HIP RESURFACING 2011

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Abstract

In 1938 Marion Smith-Peterson placed a cobalt chromium cup on a reshaped femoral head to perform the first hip resurfacing.15 Also, in 1938, Philip Wiles performed the first total hip replacement.17 Both procedures revolutionized the treatment of hip arthritis. Most surgeons are opposed to hip resurfacing because it is difficult to perform and there is a high rate of success with total hip replacement. The early complication rate may be higher with resurfacing than total hip replacement. Total hip replacement provides very good long term results in elderly patients crippled with arthritis. Young patients present today for hip surgery hoping to perform physically demanding activities. They want a stable, durable, and highly functioning hip to match their active lifestyle. Patients fear a difficult revision procedure if they undergo total hip replacement at a young age. The functional outcomes with hip resurfacing are superior to hip replacement. Young patients, therefore, must decide whether the theoretical and practical advantages of hip resurfacing outweigh its possible disadvantages. We describe two new innovations for hip resurfacing procedures and synthesize the most recent resurfacing data.

Introduction

Hip resurfacing is an attractive concept because it retains and shapes rather than replaces the natural bone. Hip resurfacing is the conservative surgical option. Total hip replacement requires resection of the entire femoral head and most of the neck. The “radical approach”, however, is the conventional practice. Compared to hip replacement, hip resurfacing promotes more consistent load transfer. Resurfacing preserves the size and shape, and natural feel of the hip. Total hip replacement has been described as “the operation of the century.”6 While this did refer to the previous century, the benefits of hip replacement are quite remarkable. Total hip replacement is the procedure of choice for most patients in need of a surgical solution for severe damage to their hip joint. Therefore, there are two valuable alternatives for hip arthritis—Hip Resurfacing and Hip Replacement. The questions requiring answers are 1) Is hip resurfacing safe? 2) Is hip resurfacing effective? and 3) What is new in hip resurfacing surgery?

Methods

Today patients feel the need to review and synthesize the literature themselves. We feel this is our responsibility. There is lag, even in the digital era, between published information and current knowledge and practice. Also, without a filter or perspective, misperceptions are possible. This report is an attempt to provide the most current hip resurfacing information. We are including the most recent innovations as well as a look at what has been published in the three most respected peer reviewed orthopedic journals: Clinical Orthopaedics and Related Research, The Journal of Arthroplasty

The author certifies that he has no commercial associations (consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest with the submitted article.

The author certifies that his institution has approved the human protocol for this investigation and the investigation was conducted in conformity with ethical principles of research and that informed consent was obtained.

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and The Journal of Bone and Joint Surgery. We have recorded our results as specific comments to the stated concerns voiced by patients and surgeons. Our literature review encompasses 60,000 published resurfacing procedures.

We also examined 2026 of our own patients to determine the results of their hip resurfacing procedure. Our procedures were consecutively performed and our patients were prospectively enrolled. All procedures were performed with informed written consent. We have had many years of experience in hip resurfacing procedures. No resurfacing procedures were performed as part of investigational trials. No recalled or unapproved devices were used.

**Issues Identified in the Literature**

There were fifteen concerns relative to hip resurfacing.

1. *Hip resurfacing is new and it is a fad:* Hip resurfacing is as old as hip replacement (73 years). Haboush performed what appears to be the first hip total hip resurfacing in 1951 with Smith-Peterson performing femoral head (no socket) resurfacing in 1938. Charles Townley began performing femoral resurfacing in 1951 with an implant very similar to the one we use today. John Charnley used Teflon to perform total hip resurfacing starting in 1958 and Townley began performing total hip resurfacing in 1960 using polyurethane.

2. *Hip resurfacing is unproven:* The literature includes data on more than 60,000 hip resurfacing procedures. The success rates reported vary from 0% (all failed) for the first report (Haboush 3 patients) to 100% for metal-on-metal. Most contemporary series report a success rate of approximately 95%.

3. *Resurfacing did not work before:* The results from resurfacing were consistently less favorable than with total hip replacement using the prior generations of resurfacing devices.

4. *Hip resurfacing is not any better:* The literature finds that total hip replacement and total hip resurfacing are highly successful procedures. Functional recovery, absence of restrictions, gait cadence and return to impact loading activity is superior with resurfacing. Resurfacing patients have an average Harris hip score of 95 (excellent).

5. *Metal ions are harmful:* Most modern hip resurfacing procedures use metal-on-metal prostheses. Cobalt and Chromium ions are found in the blood and joint fluid of all resurfacing patients but systemic reactions are rare (none so far with Birmingham or Conserve resurfacing). There is no increase in late malignancy. Metal ion release may also be high with some metal-on-polyethylene total knee and total hip replacement procedures.

6. *Minimally invasive total hip replacement procedures are better:* Rapid and complete recovery from minimally invasive hip replacement is commonly reported. There are also reports that find no difference between minimally invasive approaches and conventional surgery. There has been a gradual and progressive trend toward smaller surgical approaches for all hip procedures. There are also reports of an increased rate of complication with very small incision total hip replacement. Direct anterior procedures for total hip replacement have a higher published complication rate than posterior and anterolateral approaches and require the use of a curved femoral prosthesis. The direct anterior approach is the original approach for hip arthroplasty as described by Smith-Peterson in 1938. There is no peer-reviewed, controlled, randomized study documenting that one surgical approach is superior to another for either resurfacing or total hip replacement. We offer all three approaches for hip surgery and tailor the approach to the individual circumstance of a particular patient.

7. *The complication rate from hip resurfacing is higher than with total hip replacement:* There are femoral neck fractures with hip resurfacing (up to
1%) but there are no femoral shaft fractures. The dislocation rate is much lower (<1%) for resurfacing procedures. There may be a slightly higher risk of heterotopic bone formation with resurfacing. Deep prosthetic Infections are less common (<0.5%) and easier to treat in resurfacing patients compared to total hip replacement patients as the femoral medullary canal has not been opened.

8. Resurfacing requires a larger surgical exposure: Yes, but there is less penetration into the femur. Blood loss is less with resurfacing and markers for tissue injury suggest there is less tissue damage with resurfacing procedures compared to all types of total hip replacement. The slightly greater surgical exposure for resurfacing is necessary to provide safe access to the hip socket without removing the femoral head and neck.

9. Recovery from resurfacing takes longer: The average length of hospitalization is one day shorter with resurfacing compared to total hip replacement. The time to return to activity was less with resurfacing compared to total hip replacement among 106 patients who had a total hip replacement on one side and a resurfacing on the other. Patient satisfaction and hip scores were higher for the resurfaced hip in this group.

10. Hip resurfacing is more technically difficult to perform: Hip resurfacing takes longer and is more difficult to perform than total hip replacement. Also, the learning curve is steep. Consistently positive results are not seen with hip resurfacing until a surgeon has performed 300 procedures. Highly experienced total hip replacement surgeons do not perform better than novice surgeons as they learn the completely different resurfacing procedure. Manufacturer sponsored training in hip resurfacing is not sufficient training to perform hip resurfacing surgery. Extensive experience is the only proven method of achieving satisfactory outcomes.

11. Hip resurfacing does not preserve bone: There is always more femoral bone preserved with resurfacing procedures. There is no difference in acetabular bone removed during total hip replacement and most hip resurfacing procedures.

12. Hip resurfacing results in significant stress shielding: For younger total hip replacement patients stress shielding, prosthetic wear and loosening are the common failure modes. The presence of a medullary stem with inside to out loading of the femur results in stress shielding in all patients and with all total hip implant designs.\(^{14}\) There is modest remodeling of the femur with resurfacing implants. The femoral component of a resurfacing prosthesis rarely fails from stress shielding. There is much less stress shielding with hip resurfacing than total hip replacement.

13. After hip resurfacing you will need a total hip replacement later: Most resurfacing procedures will not fail during the patient’s lifetime.\(^{9}\) Hip resurfacing surgery is not a pre total hip replacement procedure.

14. Hip replacement following hip resurfacing is a problem: In highly experienced hands, revising a hip resurfacing procedure to a total hip replacement, when necessary, yields the same results as primary total hip replacement.

15. The cost of hip resurfacing is more: Resurfacing procedures cost less than total hip replacement. Surgeon’s fees are the same (despite the higher level of difficulty). The length of hospitalization is less, blood transfusion is not necessary, and the simple resurfacing prosthesis is less costly than high demand total hip prostheses.

**Clinical Results**

95% of our hip resurfacing patients reported they could perform each and every activity they desired. These patients claim they have no limitations. There was one dislocation. Limb lengths were within 1 cm of equal for all patients. The other complications with hip resurfacing were not differ-
ent when compared to a similar cohort of total hip replacement procedures.

We identified 53 (4%) failures requiring secondary surgery within the first four years following hip resurfacing. 32 failures were related to the bearing surface. 19 were related to failure of osteointegration of the acetabular prosthesis. There were 2 femoral neck fractures occurring within the first four years.

Discussion

Hip resurfacing has the following advantages:
2. Bone retention.
3. Reduced blood loss.
4. Reduced stress shielding.
5. Less risk of dislocation

Hip resurfacing has the following disadvantages:
1. Higher early failure rate (defined as reoperation within first 4 years)
2. Hip resurfacing can only be safely performed in centers where significant experience exists.
3. Resurfacing is only for young active patients with good bone quality.
4. Hip resurfacing is only appropriate for patients who appreciate the risks and are emotionally able to accept the possibility of an unexpected early failure. There may be a need for additional surgery following hip resurfacing.

Polymer Hip Resurfacing Sockets (Figures 1, 2 and 3)

Metal-on-metal resurfacing is a good solution for the difficult problem of providing a thin, strong and enduring prosthesis for young patients with high
expectations for activity. A few patients should not receive metal-on-metal prostheses. These are patients with renal insufficiency and proven metal hypersensitivity. Recently it has been suggested smaller (women) patients are not good candidates for metal-on-metal hip resurfacing. Some patients with metal-on-metal implants generate an excess of metal ions in the tissues over time. This condition is called metallosis and results in an unsatisfactory outcome.

Polyethylene in the past was not entirely successful as a bearing surface for resurfacing. Cross linking has improved the performance of polyethylene.

Because of the improvements in polyethylene and concerns about metal-on-metal, we are again using polyethylene for both revision and certain primary resurfacing procedures. We do not have long term data but using a polyethylene acetabular bearing surface avoids the concerns of metallosis. Cross linked polyethylene is only available, at this time, for smaller sized components.

**Titanium Resurfacing Sockets** (Figures 4, 5, 6 and 7)

Total hip replacement sockets are two pieces with a titanium outer bearing and a polyethylene, ceramic or metal inner bearing. The typical resurfacing acetabular component is one piece and entirely cobalt chromium. Acetabular components may deflect (microscopically) on impaction. The most minimal compression of the acetabular component can increase the possibility of metallosis.

Titanium is the far superior material for osteointegration. Cobalt chromium sockets were in common use for many years for total hip replacement but only titanium is currently used. It is now possible to use two piece components for hip resurfacing as well. They are thicker, however, which means the two piece components are only suitable for patients with sufficient acetabular bone.

The two piece acetabular prostheses we are using are appropriate for both hip resurfacing and replacement. They have a titanium outer shell and inner cobalt or polyethylene bearing that articulates with the cobalt femoral component. With total hip replacement, we accommodate the thicker acetabular construct by reducing the femoral head to any desired diameter. We do not reduce the natural femoral head diameter during hip resurfacing surgery. Procedures using the two piece socket are more precise, demanding and unforgiving compared to the standard one piece socket. We have had no failures, so far, with the two piece acetabular components we have used in selected hip resur-

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**Figure 4.** Preoperative AP x-ray with severe hip arthritis

**Figure 5.** AP x-ray of a titanium-cobalt hip resurfacing
facing procedures. Long term data, however, is not yet available. There are three reasons to consider a two piece acetabular component for resurfacing:

1. Superior osteointegration
2. Alternative of polyethylene bearing surface
3. Lack of deformation of bearing surface

Developmental Projects

We continue to explore alternative bearing surfaces. These include other polymers (urethanes), Poly-Ether-Ether-Ketone, and Ceramics. None of these materials are currently approved for implantation. The laboratory wear simulator testing has been completed. We are not certain which of these areas of inquiry have the most promise for our patients.

We are using computer navigated robotic assistance for total hip replacement. We will use this technique for resurfacing when our testing validates its safety and efficacy.

Hip Recall

A common concern has been the highly publicized recalls of two hip prostheses. These implants were primarily used for total hip replacement but occasionally for hip resurfacing. These were the ASR (DePuy Orthopedics Inc.) and the Durom (Zimmer, Inc). Neither implant was used very much in the United States. The common resurfacing prostheses in the United States have been the Birmingham-BHR (Smith&Nephew released in the USA 2006) and the Conserve-C+ (Wright Medical 1995). Both the Birmingham and Conserve have excellent published track records.

The reason for the ASR recall was adverse wear. There was at least a 12% incidence of metallosis. A 3-5% incidence of metallosis would be consistent with other available devices. The Durom was recalled for failure of osteointegration. Both DePuy and Zimmer have a long history of providing safe and successful hip prostheses and both companies are market leaders.

Most patients with recalled devices have no adverse findings relative to receiving their prosthesis. They require only monitoring. Also, most patients with concerns do not have a recalled device. Patients with the ASR and Durom devices should be evaluated by an orthopedic surgeon with in-depth knowledge and significant experience treating complications from resurfacing prostheses. X-rays and serum cobalt levels are recommended. For additional concerns advanced imaging with MRI or
ultrasound can be helpful. We often aspirate fluid from the hip joint in cases where there is a high concern for metallosis.

The cobalt level will be elevated in essentially all patients with metal-on-metal joint prostheses. Cobalt levels less than 10 mcg/L suggest that metallosis is not an issue. We follow patients with cobalt levels up to 20 mcg/L. Patients with moderately elevated Cobalt levels are not served by removing their prosthesis. Recalled prostheses are only removed if there is a clear cut complication.

Revision Hip Resurfacing

The revision options for a problem hip resurfacing procedure are individualized. Total hip replacement is not the only revision alternative. If the failure is on the acetabular side only, we usually perform a revision of the hip resurfacing procedure. In experienced hands, the outcome from revision surgery is usually favorable. We have not seen systemic illness from elevated cobalt levels following resurfacing prostheses but there have been very rare case reports of systemic cobalism both with metal-on-metal total hip replacement and metal-on-polyethylene or ceramic-on-polyethylene total hip and total knee replacement prostheses.\(^4\)

Conclusion

Hip resurfacing provides a safe, effective and reliable solution for most young in patients who require surgery for hip arthritis. Total hip replacement is not the only revision option for a problem hip resurfacing procedure. New developments are the availability of two piece acetabular components for primary and revision resurfacing indications. Additional bearing surface alternatives and robotic guidance are developmental topics.

References