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Hip, Knee and Total Joint Replacement

HIP REPLACEMENT

The hip is your body's largest weight-bearing joint. This joint is also called a ball-and-socket joint. The ball is the upper end of the thigh bone (or femur), which fits into the socket (or acetabulum) at your pelvis. In a normal hip, cartilage covers the ends of these bones and cushions the hip joint for smooth, pain-free movement. When a hip is arthritic, the cartilage wears away, causing the bones to grind together. This produces pain and loss of motion. Total hip replacement surgery involves removing the diseased portion of the hip joint. An artificial hip, known as a prosthesis, replaces it. The worn hip socket is replaced by a cup, and the worn head of the thigh bone is replaced by a ball on a stem that is inserted into the thigh bone. These parts are made of metal and plastic and come in various sizes and designs.

Attempts at joint replacement for arthritic, painful hips date back to the 19th century. However, it was in the 1920's that the first realistic operation was developed that laid the foundation for what we know today as modern total hip replacement. These early operations used glass, and then a metal known as vitallium, to cap the arthritic femoral head or ball. This was known as mold arthroplasty. In these early days, no implants were placed in the acetabulum, or socket. The patient was then maintained non-weight bearing for weeks with range of motion exercises, and the intent was for this cap to "mold" a layer of fibrous tissue in the socket, effectively covering the arthritic surface, and hopefully relieve pain. This operation was very technique dependent, not very reproducible from surgeon to surgeon, and required an extended rehabilitation after surgery. Subsequent surface replacement designs attempted to improve on this basic theory, all with limited success.

The real breakthrough came in the 1960's, with the advent of Sir John Charnley's low friction arthroplasty. These were the first modern total hip replacements utilizing a fixed acetabular socket with an inner bearing, and a cobalt chrome femoral stem and ball that articulated with the socket. The initial choice for inner bearing surface of the socket was Teflon, which had a very low co-efficient of friction, but damaged and scratched easily. This wear couple did not last long. The breakthrough came when they began using a polymer, known as polyethylene, for the socket bearing surface. This provided durability, low friction, and excellent pain relief.

In the early days of total hip replacement, if a surgeon wanted to begin doing total hip replacement, he would have to travel to England and study with Dr. Charnley, learn the technique and then get Dr. Charnley's blessing to begin using his hip replacement design. Bone cement was used for both the femoral and acetabular components in this system, and in the late 60's and early 70's, to use acrylic bone cement in the USA, one had to obtain an FDA license to use bone cement in practice. As more surgeons learned this technique and American surgeons began training others, this requirement was dropped. New, but not always improved, designs were developed, and the inventories of implants increased. Different surgical techniques and approaches were developed to help make the surgery more reproducible by a greater number of surgeons.

With longer duration of follow up, surgeons began to realize the failure mechanisms of total hip replacement that lead to revision surgery. Early on, it was felt that the bone cement was the cause of the bone loss witnessed around implants after a number of years, and this was termed "cement disease." As the basic science and understanding of the biology of wear improved, bone cement was vindicated and the real culprit became known as osteolysis. Osteolysis simply means bone destruction. Osteolysis is the number one reason for long term failure of total hip replacement.

What is osteolysis? Simply, it is the body's response to a load of particulate wear debris. The large implants, commonly made of titanium, stainless steel or chrome cobalt, used in hip replacement are too large for the body's immune system to attack and are thus inert. However, the femoral head and acetabular socket form a wear couple, like a ball bearing. Over time, with walking, sitting, etc, as the femoral ball and socket wear against each other, microscopic particulate wear debris is formed. This debris is ingested by a certain type of white blood cell in the body. If too much of this debris is formed over time and ingested, it can trigger a response by the body and this response leads to an enzymatic cascade that can eat away at the bone around the total hip implants. This is osteolysis. Thus, the biggest challenge has been to find ways to reduce the amount of wear debris that is generated by hip replacement, thereby providing a more durable and long lasting solution for people who suffer from hip arthritis.

Today, we have available alternatives to standard metal on polyethylene bearing couples, including highly crosslinked polyethylene, ceramic bearings, and metal on metal bearings. Certainly, these offer hope for more durable hip replacement, but time and careful follow-up will be the true judge of their performance.

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