Hip Resurfacing—Keys to Success


Abstract

In recent years, metal-on-metal hip resurfacing has become an increasingly popular treatment for patients needing hip arthroplasty. Important factors to consider for a successful outcome include proper patient selection and surgical technique, including approach, component positioning, and cementing technique. This review will serve as a guide to both those who are learning the technique of hip resurfacing and to more experienced surgeons.

Hip resurfacing has seen a recent revival in popularity, with the latest generation of metal-on-metal components and hybrid fixation proving to be more successful than previous methods. Resurfacing is increasingly utilized instead of traditional total hip arthroplasty (THA) in young, active patients who need greater retention of bone mass to be available for future revisions as both the patient and the prosthetic components age. This retention of bone mass also causes hip resurfacing to be a more technically challenging procedure than THA, due to the difficulty in accessing the acetabulum.1,2 Revision after resurfacing is commonly necessitated by femoral component failure, femoral neck fracture, or component loosening.3,6 Previous studies have shown that femoral failures appear to be related to poor patient selection and surgical technique;7 patient selection and attention to surgical technique can be optimized with the following tips to facilitate successful hip resurfacing.

Patient Selection

The ideal candidate for hip resurfacing is a young, thin male who is unable to lead an active lifestyle due to osteoarthritic degeneration of the hip. Although successful hip resurfacing has been reported in patients as old as 88 years,5 younger patients report significantly higher satisfaction.9 Studies vary in defining “young” patients, with age limits ranging from 55 to 65 years, but most studies agree that younger patients have fewer complications following resurfacing.2,10-12 This does not mean that age is an absolute contraindication, especially with an aging population that is increasingly active. A recent study by McGrath and colleagues suggested that patients over 60 years of age had similar satisfaction and complication rates to their younger counterparts.13 Obesity is also not an absolute contraindication to hip resurfacing,14 possibly as a result of the lower likelihood that obese patients will engage in high levels of activity. Despite this theory, a statistically significant greater number of obese [a body mass index (BMI) of 30 kg/m2 or higher] patients suffer femoral neck fractures than thinner patients, particularly if components are improperly implanted.1-2,15 Recently, a study by LeDuff and coworkers found a protective effect on resurfacing of high BMI, presumably due to reduced activity levels in this patient population.14 Females are another group who are likely to have femoral neck fractures, with 1.91% of females who undergo resurfacing also suffering fractures, a rate twice that of males.10,12,16 This higher fracture rate is likely due to the low bone density frequently found in postmenopausal females. Diagnosis is the final key factor in patient selection. Patients with osteoarthritis have been shown to have better results than those with other diagnoses, particularly developmental dysplasia.9,17

A useful way to identify patients who are not ideal can-
didates for hip resurfacing is the Surface Arthroplasty Risk Index (SARI). A patient may score up to six points: two points for cysts greater than 1 cm in the femoral head, two points for patients weighing more than 82 kg, one point for prior hip surgery, and one point for a UCLA (University of California Los Angeles) activity score of more than six. A SARI score greater than three positively correlates with early implant failure. Several of the components of the SARI score are also considered absolute contraindications for hip resurfacing by the U.S. Food and Drug Administration (FDA) (Table 1).

### Surgical Technique

#### Approach

Various surgical approaches have been previously analyzed for the risk of avascular necrosis. Blood supply is preserved with an anterolateral approach or trochanteric flip approach, but equal results are possible with a posterior approach. The posterior approach also shows a greater reduction in blood flow than the trochanteric flip approach during the initial exposure and capsulotomy, when blood flow drops the most. Blood flow is also impacted by femoral head reaming, which should be done with the reamer superolaterally in order to avoid damaging the retinacular vessels. Trochanteric flip and anterolateral approaches also show more superior oxygenation at the femoral head-neck junction than the posterior approach. Despite studies that suggest decreased blood flow and oxygenation with a posterior approach, McBryde and associates have shown no differences in successful outcomes between the posterolateral and anterolateral approaches when evaluating complications, additional surgery, implant survival, or Oxford hip scores. In the hands of the senior investigator (RHJ), we have not experienced any problems such as avascular necrosis or higher dislocation rates related to the posterior surgical approach. This could be due to recent evidence that extensive intraosseous anastomoses exist between the superior retinacular arteries, the inferior vincular artery, and the subfoveal plexus.

A modified and extended posterior surgical approach used for femoral head resurfacing is more demanding than the standard posterior approach used for stemmed femoral components. This modified approach provides the best exposure of the femoral head and acetabulum despite the increased risks to the medial epiphyseal and medial circumflex femoral arteries and to the sciatic nerve. The proximal half of the gluteus maximus tendon is transected to facilitate anterior displacement of the femoral neck and extreme internal rotation of the hip to visualize the femoral head. The gluteus minimus muscle is elevated off the pelvis and an anterior pouch is developed to house the femoral head and enhance exposure of the acetabulum (Fig. 1). A circumferential hip capsulotomy or capsulectomy is required to adequately mobilize the proximal femur.

### Component Positioning

Numerous studies promote the implantation of the femoral component in a valgus position over varus in order to reduce tension and shear stresses. Biomechanical
studies have shown that femoral neck strain with valgus alignment offers the best resemblance to the normal physiologic strain patterns.\textsuperscript{28} In a study comparing stem-shaft angles at 133° and 139°, a statistical difference was shown to favor 139° in terms of fewer complications.\textsuperscript{19} Complications can also arise if the femoral component is placed in too great a valgus position. This can lead to notching in the femoral neck, placing the patient at risk for femoral neck fracture.\textsuperscript{28} Other factors of component positioning to consider are complete coverage of femoral component, full seating of the femoral component, and maximizing the size of the femoral component, even if it is at the expense of acetabular bone. These techniques in component placement have collectively been shown to reduce overall complication rates from 13.4% to 2.1% and femoral neck fracture rates from 7.2% to 0.8%.\textsuperscript{27}

**Cementation**

A hybrid method of cementation is recommended; cemented acetabular components have been shown to have higher failure rates and are not recommended for use.\textsuperscript{27,29} Proper cementation of the femoral component requires correct cement viscosity, cement application, and mantle thickness. Cement viscosity affects penetration depth, with lower viscosity cement having the greatest (and least reproducible) penetration depths.\textsuperscript{30} Cement penetration depth is a key factor in resurfacing success because the interdigitation of cement and cancellous bone helps to seat the component on the reamed femoral neck. Ideal penetration, approximately 2 to 3 mm, must reach at least one level of transverse trabeculae, but not be so deep as to cause bone necrosis.\textsuperscript{31} The most reproducible method of cementation that achieves proper penetration depth is manual packing with high viscosity cement.\textsuperscript{30,31} Manual packing has been shown to be superior to all other methods of cementation including component filling.\textsuperscript{31} Component filling typically results in excess cement, with deeper penetration and larger cement mantles.\textsuperscript{31} Excess cement is believed to be a potential cause for implant failure; femoral components retrieved from aseptic loosening have shown more cement than femoral heads retrieved from fractures or nonfemoral failures.\textsuperscript{32} This aseptic loosening could also be due to the fact that thick cement mantles (1.5 mm) cause higher temperatures at the cement-femoral bone interface and, thus, pose a greater risk of thermal necrosis.\textsuperscript{31} Studies vary on recommendations of correct mantle thickness, with some recommending 2 to 3 mm and others recommending 1 to 2 mm.\textsuperscript{1,30,34}

High risk patients, such as those with a small femoral component size or large femoral defects (greater than 1 cm), have special considerations with cement technique. Cementing the metaphyseal stem may be effective for these patients.\textsuperscript{35} These same high risk hips might have additional drill holes made in the femoral head in order to increase the cement fixation area.\textsuperscript{34}

**Conclusion**

It is strongly recommended that all surgeons who wish to perform hip resurfacing be educated in proper patient selection and in correct surgical techniques specific for this procedure, including surgical approach, component positioning, and cementation.\textsuperscript{27} Reports in the literature from experienced surgeons often use less rigorous patient selection criteria. These surgeons typically have extensive experience (more than 500 hip resurfacings performed). For less experienced surgeons and newcomers to the procedure, the safest and most successful approach to performing hip resurfacing is proper patient selection and training at a site with an experienced surgeon. The details presented here are an excellent starting point to achieve higher success rates with metal-on-metal hip resurfacing.

**Disclosure Statement**

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