TOTAL HIP REPLACEMENT SURGERY: NEW TECHNOLOGY AND TECHNIQUES

INTRODUCTION

As hip replacement surgery has become more successful and commonplace there has been increasing demand for implants and surgical techniques to provide for a more normally functioning artificial joint with ever shorter recovery periods and greater implant durability. And as interest in these goals has risen, much hype and hope has made its way prematurely into the lay press regarding new developments. As a consumer, it is often difficult to separate the new and unproven yet promising from the new and unproven yet risky developments. This paper is an effort to sort this out.

THE PROBLEM

Hip replacements, being man made moving parts, have always faced the dual prospective problems of wear and loosening leading to failure after 10 to 20 years of use. As baby boomers living active lifestyles enter their 50’s and 60’s they are reaching the age at which they begin to face the problem of dealing with worn out painful hip and knee joints. As improvements in health care have led us to expect to live active lifestyles well into our 80s and beyond, the necessity for the development of hip implants of greater durability is obvious. And with the ever quickening pace of our modern lifestyle, demands are similar to develop surgical techniques that are less invasive and provide for quicker recovery.

PREVENTION OF IMPLANT LOOSENING

In the early days of hip replacement surgery, all implants were cemented to the bone. Cemented implants would generally last 10 to 20 years before showing signs of loosening. Over the last 25 years, techniques of eliminating the cement by coating the hip implants with a porous surface into which bone will grow have been largely perfected. For many patients the need for cement fixation in hip replacement surgery is a thing of the past. Cementless porous fixation of the femoral (ball) and acetabular (socket) components is successful in all but a tiny percentage of patients. And once the bone has ingrown into the implant’s porous surface (which usually occurs in the first 6 weeks after surgery), the risk of implant loosening largely is eliminated even after many years of use.

PREVENTION OF WEAR OF THE ARTICULAR BEARING SURFACE

Traditionally the articular bearing surface in hip replacement surgery has been a metal ball articulating with a plastic cup. The plastic cup (which is typically snapped into a metal shell fixed into the pelvis) will wear down in 10 to 15 years frequently requiring replacement at that time. The plastic wear particles can be damaging to the bone causing bone eroding cysts to develop. Alternatives to the metal and plastic bearing surface have been developed.

Ceramic on Ceramic Bearing Surface:

One alternative to the conventional metal ball articulating with a plastic cup is the development of ceramic on ceramic bearing surface. Their chief advantage is its insignificant wear rate. Its disadvantages include the fact that ceramics are a form of glass and thus brittle and difficult to utilize. There is a risk of late implant fracture creating a hip full of glass shrouds. And due to design constraints, the cup can not be designed as deep or the ball as large thus leading to a greater risk of hip dislocation.
Metal on Metal Bearing Surface:

A second alternative to the conventional metal ball plastic socket is the development of the metal on metal bearing surface. The metal on metal construct (a metal ball articulating with a metal cup) has the advantage of being very durable with almost no wear. There are few design constraints in the metal on metal systems. Thus the cup can be made deeper and the ball bigger resulting in the hip being more stable. The effect of these design advantages is to minimizing the risk of postoperative hip dislocation. The chief disadvantage of metal on metal articulations is the generation of metal ions from the friction of motion at the bearing surface. Despite intense epidemiologic efforts, no adverse health issues have been identified as a result of these metal ions.

MINIMAL INCISION SURGERY

Minimal incision hip replacement surgery has blossomed to the point of almost being standard of care. Minimal incision surgery involves making a smaller skin incision and “minimizing” the deep dissection of muscle and ligament tissue. Smaller surgical exposures can make the procedure more difficult, and surgeon experience is required. The end result of minimal incision surgery produces an operation associated with less bleeding, less immediate postoperative pain, shorter time using ambulatory aids such as a walker or cane, and a generally faster rehab program. Thin patients with straightforward anatomy can have surgery through 7 cm (3 inch) incisions. Larger patients or patients with more complicated anatomy may require somewhat longer skin incisions to safely perform the operation. Patients should remember that it is not the length of the skin incision that makes an operation “minimal”, but instead it is how the deeper muscle and ligaments tissues are handled and protected.

Two surgical approaches have become popular. They are the anterior approach and the posterior approach.

The Anterior Minimal Incision Approach:

Advantages: The muscles and ligaments in the back of the hip are totally protected. Since most hip dislocations occur posteriorly, the incidence of postoperative hip dislocation is reduced with this approach. In theory, no specific postoperative precautions to prevent hip dislocation are required, though prudence is recommended (remember, the risk factor is never “zero” in any surgical procedure).

Disadvantages: Nerve and vascular damage is more likely to occur with the anterior approach. The operation itself is somewhat more difficult and takes longer to perform. Exposure of the femur can in some cases be particularly difficult, and there is a somewhat increased risk of intraoperative fracture if the bone is weak or osteoporotic. If the adequate exposure can not be obtained, intraoperative bail out to a more extensile approach is difficult. Patients with severe deformities, flexion contractures or significant obesity are not ideal candidates for this approach.

The Posterior Minimal Incision Approach:

Advantages: The operation is easier to perform, no special equipment is required, and there is less danger of intraoperative damage to the nerves, vascular system, and bone. The procedure generally takes less time to perform. And if exposure is difficult, extending it to a more conventional full exposure is straightforward. Essentially all patients are candidates for this approach.

Disadvantages: The sole disadvantage is a somewhat greater risk of posterior hip dislocation. To assess the magnitude of this particular risk / disadvantage, a patient needs to determine their surgeon’s dislocation rate. My personal dislocation risk with the minimal incision posterior approach is less than 0.5%.
The Hype: Anterior vs. Posterior Approach:
Unfortunately, there has been much unsubstantiated hype in the lay press regarding advantages of one approach (anterior vs. posterior) over another. Much of this stems from surgeons and hospitals efforts to advertise and market their skills in an effort to gain market share. Ethics of this marketing approach are unclear. What is clear is that there is no convincing evidence that one surgical approach is superior to the other. Hospital stay, postoperative narcotic requirements, speed of rehab, time spent on a walker or cane, time back to sports and work, and other parameters of judging a successful result are similar when the operation is performed by an experienced hip surgeon. In conclusion, choose your surgeon based on other factors, and let your surgeon choose your technology and technique. Be prepared to ask the hard questions of your surgeon regarding experience, complications, and outcomes.

RESURFACING HIP ARTHROPLASTY
The resurfacing hip arthroplasty was first pioneered 30 year ago. Its basic concept is preservation of the femoral head bone stock. Instead of the femoral head being resected and discarded at the level of the base of the femoral neck as in conventional hip arthroplasty, the femoral head in a resurfacing procedure is preserved by carefully shaping and contouring it. A metal cap is then cemented to the preserved femoral head. Previous versions of resurfacing hip replacements often failed due to a poorly designed socket. The socket problems seem to have been solved. However other issues remain.

Advantages of Resurfacing Arthroplasty:
1. The chief advantage of resurfacing hip replacement is the preservation of the femoral head. Saving bone, especially in young patients, is intuitively desirable.
2. If the resurfacing hip replacement fails, it can be converted in a straightforward manner to a conventional cementless hip replacement. The socket of the resurfacing replacement can be used without revising it.
3. The bearing surface is metal on metal, the most durable of all bearing surface alternatives.

Disadvantages/Risks of Resurfacing Arthroplasty:
1. The femoral component must be cemented. Cement will crack and loosen over time leading to the need for further surgery. Since resurfacing procedures are typically recommended for younger high demand patients, the use of any cemented implant is less desirable since cementless alternatives exist (see above).
2. The blood supply to the femoral head is precarious. It can be damaged intraoperatively leading to death of the bone of the femoral head, a condition known as avascular necrosis (AVN). Femoral head AVN leads to femoral component loosening and subsequent revision surgery.
3. Resurfacing arthroplasty puts significant stresses on the preserved femoral neck. Occasionally femoral neck fracture at the base of the metal femoral cap can occur, again leading to the need for revision to conventional hip replacement.
4. Because of the risk of fracture, resurfacing arthroplasty is contraindicated in any patient at risk for osteoporosis.
5. Minimal incision surgical techniques cannot be employed in resurfacing hip replacement. The reason for this is that the femoral head sits in front of the socket during surgical exposure. When it is removed during conventional minimal incision hip replacement surgery visualization of the socket is easy. When preserved in resurfacing procedures, the femoral head impedes socket exposure. It must be retracted out of the way, which requires a significant soft tissue dissection of the deep muscles and ligaments in order to gain this exposure.
6. Range of motion and hip stability are not as great in resurfaced hips as in large femoral head metal on metal conventional hip replacements (contrary to some lay press marketing).

**The Hype: Resurfacing vs. Conventional Hip Replacement:**

Much has been written of late in the lay press regarding this “new” procedure, the resurfacing hip replacement. Some of what is written is true. Some is hype. Buyer beware: though hip resurfacing may turn out to be a successful option for the young active patient, previous versions failed and opting for this intuitively attracting surgical strategy carries risk.

**CONCLUSION**

New technology and surgical techniques continue to improve both the actual hip replacement implants and the method by which the surgeon inserts them. Patients should keep in mind that not all that is new, and especially not all that is hyped in the lay press, proves durable over time. Many new seemingly good ideas come and go as the initial hype wears off and they are examined more critically and scientifically. Best advice: pick your surgeon; let your surgeon pick your technology.