Ceramic-Coated Positive Eccentricity Mobile Hips Provide Excellent Stability And Low Wear: An Unconstrained Tripolar Hip Replacement Is Safer Than Dual Mobility

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INTRODUCTION:

Mobile-bearing hip prostheses are used to treat dislocation or fear of dislocation. In a dual-mobility implant, a fixed one- or two-piece metal socket is matched with a two-piece mobile bearing femoral head. The femoral head has a small inner head with a snap fit polyethylene larger outer head (Fig. 1: dual-mobility hip prosthesis). There are three fundamental flaws with the dual-mobility concept: 1) femoral neck/polyethylene impingement results in internal prosthetic disassociation in 2% of patients, 2) metal ions are released from the acetabular shell, and 3) polyethylene use in a convex configuration has a 6-fold increase in wear.

METHODS:

This study evaluated a tripolar prosthesis as a better alternative to dual mobility implant due to three design improvements: 1) highly cross-linked polyethylene allowing the use of thin acetabular polyethylene and a large femoral head; 2) peripherally placed eccentric polyethylene inside the bipolar femoral cap creating a positive force couple on the two articulations. The positive eccentricity maintains a valgus orientation, preserves movement between both articulating surfaces, and increases separation force resistance; and 3) ceramic coating of the bipolar cap that reduces wear and enhances motion between the mobile-bearing surfaces (Fig. 2: tripolar prosthesis with titanium-nitride ceramic coating).

The study followed 221 tripolar implant patients for a mean of 12 years (range, 7-23). All prostheses were cementless, with positive eccentricity, ceramic coating, and a thin highly cross-linked acetabular bearing (Fig. 3: photograph of tripolar prosthesis with titanium-nitride ceramic coating). Patients studied participated in adventure sports, had high-risk occupations, and/or other risk factors for dislocation. Patients were assessed for range of motion, functional outcomes, and complications. Additionally, 23 retrieved tripolar implants from other centers were evaluated for wear and mechanical properties, such as resistance to component separation.

RESULTS:

No implant dislocated, impinged, or failed clinically. Two patients died and 3 were lost to follow-up. The mean femoral head size was 48 mm. Postoperatively, the mean HHS was 99, mean UCLA activity score was 7.9, and mean flexion was 145°. Radiographic studies confirmed that motion continued at both articulations in a 40/60 proportion. The tripolar prosthetic separation force was 2180 N compared to dual-mobility separation force of 316 N; high-demand activities generate approximately 340 N. The tripolar total volumetric wear was 24 mm^3/yr. compared to 54-98 mm^3/yr. for dual-mobility implants.

DISCUSSION AND CONCLUSION:

This tripolar hip replacement created a stable hip even for the most demanding patients These results are attributed to the specifics of the design and manufacture of this prosthesis and cannot be generalized to other unconstrained tripolar designs. This tripolar prosthesis is a superior choice to a dual-mobility hip prosthesis when enhanced stability is needed because of 1) reduced wear, 2) lack of internal prosthetic dissociation, and 3) less metal wear debris due to the ability to use a conventional titanium/polyethylene acetabular component rather than a one- or two-piece metal acetabular component.