5 points on

Hip Resurfacing

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Hip resurfacing has enjoyed a resurgence in popularity as an alternative to total hip replacement (THR) for the treatment of end-stage arthritis in younger, active patients. However, technical difficulties in implant positioning have been realized, as the procedure has been introduced amongst surgeons new to the concept. Furthermore, as the follow-up interval increases beyond the short-term, it is evident that certain issues with the metal-on-metal bearing surface may lead to complications.

These 5 points on hip resurfacing are selected to highlight the factors that will help ensure an optimal outcome.

1 Patient Selection

The selection of the appropriate patient for hip resurfacing is of first and foremost importance to ensure its success. Several factors are discussed below with regard to patient selection.

Demographic Considerations

Age. Numerous studies have demonstrated superior results of resurfacing in younger patients; this is encouraging, given that these patients are the most challenging upon whom to perform arthroplasty. The probable reason for improved results in younger patients is that the bone quality of the femoral head and neck is better than in the older patient. This translates to a lower risk of femoral neck fracture, the number one reason for early failure. In examining the Australian Registry,[1] which has captured information on hip resurfacing since 2000 and now has 7 years of follow-up information, men younger than 65 years have the best results with hip resurfacing, with a revision rate comparable to conventional THR (Table). In men older than 65 years, and in women of all age groups, the revision rate for hip resurfacing was greater than that of total hip replacement at all follow-up time intervals.

Gender. As discussed in the previous section, women have inferior results with hip resurfacing when compared to men. The Australian registry[1] has further stratified their data by implant size. When femoral implant size was controlled for size, less than 50 mm or 50 mm and greater, gender had no effect. In other words, women fared as well as men if the femoral implant size was greater than or equal to 50 mm. Despite this data that gender may be a surrogate for bone size and therefore lead to poorer results, there are several publications that highlight an increased rate of complications due to the metal bearing in women.[2,3]

Thus, the use of hip resurfacing in women is to be carried out with the understanding that the procedure has a greater risk than in men.

Table. Revision Rate (%) of THR and HRA in Men, Stratified by Age

	1 year	3 year	5 year	7 year
THR <55	1.2	2.7	3.7	4.6
HRA <55	1.3	2.3	3.2	4.2
THR 55-64	1.5	2.8	3.6	4.9
HRA 55-64	1.6	2.3	3.3	4.3
THR ≥65	1.3	2.4	3.3	4.4
HRA ≥65	3.3	4.3	5.0	6.0

Weight. Although some studies have cited obesity as a contraindication to hip resurfacing, Le Duff and colleagues[4] demonstrated that a high body mass index (BMI) (ie,> 30) was not a risk factor for femoral neck fracture. Though a more technically demanding procedure, the success can be explained by good bone quality in these

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Figure 1. AP pelvis radiograph of a patient with bilateral coxa vara. The short femoral neck and decreased offset make traditional THR a better surgical option than hip resurfacing.

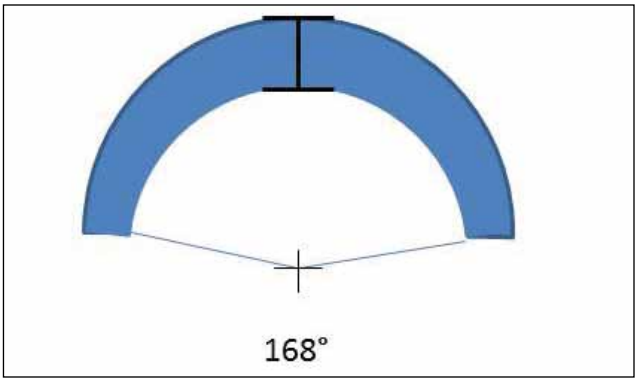

Figure 2. The lateralized center of rotation of the Birmingham Hip Resurfacing reduces the articular arc of coverage to less than 180°.

heavier patients. Thus, a high BMI need not factor into selection criteria other than for its impact on successfully performing the procedure.

Medical Considerations

Osteoporosis and osteopenia should be considered relative contraindications to hip resurfacing. A biomechanical study examining risk factors for femoral neck fractures in cadaveric specimens found osteoporosis and osteopenia[5] to be the greatest influence on the development of fracture.

Normal renal function is essential in clearing the circulating metal ions from the bloodstream. Hip resurfacing should be avoided in patients with renal insufficiency, as they may accumulate higher levels of cobalt and chromium in their bodies. Furthermore, patients at risk for renal disease must be carefully assessed; if a high risk of progressive loss of kidney function exists, hip resurfacing should be avoided.

Diagnosis

Osteoarthritis is the diagnosis with the best results after hip resurfacing.[6] Again, this is likely because the bone quality and architecture are superior to other diagnoses. Inflammatory arthritis is often viewed as a relative contraindication to hip resurfacing because of associated osteopenia. However, in younger patients with inflammatory arthritis, hip resurfacing may still be the logical first step in performing an arthroplasty.

Osteonecrosis of the femoral head has been shown to have poorer results with resurfacing than other diagnoses.[7] With a 93% survival rate from revision at 6.1 years, it is still a worthwhile endeavor in these younger patients.

Anatomic Considerations

Hip resurfacing arthroplasty has some limitations in dealing with anatomic abnormalities due to preservation of the femoral neck.

In patients with severe deformities resultant from Legg-Calve-Perthes or slipped capital femoral epiphysis, resurfacing may not be able to correct the anatomy, leading to inferior biomechanical results. A short femoral neck, as seen in congenital coxa vara (Figure 1), also would pose technical difficulty and a traditional total hip replacement would be a better option. In addition, hip resurfacing is unable to correct leg length discrepancies of greater than 1 cm in most instances. In these circumstances, a conventional THR may be preferred due to its ability to alter the proximal femoral geometry.

To summarize the patient selection process, the best outcome of hip resurfacing will be achieved in a man with osteoarthritis, younger than 65 years, with good bone quality, and normal renal function.

2 Implant Design

The selection of a hip resurfacing implant is of critical importance in ensuring successful outcomes. A surgeon must have knowledge of the implant design in order to insert it correctly. All hip resurfacing acetabular components have a circumferential arc of less than 180° (ie, less than a hemisphere). A recent study[8] has highlighted how different implants have varying arcs of cover that are affected by component size. The reduced arc of cover leads to a need for greater precision during insertion. The traditional view of inserting a cup at 45° of inclination will result in an excessively vertically oriented, or "steep," cup because of the reduced circumferential arc, possibly leading to edge-loading against the rim of the cup. For example, if the inner articular surface has an arc of 170°, an implant position that measures a 45° abduction angle will actually be 50° at the articulation. Since these dimensions may change with implant manufacturers and size of the implant, information about the implant geometry is needed for proper positioning (Figure 2).

3 Surgical Exposure

Whether performing a posterior, anterior, anterolateral, or trochanteric flip approach, the ability to visualize the patient's anatomy is critical in being able to achieve good results. This entails choosing an approach that is both comfortable to the

Figure 3. A tissue-sparing approach to the hip allows for preservation of neck retinacular vessels.

surgeon and extensile. The need to retain the femoral head and neck while the acetabulum is being prepared requires a larger exposure than a THR. Placing the cup through a smaller incision increases the risk of malposition.

Preserving vascularity of the retained femoral is also an important part of the surgical exposure. To protect the retinacular vessels along the femoral neck, we avoid the use of electrocautery when performing the capsulotomy to avoid inadvertent injury. Furthermore, a cuff of capsule is retained on the femoral side to avoid detachment of the retinacular vessels (Figure 3). Even with a posterior approach and dislocation of the hip joint, this tissue-sparing technique can preserve perfusion to the femoral head.[9,10]

4 Implant Positioning

It is now evident in several studies that acetabular component orientation is the most important factor in ensuring longer term success.[11,12] In order to ensure good tribology of the hip resurfacing implant and avoid edge-loading, extremes of acetabular positioning are to be avoided. The metal-on-metal bearing is less forgiving of malposition. As with any high performance piece of equipment, the tolerance for error is lower. Unfortunately, acetabular malposition was the most frequent reason for revision surgery in one series.[11]

To achieve optimal acetabular implant position, good visualization is necessary. Furthermore, a curved introducer is helpful to avoid conflict with the distal incision that may tip the introducer more vertically (Figure 4). The target for acetabular component inclination angle should be approximately 40°. In the sagittal plane, excessive anteversion must be avoided. A combination of femoral and acetabular anteversion should be no more than 45°.

With regard to femoral position, the resurfacing femoral head is ideally placed centrally upon the femoral neck. Any deformity of the femoral head must be ignored, and the placement of the femoral guide pin must be carried out with reference to the femoral neck. Although some surgeons initially recommended a more valgus position of the femoral stem,[13] a central position is adequate and may help avoid femoral neck notching. The sagittal plane of the femoral neck must also be followed when positioning the femoral guidepin. A guidepin placed in anatomic anteversion or slight retroversion is preferred.

Figure 4. A curved acetabular introducer allows placement of the component at a more desirable, horizontal angle.

Femoral component sizing is also a consideration. We measure the native femoral head in all cases to record the patient's starting head diameter. To balance the needs of hip joint motion with bone preservation, we will typically downsize the implanted femoral head by 3 to 4 mm. Since the acetabular component is generally 6 mm larger than the femoral component, this will make the implanted acetabulum 2 to 3 mm larger than the native head diameter. The reason that the implanted femoral component does not match the exact size of the native head diameter is that it would require excessive acetabular bone resection. With this technique, Su and colleagues[14] have demonstrated that hip resurfacing does not require any additional bone resection when compared to THR.

5 Postoperative Rehabilitation Follow-up

Finally, as with any surgical procedure, it is important to understand the subtleties of the postoperative rehabilitation to avoid injury during the recovery process. Although hip resurfacing is similar to conventional THR, preservation of the femoral neck does impart other potential consequences. Since there is a risk of postoperative femoral neck fracture, it is best to advise patients to be aware of this possibility. Most femoral neck fractures occur in the first 3 months, so we advise caution during this time. We advise against any impact activity and encourage the use of assistive devices to help offload the hip in the event of pain.

From a posterior approach, the iliopsoas muscle and tendon are stretched because of the rotation necessary to expose the femoral head. Therefore, we advise therapists and patients to avoid straight leg raising for the

first 1 to 2 months to avoid inflammation of the muscle-tendon complex.

The recent studies describing soft-tissue reactions around metal-on-metal hip resurfacings,[2,3,15] as well as the implant recalls (Zimmer Durom and Johnson & Johnson ASR), highlight the importance of patient follow-up. Because the metal-on-metal articulation can produce runaway wear if malpositioned, and metal hypersensitivity is a possibility, close initial follow-up of the postoperative patient is important. Blood metal ion testing can be a useful tool to monitor the amount of metal ion production; the British regulatory agencies have recommended measurement of blood metal levels if a patient has any symptoms (pain, swelling, mechanical findings).[16] Furthermore, cross-sectional imaging with computed tomography scan, magnetic resonance imaging, or ultrasound is advised if metal levels are elevated above 7 parts per billion.

It is imperative to perform regular follow-up examinations if the metal levels are elevated or there is evidence of abnormality on cross-sectional imaging, even if the patient is asymptomatic. If a patient has elevated metal levels and/or swelling in the soft tissues and is left in this situation, the danger is that this may progress to tissue necrosis and bone loss.

Conclusion

Overall, we believe these 5 points will aid in achieving optimal results with hip resurfacing arthroplasty. However, controversy still abounds about this procedure, as results of uncemented total hip arthroplasty have been excellent in the intermediate term. Many surgeons are still wary of the possible complications of the metal-on-metal bearing and are awaiting longer follow-up. Nevertheless, the results of the national joint registry of Australia[1] are encouraging, giving support to the use of resurfacing in the young, active, male patient.

Authors' Disclosure Statement

Edwin P. Su, MD provides consulting work to Smith and Nephew, Inc, the manufacturer of the Birmingham Hip Resurfacing implant. Although this represents a possible conflict of interest, the authors have attempted to eliminate bias by keeping the 5 points as generic as possible, with principles that apply to all implants. Dr. Sherwin L. Su reports no actual or potential conflict of interest.

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Erratum

In the article, "Hypothenar Hammer Syndrome" (*Am J Orthop.* 2012;41(8):380-382), the order of the study authors was reported in error. The correct order is as follows: David Dreizin, MD, and Jean Jose, MD. This was corrected online. *The American Journal of Orthopedics®* makes every possible effort to ensure the accuracy in its articles and apologizes for the mistake.