). Among the remaining 148 hips, 2 groups have been formed. The first group of patients ($n = 85$ hips), called "the classic group" was analyzed retrospectively because they have been operated earlier than the second group. In the classic group, the method used to put the femoral implant is the guide pin inserted in the femoral neck as it was calculated in the preoperative template planning (Fig. 1). This method was described by McMinn in his original surgical technique using the distance between the tip of the greater trochanter and the insertion point on the external cortex of the femur. The McMinn alignment guide given by the firm was used to determine the size of the components and to avoid notching. The second group ($n = 63$ hips), called "the navigated group," was followed prospectively and we used the navigation during the procedure to put the femoral implant in the desired position. The navigation system, BrainLab Hip Essential, determined the size of the components and how to avoid notching. That imageless navigation uses point/surface acquisition during a recording process to generate a three-dimensional model of the femoral neck and head and to measure the native neck-shaft angle in all planes (Fig. 2).

All patients were operated on by the same surgeon (M.P.) with the same classic posterior approach using the hybrid metal-on-metal Birmingham Hip Resurfacing implants (Smith and Nephew, Memphis, TN, USA). During the procedure, the acetabular component was first implanted in a free-hand manner and then the femoral component was implanted using the classic method with the guide pin and conventional jig or the navigation system. Clinically, the patients were

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All authors disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within 3 years of beginning the work submitted that could inappropriately influence (bias) their work.

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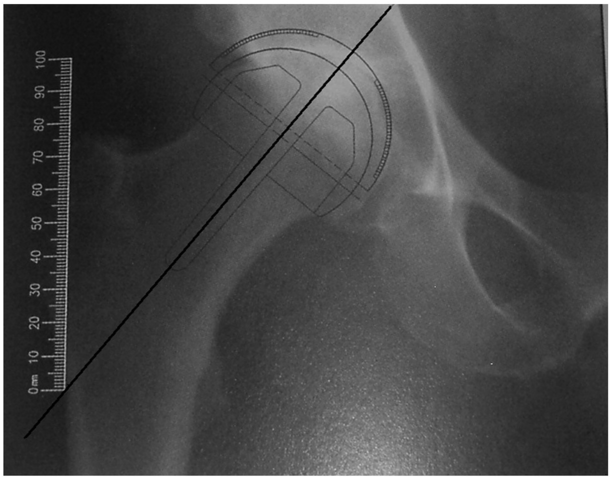

Fig. 1. Preoperative planning showing the insertion site in the lateral cortex of the guide pin relative to the top of the greater trochanter.

divided into Charnley A, B or C subgroups [11] and evaluated by the first author using the Harris hip score, the Postel–Merle d'Aubigné score at last follow-up and the UCLA activity score [12–14]. Patients needing revision for femoral component failure benefitted from a modular stem fitting with BHR cup (Smith and Nephew). The radiological measurements and assessment of implant notching were carried out by a single independent operator (M.E.) using the digital radiographic system Telemis (Louvain-La-Neuve, Belgium). A plain anteroposterior radiograph with the inferior leg in 15° internal rotation was obtained for all patients at last follow-up. This view was used to measure the native preoperative neck-shaft angle and the postoperative stem-shaft angle. The difference between these two angles gave us the varus, neutral or valgus position of the femoral component. The abduction angle of the acetabular component was recorded and compared in the two groups. A frogleg lateral view of the hip was obtained by putting the patients in supine position with knees flexed, soles of feet together, and the thighs maximally abducted. This lateral view was used to analyze the neutral position,

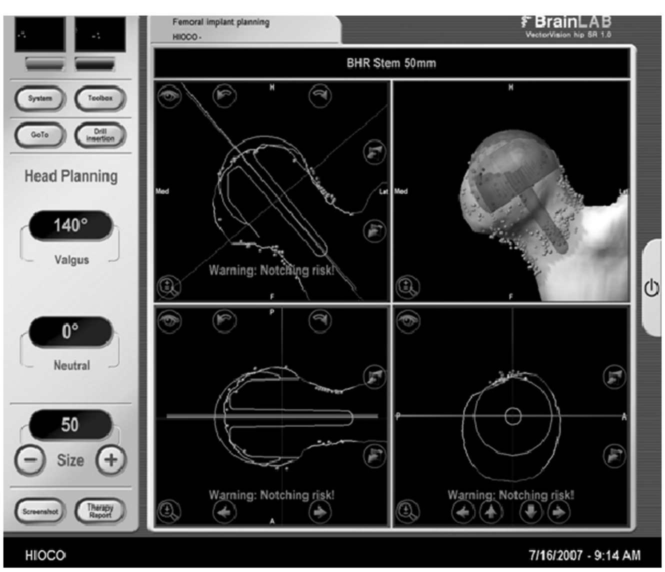

Fig. 2. The planning screen (BrainLab system for BHR) showing the implant positioning and sizing in order to achieve the best alignment on the neck and appropriate cover of the femoral head without notching risk.

anteversion or retroversion of the stem relative to the femoral neck. Studies have suggested that the femoral component should be placed in valgus and that biomechanically, a valgus position of 10° optimizes the load bearing capacity of the femoral neck [8,15]. During the procedure, for all patients, the senior surgeon (M.P.) aimed to place the femoral component in a 10° valgus position on the frontal plane and strictly neutral on the sagittal plane. In the classic group, the preoperative planning assessed the exact entry point for the guide pin on the lateral cortex (distance measured on the template from the tip of the greater trochanter). In the navigated group, the position of the implant was previewed on the screen before the osseous cuts using the navigation system BrainLab. This system uses diodes to reconstruct the anatomical hip in a three-dimensional model. That reconstruction allowed putting accurately the implant in 10° of valgus and neutral position within the femoral neck. We compared the demographic data and clinical status between the two groups. Radiologically, we compared in each group the proportion of outliers defined as patients who had a postoperative stem-shaft angle superior to 5° from the planned angle. On the lateral view, the outliers were all implants in anteversion or retroversion.

The data were collected on Excel spreadsheets (Microsoft Corp, Seattle, WA, USA) by the first author and submitted to an independent statistician. The statistical analysis was performed using the statistical package software StatView 5.0 (SAS Institute Inc, Campus Drive, Cary, NC, USA). The chi-square test was used to compare the proportion of outliers in the two groups. The ANOVA statistical test was used to analyze the interrelation between the Charnley subgroups for the clinical scores. The two-sample Student's *t*-test was used to evaluate the statistical difference in the demographic data and radiologic measurements. A P value of <0.05 was considered significant. A survival analysis was performed using a Kaplan–Meier survival curve.

Results

Regarding the general population of the study (both groups fused) the BHR was implanted in 90 men and 58 women. There were 69 left and 79 right hips. Ten patients were bilaterally implanted with staged surgery and both sides were included in the study. The mean follow-up was 50.54 months (SD 15.15; range 6 to 72). One hundred twelve patients were classified Charnley A and 36 patients Charnley B. All etiologies were included and are listed in Table 1. The mean age of the patients at the time of operation was 55 years (SD 6.97; range 32 to 68). The mean height was 1.71 m (SD 0.09; range 1.5 to 1.9), the mean weight was 86.8 kg (SD 18.7; range 52 to 148) and body mass index was 29.72 kg/m^2 (SD 5.66; range 19.8 to 47.2). The mean size of the femoral component was 48.28 mm (SD 3.96; range 40 to 60) and the mean size of the acetabular component was 54.55 mm (SD 3.7; range 46 to 64). All these data were compared between the two groups and are summarized in Table 2. The outcomes as assessed by the Charnley classification, Harris hip score and Postel–Merle d'Aubigné score were compared between the two groups and summarized in Table 3. Clinically, both groups improved significantly their clinical scores at last follow-up. In the classic group, the mean HSS and PMA scores improved

Table 1
Pre-Operative Diagnosis in Each Group.

Preoperative Diagnosis	Navigated ($n = 63$)	Classic ($n = 85$)
Osteoarthritis	58	75
Femoral head necrosis	5	5
Hip dysplasia	0	4
Epihphysiolysis	0	1