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Revision Hip Replacement

Revision hip replacement refers to the procedure to repair or replace a failed first hip replacement. Over the past three decades total hip replacement has become one of the most important surgical procedures to return patients to active, contributing members of society. The surgical procedure to replace a worn out, painful hip with prosthetic components (primary total hip replacement) has been performed on millions of patients with great results and overall few complications. Once reserved for the senior citizen with a sedentary lifestyle, total hip replacement is rapidly becoming an operation in demand by a mid-life, still working patient population who demand high function and long lasting mechanical properties to coincide with a highly active lifestyle.

Recent studies have confirmed that roughly 300,000 total hip replacements are done annually in the U.S with projected growth to reach 570,000 procedures each year within the next two decades [1]. It is expected that 50% of all total hips done will be on patients that are less than 65 years of age within the next few years [2]. Fortunately, with modern techniques, equipment, and implants, the hip replacements put in today have a 90% chance of lasting 10 – 15 years.

Despite the success achieved with most primary total hip procedures, factors related to implant longevity and a younger, more active patient population have, for a variety of reasons, led to a steady increase in the number of failed total hip replacements seen every year. In these cases a revision hip replacement will be necessary to replace or revise the failed first replacement. The increasing demands placed on these implants by patients in terms of expected longevity and durability; and the insistence of patients to maintain their active lifestyles, even with a hip replacement, has presented a considerable reconstructive challenge to the surgeon. Currently, it is estimated that 18% of all hip replacement surgeries done each year are revision hip replacement surgical procedures [1].

Why revision hip replacement is needed

The most common situations that lead to the need for a revision hip replacement are instability / dislocation, mechanical loosening and infection. According to one national review study, instability issues account for 22% of all revision hip replacements, aseptic

loosening for 20%, and infection the cause of 15% of yearly revision hip replacement surgeries [3]. Periprosthetic fracture, component failure and osteolysis-related wear are the causes for the remaining revision hip replacements done each year. Of great concern looking forward is that infection by the year 2030 will account for 48% of all revision hip replacements that will be done [4]. This has grave economic implications, as infection is one of the most expensive complicating events related to joint replacement surgery.

Symptoms of a failed hip replacement

In almost all cases, the presenting symptom of a failed hip implant is PAIN! This is especially true if the implant is coming loose from the bone or there is an infection around the implant. Associated symptoms include stiffness of the joint or a persistent limp. In the case of instability or frank dislocation, the hip may feel just fine until which point, with even a slight twist, it disengages from the socket and pops out, leading to sudden pain and an inability to bear weight on the involved leg.

Each of these symptoms should be evaluated by the surgeon to help determine if the hip replacement has something wrong with it or if it is functioning as expected. A variety of tests are available to the surgeon and often many of them are necessary to sort out the issues that have left the primary hip replacement dysfunctional. Many of the common causes for failed total hip which would lead to the need for a revision of part or all of the prosthetic implant are discussed below.

For a hip replacement to function well, the ball must be retained within the socket at all times. Several factors must work in concert to keep this mechanical relationship intact, including proper alignment of the acetabular prosthesis (the socket) and the femoral prosthesis (articulating ball part). In addition, the muscles that attach to both the pelvis and the femur must be strong and able to withstand pressure. Sometimes the muscles of the elderly patient are quite weakened with age or health-related issues and are unable to hold the ball in the socket.

Hip dislocation in patient following a fall

Even if the positioning of the components is optimal and the muscles are functioning normally, it is possible to put the leg in a position that forces the ball out of the socket, a conditioned referred to as **hip dislocation**. Statistically this happens at a rate of about one in 25 hip replacements. This is more common when the hip is implanted using a posterior approach, which weakens the soft tissue structures supporting the back of the hip joint. The dislocated hip can often be relocated with sedation of the patient and closed manipulation of the hip back into position without a repeat surgical procedure.

For most patients, this event occurs within the first few months following surgery when the tissues that are disrupted at the time of surgery are healing and gaining strength. Most

commonly hip dislocations happen only once, but on rare occasions it can happen again and even repeatedly. If this occurs, the hip will need to be revised once the cause of this instability can be determined. Instability issues about the hip are the most common causes for a hip to be revised.

Mechanical loosening

In most hip replacements there is a metal stem that is fixed inside the tube-like femur (thigh bone) upon which is perched an articulating ball bearing; and a metal cup that is fixed within the acetabulum of the pelvis (socket) containing a bearing surface on the opposite side within which rides the ball bearing. The socket bearing surface is commonly a plastic (polyethylene) or a ceramic (glass); the ball bearing is commonly a highly polished metal or ceramic. Each of these come is variable sizes and are mixed and matched by the surgeon for various mechanical properties and chosen as each situation demands.

Despite constant improvement in the articulation of hip replacements, a certain amount of wearing is going on over time due to friction between the ball bearing and the socket surfaces. This mechanical wearing generates very small particles of metal, ceramic, cement, or plastic which in turn collect in the tissues about the hip joint. The patient's immune system has cells which clean up these foreign particles and dispose of them. Interestingly, this normal protection response can lead to the resorption and destruction of the bone that supports the socket and the stem through a process known as "**osteolysis.**"

Extensive osteolysis consistent with mechanical loosening.

As this resorption continues over time, the components reach a tipping point where the bone can no longer hold the prosthesis solidly and it starts to move within the bone. This is when the pain typically starts to become problematic. Early on the pain is often just with startup, like when getting up from a chair or out of bed in the morning and will improve as walking continues. Later in the process, the pain can be constant, even when at rest.

When the femoral component comes loose, the pain is felt in the anterior aspect of the thigh; and when the socket component loosens, the pain is felt in the groin. Regular checkups with the surgeon for an exam and X-rays can often detect signs of impending loosening and it may be suggested to intervene with a revision surgical procedure before the pain starts.

Infection

In sorting out persistent pain around the hip, infection is a distinct but uncommon diagnosis reported to occur in less than 1% of all total hips ever getting infected in most

studies of this issue. Fortunately, there are many other causes for pain around the hip joint other than infection, but infection always remains a diagnosis that must be considered in dealing with painful hip replacements.

Nevertheless, as a cause leading to revision hip replacement, infection is the third most common. In several studies which assess the causes of primary hip replacement failure, infection of the joint is the most challenging and potentially devastating cause with 15% of all revision hip replacement procedures being done for this reason [3]. If an artificial joint becomes infected, the pain is typically more constant than with a loose but non-infected joint, but symptoms greatly vary with the type of infecting organism. Along with pain, symptoms include a stiffening of the joint, making movement quite difficult. On rare occasion, a prosthetic joint infection can make the patient systemically ill with fever, chills, weight loss, and lethargy.

Infection of a hip replacement can occur at any time after surgery, sometimes many years after surgery. The risk, however, is higher in the first few weeks following a surgical procedure. A sudden change in the pain around a hip that has otherwise been recovering normally should be investigated. The challenge in this situation is that many of the laboratory studies will not be helpful in sorting out normal healing from a low-grade infection. Superficial wound infections are typically identified by a dramatic change in the appearance of the incision, but a deep infection around the joint itself can be hard to prove without some interventional study.

In assessing a hip for infection several steps may be needed as the diagnosis of an infection can be elusive. Plain X-ray studies can occasionally be helpful with observed changes at the interface of the bone and metal implant. Various studies including MRI, CT, and bone scans may be needed in addition to plain X-rays to assess the character and integrity of the supporting bone. Laboratory studies are frequently collected from the blood and fluid taken from the hip joint in an attempt to validate or refute the diagnosis of a joint infection.

Temporary antibiotic hip spacer.

Once the decision is made that a hip is infected, the surgical plan is typically as follows involving a two-stage technique. An infected joint routinely requires the removal of all parts of the hip replacement from the bone so that the infection can be cleared. The space occupied by the removed hip prosthesis is filled with an antibiotic laden cement spacer shaped like a hip prosthesis. This spacer serves to keep the soft tissues stretched out to proper length and provides antibiotic which leaches out of the cement spacer directly to the infected area over time.

In addition, 6 – 12 weeks of IV antibiotics are given, depending upon the infecting organism. Once this treatment is completed, it is commonly possible, through a second operation, to implant a new hip replacement into the now sterilized hip area.

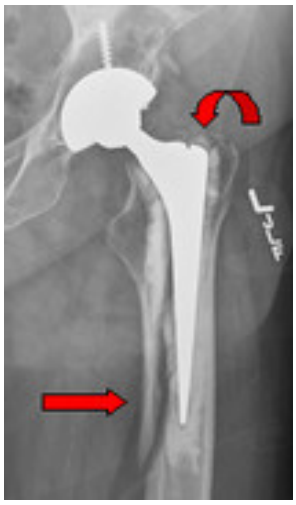
Although this complex series of surgical events frequently can salvage an infected hip replacement, there is still a high re-infection rate, with some estimates giving a disappointing 10 – 15% of hips revised for infection staying infected [5]. Persistent infection in a hip joint presents difficult decisions for the patient and the surgeon and each circumstance will require unique and individualized consideration.

Despite a variety of high technology, proving a joint to be infected remains one of the most challenging and elusive diagnoses and is an area of constant research to improve this discovery process. Some low virulent organisms can defy preoperative discovery only to present in florid fashion once a revision joint has been re-implanted for what was thought to be aseptic mechanical loosening; a very disappointing situation for a patient to face and harder yet to prove that the infection was present all along.

Fracture

A fracture may occur to the tube-like femur bone within which is fixed the femoral prosthesis with either bone cement or biologic attachment, or to the supporting bone of the pelvis to which is fixed the acetabular prosthesis. There is a wide variety of fracture patterns which occur, each having many possible solutions. A patient's age, activity level, and overall health will be weighed along with the various options to repair a fracture around a hip replacement.

The prevailing principal in dealing with any fracture around the hip is to gain stability of the fracture and then gain stability of the hip replacement. Both the bone and the prosthesis must be stable to allow any weight bearing. It is rare that full weight bearing is allowed before the fracture is healed. In addition, if the prosthesis comes loose from the fractured bone the surgeon will typically try to bypass the fractured area of the bone to obtain firm fixation on bone further down the shaft. On very rare occasions it may be necessary to replace most of the shattered femur with a very large hip replacement prosthesis referred to as an oncologic prosthesis, one that is used in cases where a tumor has destroyed the bone.



Pre-op periprosthetic femur fracture, loose femoral component, cracked cement mantle.

Post-op femur fracture stabilized - complex revision hip prosthesis.

Stabilizing a complex fracture of the femur or acetabulum while providing a hip replacement that will be stable, support weight, and hold up to normal activities is among the most challenging of reconstructive surgeries undertaken by the surgeon. Poor bone quality, advanced age of the patient, and lengthy surgical times are common obstacles faced by the surgeon when planning treatment for these difficult situations. Persistent instability of the hip joint and chronic pain problems are not uncommon after this type of revision hip replacement surgery. This can be very difficult surgery for even the most experienced surgeon and is often referred out to tertiary care and teaching facilities.

Preparation for revision total hip replacement

Since each failed hip replacement has a different reason for its failure, preparing for the revision hip replacement is also going to be unique. Specialized CAT scans or MRI tests may be needed to evaluate bone loss around the current implant or position of the prosthesis relative to the normal anatomy. Various laboratory or nuclear scans to check for infection may be indicated such as CBC, CRP, Sed. Rate, or Bone Scan. An aspiration of the hip joint may yield fluid that can be analyzed by cell count and culture. Finally, consultations with other medical or surgical specialists may be required to evaluate the medical condition or special circumstances of the patient prior to surgery, to optimize the outcome.

Despite thorough preparation, the risks involved in revision hip replacement surgery are increased several fold from the level of risk of a primary hip replacement. The surgery is more difficult and time-consuming; the soft tissues, nerves, and blood vessels more difficult to mobilize and protect; and the prostheses are more complex to implant properly into the supporting bone. The soft tissues become more difficult to stretch and the pain of revision hip replacement surgery can be an obstacle to full mobilization of the joint. Notably, it is important that patients realize that the revised hip frequently never reaches the same level of function as did the first hip replacement. Complications and chronic pain are far more common with revision hip replacement surgery than with primary hip replacement.

Surgical procedure

The approach into the hip is usually through the same incision used to put in the primary hip replacement. Often the incision must be extended in one direction or the other to expose the hip joint adequately. Dense scar tissue is always found surrounding the old hip prosthesis and much time and care is devoted to the removal of as much of this deep scar tissue as is needed to allow the hip joint to be positioned in such a way as to allow access to the implants to be removed. There are several clever techniques that each experienced surgeon knows to gain maximum exposure while disrupting as little of the supporting bone, muscles, and ligaments as possible.

Once the hip is exposed, the very important step of removing the old hip replacement is begun. When the reason for the revision hip replacement surgery is mechanical loosening, otherwise known as aseptic loosening, with extensive osteolysis of the bone, one or all components are not well-fixed to the supporting bone and can be removed with relative

ease. Unfortunately, when this is the case, there will be large cavitary bone defects that will need to be reconstructed in some manner to fill in these holes in the bone with either bone cement or bone graft.

In contrast, when the reason for the revision hip replacement is infection or instability, the implanted components are usually very well attached to the supporting bone and the removal of the prosthesis can be quite laborious and time-consuming. Great care is taken so that while removing the prosthetic implant, as little supporting bone is removed as is possible. The bone of the more senior patient is often quite osteoporotic and the process of removing the implant can result in fractures of the supporting bone, thereby greatly complicating the situation and leading to the need for a more complex implant than was originally intended. One trick that the experienced surgeon uses to extract the femoral component is to split the bone in a controlled fashion to allow access to the well-fixed stem. With the use of sophisticated burrs and other surgical instruments, the stem can be freed, and the femur put back together to hold the new prosthesis.

Once the implant is separated from the bone on both sides of the joint, samples of the biologic material that has developed in the defects of the bone may be sent off to the hospital lab for immediate analysis, especially if an infection is suspected. Sometimes, even when preoperative lab studies to assess for infection are negative, presentation at surgery may lead the surgeon to have concern that a low-grade infection is present. The material that is harvested from the area directly between the implant and the bone is often the best and only way that these occult infections can be found. If there is evidence that such a low-grade infection exists, the surgeon will not proceed with the re-implantation of a new, revision hip replacement at that time. Rather, an antibiotic spacer will be left in the hip temporarily, the operation ended, and treatment will proceed to clear the infection.

Revision hip replacement surgery is much different from that of performing primary hip replacement surgery as there are many variables that occur during surgery that, while anticipated, can change the course of the surgical procedure to one of increased difficulty and operative time. For instance, in almost all revision hip surgery procedures there will be bone loss around the implant. This occurs from either a biologic event such as osteolysis, where the bone is dissolved away through a complex series of biologic interactions between the plastic or cement debris and the cells of our bodies that clean up such things; or from infection, where the offending organism chews away at the bone; or from the resultant fracture of weakened bone in the removal of the implant.

In all of these cases the resultant structural bone defect must be reconstructed. Sometimes smaller defects can be ignored, and the new implants are chosen to bypass the weakened area, being fixed to a more solid part of the bone. Other times processed bone graft or even large pieces of bone are required to fill in defects for more biologic support. Large pieces of bone must often be shipped in prior to surgery and thus the preoperative planning for this need is just one of the many things the surgeon must anticipate for these complex reconstructions. In many large teaching hospitals, a bone bank is kept on the premises and bone graft is readily available during surgery.

In conjunction with the reconstruction of any bone defects, the surgeon will need to determine which of the many revision prostheses available is right for the current

situation. In most systems used today for this type of surgery, manufacturers of these implants have multiple and variable attachments to the implants which allow the surgeon to create the tightest and most stable construct possible while maximizing the normal motion of the hip.

Dislocation is one of the most common complications that occurs after revision hip replacement surgery and is a result of many adverse forces at work. Sometimes weakened musculature fails to keep the hip together. Other times the position of the components is not optimal. Still other times, the patient does not follow the instructions given and puts the hip at repeated risk through early over-activity. There are a variety of techniques known to the surgeon to improve the chances that the ball will stay in the socket after surgery, but dislocation is still a common event for the revision hip replacement patient.

Revision hip replacement summary

Revision hip replacement surgery is significantly more challenging to perform and fraught with many more complicating events than is found with primary hip surgery. It is truly more art than science to successfully complete some of these very difficult revision surgeries and achieve a stable, flexible and functional hip in the end. Many surgeons who feel comfortable doing primary joint replacement surgery will not tackle revision surgery because of these added challenges and risks.

From the patient's perspective, the recovery from a revision hip replacement can take much longer than what the patient remembers from the original hip surgery. In fact, it can take up to a year after surgery before the patient finds routine daily activities easy to do. Some patients will require some form of walking assistance in the form of a cane or walker for the rest of their lives. The final maximum range of motion achieved is often less than what the patient remembers their first hip replacement had reached and in fact, stiffness is quite common with revision joints. In addition, leg length discrepancies are more common with revision hip replacement surgery than with primary hip replacements and patients may need a lift in a shoe or have many of their shoes fixed with lifts to compensate for a shorter or longer leg.

Finally, revision hip replacement surgery has a less predictable longevity. Typically a revision hip surgery done for loosening or instability is secured to less healthy bone and as such will not bear up as well to the stresses of living as well as when the bone was of better quality when the patient was younger and more active. Additionally, if the revision was done for an infected hip replacement, the risk of a re-infection is high with studies that indicate that in 10 – 15% of the joints the infection is not cleared, and they become infected again [5]. Re-infected joint replacements are particularly difficult challenges for the patient and the surgeon.

Fortunately, despite the complexity for the surgeon and the prolonged rehabilitation for the patient – if the underlying cause for the failure of a total hip replacement can be determined, and a well thought out plan is executed well, a satisfactory outcome for revision total hip replacement can be as high, with up to 90% of patients having a good to excellent result. It is important to have an experienced surgeon and support staff to take on

the difficulties inherent to this type of surgery in order to improve the chances of achieving this high rate of success.

References

1. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg AM. 2007;89(4):780-785.

2. Kurtz SM, Lau E, Ong K, Zhao K, Kelly M, Bozic KJ. Future Young Patient Demand for Primary and Revision Joint Replacement: National Projections from 2010 to 2030. Clin Orthop Relat Res. 2009 Oct;467(10):2606-12.

3. Bozic KJ, Kurtz SM, Lau E, Ong K, Chiu V, Vail TP, Rubash HE, Berry DJ. The Epidemiology of Revision Total Knee Arthroplasty in the United States. Clin Orthop Relat Res. 2010 Jan;468(1):45-51

4. Kurtz S, Ong K, Schmier J, Mowat F, et al Future Clinical and Economic Impact of Revision Total Hip and Knee Arthroplasty. J Bone Joint Surg AM. 2007; 89(Suppl 3):144-151

5. Salvati EA, Chekofsky KM, Brause BD, et al. Reimplantation in Infection: a 12-year experience. Clin Orthop. 1982; 180:62-75