Total hip replacement has emerged as one of the most successful treatments available in modern medicine, with extraordinary gains in pain relief, quality of life, and return to normal function. A large body of knowledge has developed regarding the implants, surgical techniques, and the general outcomes. This review will cover recent concepts in the basic approach but will not deal with special conditions or treatment of complications.

**Prosthetic Implants: State of the Art**

**Cemented Acetabular Components**

Long-term data on cemented total hips continue to show that acetabular component loosening is generally more of a problem than femoral stem loosening beyond 10 years. Charnley recognized the potential problem with the cemented acetabular interface, which usually was composed of fibrous tissue after six months. Over the long term, polyethylene wear particles will degrade this interface, and enhance the aseptic loosening problem. In one recent study of patients in whom 62 Charnley total hips were still in place more than 25 years postoperatively, the prevalence of acetabular revision was 15% compared with 7% for femoral stems [4]. There is generally a higher rate of loosening reported for metal-backed cups compared to analogous reports of cemented all-polyethylene components. Huiskes, and others have been able to demonstrate a poor stress transfer to the underlying bone interface with the interposition of a metal surface.

**Cementless Acetabular Components**

The clinical results of the use of porous-coated cementless acetabular components in a 5- to 10-year time frame has been reported from a number of centers. Reliable fixation is generally obtained in 95% to 99% of cases [6]. Those results however have focused on the fixation of the titanium mesh metal shell employed which has been most extensively studied with the Harris-Galante I (Zimmer, Inc., Warsaw, IN). Originally, the technique was to use a line to line reaming preparation with insertion of screws for additional fixation. More recently, authors recommend a press-fit of the acetabular prosthetic component with a 1 to 2 mm under-reaming of the acetabulum, depending on the rigidity of the porous surface utilized, using screws only in marginal situations such as the revision or compromised bone stock. As follow-up has progressed, an alarming incidence of osteolytic lesions have been identified with certain modular metal shell acetabular components. Poor locking mechanisms, screw holes in the cups, incongruent backside geometries of the metal polyethylene interface, and exaggerated micromotion against rougher metal surfaces have been factors contributing to this problem. In addition, particle debris from fragmented beads, hydroxyapatite particles, or bone fragments have added to this problem. Recent innovations such as improved locking mechanisms, polished metal back-sided surfaces, or even non-modular implants such as the Trabecular Metal Cup (Zimmer, Inc., Warsaw, IN) with heat pressed polyethylene have been measures to deal with this problem. Though many European centers continue to use threaded screw in cups, the early American experience was dismal, and most centers have abandoned this device.
**Acetabular Components With Alternative Bearing Surfaces**

The clinical performance of cementless porous-coated acetabular components over 10 years indicates that problems with component fixation are rare. However, the resulting osteolysis associated with polyethylene wear and modular components has continued to be a concern and has led to heightened interest in alternative bearing surfaces to substitute for polyethylene as the articulation with the femoral head. These alternatives include metal-on-metal and ceramic bearing surfaces, and cross-linked polyethylene.

Chrome cobalt metal-on-metal bearing surfaces have had over 20 years of European clinical experience with favorable results and lack of osteolysis. In one American study of metal-on-metal hip replacements, 70 hips were evaluated at an average of 5.2 years [12]. There was one revision for acetabular loosening, two acetabular component revisions for dislocation, and no femoral component loosening. There was no measurable wear on radiographs and there was no evidence of acetabular osteolysis. It should be noted that these were cemented acetabular components. An underlying concern that yet remains unknown is the long-term problem posed by increase levels of metallic ions in the tissues from these devices. A recent retrieval analysis demonstrated disturbing histological findings in a few cases where there had been impingement or mechanical failure of the metal-on-metal devices creating a concern if wear formation becomes exaggerated. A final area of interest is the cup arthroplasty model such as the McMinn prosthesis which is a metal-on-metal resurfacing device. This device has the advantage of preserving the proximal femur but the disadvantage of proximal fracture that may occur in a few cases as the femur is weakened with insertion.

The other potential hard-on-hard bearing surface is ceramic. The two primary materials are aluminum oxide and zirconium oxide. Both materials have been used as femoral head bearing surfaces against polyethylene but alumina has also been used in a ceramic-on-ceramic configuration. Polyethylene wear against ceramic heads has been reported to be 5 to 10 times lower than that against metal heads in wear simulator studies; however, in clinical radiographic wear measurements the results have been extremely variable. There is conflicting data regarding ceramic bearing surfaces. Some studies have shown significantly lower radiographic wear rates of the ceramic head against the polyethylene, while an equal number of studies have not shown any significant difference in wear rate. Two major issues associated with the use of ceramic heads are cost and breakage. There have been a number of case reports of fracture of ceramic heads; however, with current specifications fractures should be a rare occurrence. Ceramic-on-ceramic wear rates have been reported to be 10 times less than the lowest polyethylene wear rates. However, a high incidence of lysis and wear has been documented for at least one alumina-on-alumina hip of early design.

The most popular recent approach to enhance the wear characteristics of standard ultra-high molecular weight polyethylene has been to use various methods of cross-linking of polyethylene. A number of highly cross-linked polyethylenes have recently been approved by the U.S. Food and Drug Administration and are currently available on the American market. Laboratory testing would suggest that these materials may reduce clinical wear rates by a factor of ten but these results are unknown in clinical experience. Numerous studies are expected in the coming years that will better delineate the expected rate of wear and osteolysis using the alternative bearing surfaces of metal-on-metal, ceramic-on-ceramic, ceramic-on-polyethylene, metal-on-cross-linked polyethylene, and ceramic-on-cross-linked polyethylene.

**Femoral Components**

**Cemented Stems**

The cement technique is recognized as an important factor in increasing the longevity of cemented stem fixation. In the late 1970s, the so-called «second-generation» cement technique was introduced and included the use of an intra-medullary plug, pulsatile lavage of the medullary canal, the use of a cement gun, retrograde filling of the femoral canal with doughy cement, pressurization of the cement, and use of a forged cobalt-chrome stem with rounded corners. Long-term studies at 10 to 15 years and beyond document excellent results with cemented stems implanted with this technique [2]. Despite the excellent