Is There a New Learning Curve with Transition to a New Resurfacing System?

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Abstract

Metal-on-metal hip resurfacing has been proven to be a successful option for treating hip osteoarthritis in young, active patients. However, compared to a standard primary hip arthroplasty, hip resurfacing has a higher degree of technical difficulty. While all resurfacing systems utilize similar principles, there can be some variation in surgical technique. The purpose of this study was to determine if there was a second learning curve when a surgeon transitioned from one hip resurfacing system to another.

Materials and Methods: In 2007, the senior investigator (MAM) transitioned from using one resurfacing system for a majority of his patients to a different system. The records of 200 resurfacings were reviewed, including the last 150 patients who underwent this procedure prior to the switch, and who were then compared with the first 50 patients using a newer system. The mean age and mean body mass index (BMI) of the patients in the prior 150-patient group was 53 years and 28 kg/m², respectively, compared to a mean age of 51 years and a mean BMI of 29 kg/m² in the newer system group. The mean follow-up for the prior 150 patients was 45 months (range, 40 to 50 months), compared to 31 months (range, 25 to 37 months) for the first 50 receiving the new system. Clinical survivorship and complications were monitored, and clinical outcomes were evaluated using Harris hip scores.

Results: The implant survival rate of the last 150 patients regarding the first resurfacing system was 97.3 (146/150), compared to 100% survival with the second system. The mean Harris hip score improved from 61 points (range, 40 to 76 points) to 93 points (range, 50 to 100 points) in the first group and from 52 points (range, 31 to 83 points) to 97 points (range, 86 to 100 points) in the latter group. There were four revisions: three for femoral neck fractures and one for unexplained groin pain; two revisions were in the postoperative period, and one was 1-year postoperative and the other 2-years postoperative. Of these four revisions, all had femoral component sizes smaller than 48 mm and were revised to total hip arthroplasty; all are doing well at the most recent follow-up (Harris hip scores greater than 80 points).

Conclusion: This study illustrates that there is no additional learning curve when transitioning from one resurfacing system to another for an experienced surgeon. It also reinforces the previously established criteria that only well-selected patients should have a hip resurfacing arthroplasty performed in order to minimize the likelihood of postoperative complications such as femoral neck fracture. The learning curve appears to be a phenomenon that only occurs once for resurfacing and is not related to the specific implant manufacturer, but rather to the nature of the operation itself.

There have been many recent studies reporting an early and mid-term success of greater than 90% for metal-on-metal hip resurfacing arthroplasty patients.¹⁻⁵⁻⁷⁻⁹⁻¹⁰ There has been tremendous interest in using this modality as a bone-conserving alternative to standard total hip arthroplasty, especially in younger male patients (less than 55 years of age).⁵⁻⁹ Most reports of excellent results have come from institutions where the surgeons have extensive experience with this technique and do a large volume of these procedures. However, as with many new procedures, there is a substantial learning curve. A resurfacing procedure is technically much more difficult than a standard hip
arthroplasty, and there are a number of reports describing high early complication rates at the beginning of a surgeon’s experience.11-17 Various studies have described this learning curve to include fracture rates ranging from 0% to 17%. Amstutz and Le Duff6 described their highest failure rate in the first 300 hip resurfacings, with a much lower rate in the next 1000 resurfacings performed. Marker and colleagues reported 14 fractures in the first 69 cases performed; in the next 381 cases, the incidence of femoral neck fracture reduced to only 0.4%. Numerous other studies have shown this significant learning curve after metal-on-metal resurfacing.

In addition to the difficulty of transitioning from performing a standard total hip arthroplasty to a resurfacing, there may be a learning curve associated with switching from one resurfacing prosthetic device to another. We do not know of any report specifically concerning the difficulties encountered when different resurfacing systems are used, even by experienced surgeons. This prompted the present study, in which the learning curve for the first 50 cases performed with a new resurfacing device were compared to previous implanted resurfacings by an experienced surgeon. From these two cohorts of patients, we performed a clinical evaluation that included Harris hip scoring, survival rates, complication assessments, and a radiographic evaluation for any failures or changes in component alignment or progressive radiolucencies.

Materials and Methods

In January of 2007, the senior investigator (MAM) transitioned from using one resurfacing system for a majority of his patients to a new resurfacing prosthetic device. In this review, the records of the previous 150 patients who underwent hip resurfacing prior to this switch in prosthetic device were compared to the first 50 patients using the newer system. The newer system was the Cormet™ 2000 (Corin, Leicester, United Kingdom, distributed by Stryker® Orthopaedics, Mahwah, New Jersey). Prior to doing these cases, the surgeon had performed over 1600 hip resurfacings with other systems (Conserve® Plus, Wright Medical, Arlington, Tennessee, and Birmingham Hip™ Resurfacing, Smith & Nephew, Memphis, Tennessee) and had taken the Cormet™ training course, which involved cadaver instruction, as well as video and further didactic information. Institutional Review Board (IRB) approval was obtained to evaluate the clinical and radiographic data from both patient cohorts.

The mean age of the patients in the prior 150 patient group was 53 years (range, 28 to 81 years), and they had a mean body mass index (BMI) of 28 kg/m² (range, 17 to 48 kg/m²). This can be compared to a mean age of 51 years (range, 23 to 84 years) and a mean BMI of 29 kg/m² (range, 20 to 47 kg/m²). The mean follow-up in the prior group was 12 months longer than the more recent group at 45 months (range, 40 to 50 months), compared to 31 months (range, 25 to 37 months) in the first 50 patients using the new system.

All patients had been screened as acceptable candidates for hip resurfacing based on standard Food and Drug Administration (FDA) criteria. Patients had to be at least 18 years of age, without any neuromuscular or neurosensory deficiency that might adversely affect gait or weightbearing, and metal allergies or renal problems were considered absolute contraindications. In addition, intra-operative decisions concerning adequate femoral head bone stock was utilized as an indication.

All procedures were performed by the senior investigator using an anterolateral approach. The latter group had a metal-on-metal bearing placed without screws, using cementless press-fit fixation with the femoral component cemented in all cases. A standard rehabilitation protocol was utilized. Patients were recommended to increase weightbearing over a 10-week period, starting out at 50% weightbearing using a cane or a crutch in the opposite hand for the first 6 weeks. This was advanced to full weightbearing as tolerated between 6 and 10 weeks. No restrictions to motion were used after the 6-week period.

Clinically, the patients were evaluated preoperatively in our office and seen at approximately 6 weeks, 3 months, 6 months, 1 year, and annually thereafter. Patients were evaluated clinically using the Harris hip rating system. An analysis was performed for any returns to the operating room or revisions and a careful assessment was done for any medical or surgical complications.

Standard anteroposterior radiographs of the pelvis and direct lateral radiographs of the operated hip were obtained for all patients in the recovery room following resurfacing. Cup inclination was assessed on anteroposterior radiographs; stem neck angles were gauged in both anteroposterior and direct lateral views by comparing postoperative films to final follow-up radiographs. Acetabular inclination was determined relative to the horizontal line co-equal to the inferior margin of the ischial tuberosities. Preoperative anatomic neck-shaft angles were measured using the line that passes through the center of the femoral head and the mid-point of the isthmus of the femoral neck, as well as the line that passes through the center of the femoral canal at a 0.5 centimeter distal to the lesser trochanter. We also measured the stem-shaft angles on postoperative radiographs using a line passing through the center of the base and tip of the femoral component stem and the previously described shaft axis. The difference between these two angles was considered to be the stem-neck angle. The radiographic evaluation also included an assessment of any change in position or alignment of the resurfacing devices. A careful analysis was performed to determine if there were any progressive radiolucencies.

All data was collected for these patients and analyzed usingExcel spreadsheet software (version 11, Microsoft® Corporation, Redmond, Washington). Statistical analyses were performed using SigmaStat software (version 3.0, SPSS, Inc., Chicago, Illinois), with the paired-t and signed rank tests used where appropriate. All statistical comparisons
were conducted using 95% confidence intervals, with a p-value of less than 0.05 considered statistically significant.

**Results**

At final follow-up, there were no failures in the Cormet™ resurfacing group (100% survival). There were four failures in the previous resurfacing group, resulting in a survival of 97.3%. The mean Harris hip score improved from 61 points (range, 40 to 76 points) to 93 points (range, 50 to 100 points) in the first group and from 52 points (range, 31 to 83 points) to 97 points (range, 86 to 100 points) in the second group.

Radiographic evaluation of both cohorts did not reveal any evidence of change in position or alignment of the surviving acetabular or femoral components. As well, zonal analysis did not reveal any progressive radiolucencies around any of the surviving femoral components. For the four revisions, three were for femoral neck fractures, and one was for unexplained pain; two occurred in the postoperative period and one at 1-year postoperative, with the other happening at 2 years. Of these four fractures, all had femoral component sizes smaller than 48 mm. They were revised to total hip arthroplasties without any complications, and all were doing well at the most recent follow-up. One other patient suffered a cerebrovascular accident during the immediate postoperative period, but made a full recovery.

**Discussion**

The learning curve associated with hip resurfacing remains a persistent problem for young surgeons trying to learn this difficult technique. When the surgeon begins to perform this procedure, it can be difficult obtaining acetabular exposure, as well as avoiding gross femoral neck notching. Both of these events can lead to acetabular problems, such as loosening or femoral neck fractures, which are the major complications associated with this procedure. In addition, many surgeons frequently transition between different systems for various reasons, including that certain devices may be more appropriate for certain types of patients. For example, some companies only make devices of certain sizes. Because of this known learning curve for individual surgeons, the current study was undertaken to see if an experienced surgeon would have an increased learning curve specifically in transitioning from one resurfacing device to another. It appears that because there was 100% hip implant survival with the new system that an experienced surgeon is able to successfully transfer their prior experience to a new system with a minimal associated learning curve.

This study had several limitations, most notably a short follow-up period. However, with the 3-year follow-up and the knowledge that many of the complications of resurfacing, such as femoral neck fractures, do occur early in the postoperative period, we are confident that these problems have been avoided. While it is certainly important to follow these patient cohorts to mid- and long-term follow-up in order to ensure the conclusions regarding the lack of a new learning curve holds over time, we feel confident that experienced surgeons can transition from one resurfacing system to another without patient compromise.

The results of this study are in agreement with another recent study by Marker and associates in which it appears that there is more accurate positioning of the placement of the femoral component in resurfacings, as well as for the acetabular components, later in the surgeon learning curve. This study appears to further reflect the importance of surgeon experience, because even within this study it appears that the patients were doing as well or superior to patients under the surgeon’s previous experience. In a number of studies, failure has been correlated to small prosthetic size. In the first patient group, all of the four fractures occurred in patients with acetabular components that were 48 millimeters or smaller. The Australian National Registry described higher failure rates in patients with smaller femoral head sizes. In the present study, for cup sizes of 50 millimeters or higher, there were no failures in both groups. This study further emphasizes this issue when performing resurfacings.

**Conclusion**

The investigators found there was no additional learning curve when a surgeon who was experienced in resurfacing technique transitioned from one resurfacing device manufacturer to another. The outcome also reinforced prior known criteria that good patient selection is a factor in the success of resurfacing and avoidance of complications, and that the manufacturer does not play a significant role in the learning curve, beyond the learning of the initial surgery. The study did highlight that more failures were found in patients who had smaller resurfacing components placed, which has been found in numerous other studies and for which caution should be observed.

**Disclosure Statement**

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