INTRODUCTION

Total hip replacement surgery (THR) has become a highly successful reconstructive surgical procedure performed in increasing numbers each year in an ever younger and more active patient group. However until recently two lingering issues affecting function and durability have remained. These include: 1) The limited life span of the artificial hip due to wear and loosening and 2) The potential for the hip to dislocate. Over the last two decades the problem of implant loosening has largely been eliminated as the use of cement to fix the hip implants to the bone has been replaced by dependable biologic “bony ingrowth” cementless fixation. Now new technology and surgical techniques are solving the remaining problems of wear and dislocation.

POLYETHYLENE (PLASTIC) WEAR

Historically the artificial hip has consisted of a cobalt-chrome metal ball articulating with a polyethylene (plastic) socket. The metal ball, being harder than the plastic socket, causes the plastic to slowly wear. The polyethylene wear particles produced by this process are released into the joint and cause an inflammatory reaction in the surrounding bone. This leads to the formation of bone cysts and structural bone loss called osteolysis. Over 10 - 15 years the plastic would frequently wear to the point of failure requiring revision surgery to change the plastic. Thus intense research has been directed at eliminating the plastic and developing a new more durable, longer lasting, wear resistant articulating surface.

HIP DISLOCATION

The major cause of THR dislocation in the past has been the fact that the metal ball of the hip replacement has been about half the size of the normal femoral head. The smaller the ball, the more easily it can dislocate from the socket. The increased risk of dislocation led to the development of standard postoperative “hip precautions”. These precautions have prevented THR patients from bending at the waist, flexing the hip more than 90 degrees, or crossing the legs. It was theorized that if the diameter of the artificial hip ball could be increased to near that of the normal hip, the risk of dislocation would be much less and postop hip precautions could be abandoned. Now new technology has led to this very development.

THREE NEW ALTERNATIVE BEARING OPTIONS

Recent advances have produced three new alternatives to the conventional metal ball on plastic cup articulation.

1) NEW PLASTICS: Altering the mechanical properties of the plastic by irradiation or by chemical means to make it more resistant to wear. Studies have shown that the new plastics are indeed more wear resistant, but that the process of wear is only slowed not eliminated.

2) CERAMICS: The development of a ceramic ball on ceramic socket articulation. Though ceramics show little wear, other problems exist. Ceramics, as a form of glass, are brittle and difficult to manufacture. There is risk of implant fracture and breakage. The cup, as currently designed, is quite shallow. The shallow cup design significantly increases the risk of postop dislocation. And finally there is the risk of the ceramic hip "squeaking" which can in some cases be sufficiently loud so as to require revision surgery.

3) METAL ON METAL: The use of a large head metal on metal ball and socket articulation.
THE LARGE HEAD METAL ON METAL BEARING SURFACE

The metal on metal ball and socket hip construct entails use of a highly polished metal ball (made of cobalt chrome – titanium cannot be used as it is prone to scratching) articulating with a similarly polished metal socket. The metal on metal design has been in use for decades in Europe and was released by the FDA for use in this country in 2004.

Advantages: Advantages of the metal on metal THR over other alternatives are several. Almost no surface wear occurs with metal on metal. The metal on metal construct is durable with little risk of implant breakage.

In addition, fewer design and manufacturing constraints are present with the use of metal on metal implants. Due to the strength of the metal, the socket can be made much thinner. Since the socket is thinner, there is room to make the femoral head (ball) much larger. In many current designs the diameter of the artificial femoral ball has increased in size to approximate that of the normal anatomic femoral head of the patient. As noted, the importance of the issue of head size is in its relationship to hip stability. The larger the diameter of the femoral head the more stable the hip and the less the risk of hip dislocation. The development of large head metal on metal hip replacements has improved postop hip stability to the point that the previously recommended “hip precautions” of not bending at the waist, avoiding hip flexion past 90 degrees, and not crossing the legs can usually be eliminated.

Risks: The major concern to date with the use of metal on metal hip technology is the generation of metal ions that occur due to the friction of the metal head rotating in the metal socket. These metal ions are picked up by the hip’s blood supply and are excreted from the body via the kidneys. Epidemiologic studies have looked exhaustively at several decades of data from Europe and at newer data generated in clinical tests performed in the USA for signs of adverse health affects or metal sensitivity issues. Thus far none have been found.

CONCLUSION: A HIP FOR A LIFETIME

The large head cementless metal on metal hip replacement is designed to be 1) fixed to the bone via cementless biological bony ingrowth so as to minimize the risk of loosening 2) to be resistant to any wear due to the hard metal on metal articulating surfaces, 3) to be durable and resistant to implant fracture and 4) due to the use of the “large head” design principal stable so as to largely eliminate the need for previously required hip stability precautions. Indeed, the large head metal on metal hip

Figure 1: The cup of the metal on metal hip is thin so that the ball can be made similar in size to the patient's own natural femoral head. The result is a very stable hip and elimination for the need for standard "hip precautions"
replacement is the closest we have come to the function of the normal hip. The large head metal on metal system may truly turn out to be a “hip for a lifetime”.

Figure 2. Metal on polyethylene articular bearing surface. It consists of a metal ball articulating with the polyethylene (plastic) cup which itself is fixed into a metal shell.

Figure 3. Ceramic on ceramic articular bearing surface. The ceramic femoral head articulates with the ceramic liner of the cup. The ceramic cup liner fits tightly into the metal shell of the cup.