Hip resurfacing has been proposed as an alternative to traditional total hip arthroplasty in young, active patients. Much has been learned following the introduction of metal-on-metal resurfacing devices in the 1990s. The triad of a well-designed device, implanted accurately, in the correct patient has never been more critical than with these implants.

Following Food and Drug Administration approval in 2006, we studied the safety and effectiveness of one hip resurfacing device (Birmingham Hip Resurfacing) at our hospital in a large, single-surgeon series. We report our early to mid-term results in 1333 cases followed for a mean of 4.3 years (2 to 5.7) using a prospective, observational registry. The mean patient age was 53.1 years (12 to 84); 70% were male and 91% had osteoarthritis.

Complications were few, including no dislocations, no femoral component loosening, two femoral neck fractures (0.15%), one socket loosening (0.08%), three deep infections (0.23%), and three cases of metallosis (0.23%). There were no destructive pseudotumours.

Overall survivorship at up to 5.7 years was 99.2%. Aseptic survivorship in males under the age of 50 was 100%. We believe this is the largest United States series of a single surgeon using a single resurfacing system.

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very small. The usage in women in Australia has fallen to four in 410 (1%) total resurfacing procedures.13

This report details our early to mid-term experience with the BHR and includes our learning curve. It is believed to be the largest single surgeon series from the United States to use a single resurfacing system.

Patients and Methods

Every male patient under the age of 65 years with advanced arthritis of the hip was considered for resurfacing. In addition, those older patients who were unusually active, or had a deformity of the upper femur unsuitable for hip arthroplasty, were also considered. Female patients who were not of child-bearing age, were sterile, or who expressed that they had no intention of becoming pregnant, were also considered. Patients with avascular necrosis involving more than one-third to one-half of the femoral head on a plain radiograph were excluded. Developmental dysplasia of the hip (DDH) was not excluded. Large cysts of the femoral head were considered a relative contraindication.

Using these selection criteria, we resurfaced 1033 hips in 927 patients. The mean age of the patients was 53.1 years (12 to 84). Male patients comprised 650 of the 927 (70%), and the most common diagnosis was osteoarthritis (OA) in 941 of 1033 (91.1%) cases. Other diagnoses included avascular necrosis in 37 of 1033 (3.6%) hips, overt DDH in 44 (4.3%), and inflammatory arthritis in ten (1.0%).

In many cases, the pathology appeared to be femoro-acetabular impingement, with retroversion and varus alignment of the femoral head on the neck, anterior femoral neck osteophytes, and eburnated bone on the antero-superior segment of the femoral head. In these cases, radiographs revealed a prominent pistol-grip deformity.21 Retrospective and radiological analysis revealed that 341 of 1033 (33%) hips had an alpha angle > 50°, indicating cam-type femoro-acetabular impingement.22 Resurfacing involved correction of the tilted head and removal of the femoral neck osteophytes, thereby eliminating the impingement as well as the arthritis.23 The mean head size in males was 51.2 mm (44 to 58) and 45.2 mm (40 to 50) in females.

All surgery was performed by a single surgeon (PB) with the patient in the lateral decubitus position, using a modified direct lateral approach. Only the BHR device was implanted. Special ‘mushroom’ templates were designed to assist in the sizing of the head and orientation of the femoral component.24

As our experience grew, and in response to reports from other centres,13-20 we excluded all female patients with a femoral head size < 44 mm. Thus, out of the 11 available bearing sizes, we restricted ourselves to the eight largest (44 mm to 58 mm). Excluding the smallest sizes had a minimal effect on our practice and constituted < 1% of cases.

With a better understanding of the wear characteristics and geometry of the bearing, we changed our target socket inclination from the traditional 45° to between 35° and 40°. This has been recommended by others.25,26

We also considered the effect of excessive femoral neck anteversion on the bearing. As a result, we began to use a CT scan to measure femoral neck anteversion in smaller patients, as well as in any with overt dysplasia. We followed a CT protocol where slices of the hip and knee are compared with measure femoral neck anteversion,27 and began this practice in the last 140 patients (10.6%) in the series. We now also routinely obtain a standing lateral pelvic radiograph to determine the static flexion-extension orientation of the pelvis. As more data becomes available we may in future be able to make recommendations about patient selection and positioning of the component using this additional imaging.

Metal ions were not measured routinely, but only in patients with clinical problems such as pain or component malposition. Soft-tissue imaging with metal artefact reduction sequence MRI was also used in these patients.

Patients were 75% weight-bearing for six weeks and avoided strenuous exertion (running, jumping, lifting more than 40 lbs) for one year, after which there were no restrictions on their activity at all. Follow-up was at six weeks, one year, two years, and five years, with radiographs at each visit. A patient-reported, validated outcomes instrument, the Review of Musculoskeletal System (ROMS) questionnaire was completed at each visit or by phone interview.28 Patients who were contacted by telephone were asked to complete their questionnaire by post or email, and were compensated with a gift card. Information about revision and complications obtained through telephone interview was confirmed by the electronic medical record. Approval for the study was obtained from our Institutional Review Board.

Results

The percentage follow-up was 44% (408) in person with radiographs, and 37% (343) by phone giving a total follow-up of 81%. The Hip-Related Physical Limitation Score from the ROMS questionnaire improved from a mean baseline of 2.6 to 6.6, where 0 is complete disability and 10 is full function.

Complications were few. We had no dislocations, no femoral component loosening, and only one loose acetabular component (0.08%). Femoral neck fracture, a common early failure mode in other series,29 was also rare, with only two fractures in our series (0.15%). There were three deep infections (0.23%) which required removal of the components. One patient underwent revision for unexplained pain, and continues to be symptomatic. One patient was riding a bicycle 15 months after surgery, was struck by a car and died at age 58. We are not aware of any other deaths in this series.

We had three cases of revision for metallosis (0.23%), two of which were attributed to socket malposition. There were no destructive pseudotumours. The third patient with metallosis was a small woman, accurately resurfaced, who nevertheless developed high metal ion levels (cobalt 131 µg/
L and chromium 142 μg/L (Fig. 1). Bilateral 40 mm bearings had been implanted: this was the smallest size in our series and used in only 0.6% of cases.

Uncertain as to why she should have these ion levels, we obtained a CT scan of her femora and a standing lateral of her pelvis. These revealed that her native femoral neck anteversion was 22°: the implanted socket was positioned in 30° inclination and 17° anteversion. Combined anteversion has been variously recommended to be below 45° or 40°. In this patient, femoral 22° plus acetabular 17° totals 39°. The standing lateral of her pelvis revealed that her pelvis was tilted backwards by 14° (Fig. 2). We believe this could have contributed to edge loading by uncovering the head anteriorly. Indeed, after revision, wear analysis revealed anterior edge loading and excessive anterior wear. Further investigation is needed to ascertain the contribution of pelvic position to the wear performance of these bearings.

Overall survivorship was 99.2% at two to 5.7 years follow-up. Aseptic survivorship in males under the age of 50 was 100%.

Discussion

Reports of the clinical results of hip resurfacing are abundant in the literature and national registries. In most cases, the BHR has given better results than other devices. Many centres have also published results of the BHR. In summary, it is reasonable to conclude that men with OA who have a BHR implanted do well. There is a 99% overall survivorship and 100% survivorship at ten to 15 years in men under the age of 50 years. The results in women may be quite disappointing. The development of adverse tissue reactions such as pseudotumours with the possibility of tissue destruction, poor results from revision, and permanent disability must temper enthusiasm for this procedure in those at a higher risk.

Our report shows that good results can be achieved with hip resurfacing at early- to mid-term follow-up, in both male and female patients, with few complications. Longer follow-up will be necessary to assess any potential adverse tissue reactions or late complications. This is, to our knowledge, the largest single-surgeon, single-device series from the United States following FDA approval for MOM hip resurfacing in 2006. Our results are similar to those of several authors elsewhere in the world, using the same device. We believe that additional imaging, such as CT scanning to measure femoral anteversion, and a standing lateral pelvic radiograph, may better identify the ideal candidate for this procedure and avoid resurfacing in patients who are most likely to develop edge-loading and metallosis. Further study is needed in order to make recommendations about advanced imaging and patient selection.

Author contributions:

P. J. Brooks: Wrote the paper, performed surgeries.

The author has received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this article.

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