IN VIVO WEAR RATES OF CERAMIC-ON-CERAMIC BEARING TOTAL HIP ARTHROPLASTY

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Introduction. Alternative bearing surfaces for total hip arthroplasty (THA) including ceramic-ceramic articulations, offer the potential for reduced wear and particulate debris. The Autophor total hip replacement system is a ceramic-on-ceramic bearing for THA that consists of a press-fit metal femoral stem, a ceramic femoral head, and a threaded, noncemented ceramic acetabular component. The purpose of this study was to determine the in vivo wear rates of this ceramic-on-ceramic bearing at a minimum of 10-year follow-up.

Methods. A retrospective clinical and radiographic analysis was performed on 85 consecutive THAs performed on 75 patients operated between 1982 to 1986 at our institution. Five patients were lost to follow-up, 4 patients were deceased at the time of review, and 16 patients with less than 10 years follow-up were excluded (all 16 cases had been revised, 3 for deep periprosthetic infection and 13 for aseptic loosening), leaving a cohort of 60 hips. Of the remaining 60 patients, 27 were male and 33 female; their mean age was 45.2 years (range:19-63 years). Twenty patients (33%) underwent revision surgery after more than 10 years. Acetabular components ranged in size from 52 mm to 72 mm (mean:60 mm); femoral components, all of which were inserted without cement, ranged from 140 to 200 mm in length (mean:165 mm).

Acetabular radiographic analysis consisted of localization of periprosthetic osteolysis and radiolucencies in modified Charnley zones (component considered loose if it met either of the following criteria: >2 mm radiolucency in any single Charnley zone or a progressive continuous radiolucent line of any width in more than one Charnley zone), measurement of acetabular opening angle, and the presence of protrusio acetabuli. Femoral radiographic analysis consisted of fixation type (i.e., osteointegrated, fibrous-stable, or unstable fixation), presence of pedestal formation, and radiolucencies in modified Gruen zones. Clinical results, including preoperative and postoperative modified Harris hip scores, were determined at final follow-up.

Postoperative and final follow-up radiographs were analyzed to determine uniplanar wear measurements using the X-Caliper device (wear measurements accurate to 0.127 mm at 100% magnification). Statistical analysis was performed using t-tests (p < 0.05).

Results. Acetabular analysis showed a mean acetabular opening angle of 39.4; 75% of the acetabular components were in neutral position, 25% in horizontal, and only one was placed in a vertical position. Three (7.5%) cases had evidence of acetabular protrusio at final follow-up. For all hips, rates of periacetabular radioluencies of < 2 mm for the modified Charnley zones were 48% for zone A1, 48% for zone A2, 22.2% for zone B1, 40% for zone B2, and 45% for zone C. For the femoral stem, 78.3% had distal pedestal formation and 83% had > 2 mm implant-bone radioluencies in more than five Gruen zones. Radiographic fixation of the femoral stem was classified in 10 cases (16.7%) as osteointegrated, in 20 cases (33.3%) as fibrous stable fixation, and in 30 cases (50%) as unstable fixation. There were no cases of periimplant osteolysis in the acetabulum or femur. There was an increase in the modified Harris hip score from preoperative (mean: 47.3) to postoperative (mean 86.3).

Mean wear at final follow-up was 0.21 mm, averaging 0.016 mm / year for all 60 cases. Wear ranged from 0 to 1.49 mm, with 35 patients having no evidence of wear. There was no significant difference in wear rates between revised and unrevised components or due to implant alignment (femoral or acetabular).

Discussion. Our study showed mean wear rate at final follow-up to be 0.21 mm, averaging 0.016 mm/year. This data correlates well with hip simulator studies demonstrating wear of 0.005 mm/year for the Autophor acetabular component and retrieval studies demonstrating wear of 0.004 mm/year. Furthermore the low wear rates reported on in this study of young patients (≤50 years old) becomes more significant in light of reported higher wear rates in younger patients implanted with metal-on-polyethylene bearings with uncemented acetabular components (range: 0.20-0.25 mm/year). Newer-generation prosthetic systems that utilize a ceramic-on-ceramic bearing offer the promise of lower wear rates and a lower incidence of periprosthetic osteolysis.

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