Comparison of Clinical Results and Polyethylene Wear Associated with 26- and 32-mm Heads in Total Hip Arthroplasty

A Multicenter, Prospective, Randomized Study

INTRODUCTION:
Total hip arthroplasty (THA) is a widely accepted and successful procedure for end-stage degenerative joint disease of the hip. Over 90% of THA procedures are successful. Of the 10% of cases that fail, a common mode of failure is aseptic loosening secondary to wear and osteolysis. Recently, the literature has demonstrated that highly cross-linked polyethylene (HXPE) has a lower wear rate than conventional ultra-high molecular-weight polyethylene (UHMWPE). Potentially, HXPE may increase implant longevity.

Specifically, the mechanical properties of HXPE may improve the survivorship of THA cases implanted with large diameter heads. Large diameter heads are indicated in patients at risk for instability. The distance a femoral head must travel before disengaging from the acetabular cup is higher with a large femoral head than with a small femoral head. Despite the stability gained, however, literature has demonstrated higher polyethylene wear rates of large femoral heads that articulate with conventional UHMWPE liners. Alternatively, current literature demonstrates that utilizing HXPE liners with large diameter heads not only provides stability, but also, has the potential for minimal polyethylene wear. The purpose of this study is to investigate wear rates of HXPE liners that articulate with either a 26 mm or 32 mm femoral head in THA cases.

METHODS:
All patients enrolled in this study received various sizing combinations of a Trilogy acetabular component (Zimmer Inc., Warsaw, IN) with a matching modular Longevity HXPE liner and a cobalt-chrome femoral head (Zimmer Inc., Warsaw, IN). All acetabular and femoral components were inserted without cement. At the time of surgery, 168 hips were randomly selected to receive either a 26 mm diameter head (Group S) or a 32 mm diameter head (Group L). Twenty-one male and 147 female patients were available for radiographic review. Average patient age at the time of surgery was 61.1 years (range, 20 to 77 years). Average patient BMI was 24.1 (range, 16.4 to 36.0).

Prospective clinical and radiographic evaluations were performed at 1, 2, 3, 4 and 5 years postoperatively. Three-dimensional (3D) linear head penetration rates were measured using PolyWare software (Draftware Developers Inc.; Vevay, IN) on digitized anteroposterior and lateral radiographs. All radiographs were sent to one study site for scanning, wear analysis and evaluation by one investigator.

RESULTS:
The average preoperative Harris hip score was 47.6 points (range, 19 to 75 points) in group S and 49.0 points (range, 20 to 85 points) in group L. The average hip score at the final follow-up examination was 93.0 points (range, 79 to 99 points) in group S and 90.1 points (range, 79 to 97 points) in group L. There was no significant difference in the hip score between the two groups preoperatively and at the final follow-up.

At 1-year postoperatively, the amount of head penetration was successfully measured in 127 hips (S = 59, L = 68), 127 hips at 2-years (S = 57, L = 70), 114 hips at 3-years (S = 55, L = 59), 82 hips at 4-years (S = 36, L = 46) and 63 hips at 5-years (S = 34, L = 29). The 1-year average rate of head penetration revealed no significant difference between the two groups (S = 0.36 ± 0.23 mm/yr, L = 0.42 ± 0.26 mm/yr) (Figure 1). At 2-years there was a significantly higher average head penetration rate in Group L (S = 0.17 ± 0.13 mm/yr, L = 0.25 ± 0.17 mm/yr) (p = 0.002). At 3-, 4- and 5-years follow-up there was no significant difference in average head penetration rates between the two groups (3-years: S = 0.13 ± 0.09 mm/yr, L = 0.15 ± 0.08 mm/yr; 4-years: S = 0.09 ± 0.05 mm/yr, L = 0.11 ± 0.08 mm/yr, 5-years: S = 0.07 ± 0.05 mm/yr, L = 0.10 ± 0.07 mm/yr). There was no radiographic evidence of osteolysis or acetabular component loosening at any follow-up period. Three dislocations occurred in Group S. No dislocations occurred in Group L.

DISCUSSION:
An increase in the femoral head diameter and in the head-neck ratio has been shown to reduce the prevalence of dislocation. The jump distance is higher with a large femoral head, thereby resisting dislocation. Large heads, however, have been associated with increased polyethylene wear debris leading to osteolysis and loosening of implants in comparison with wear rates of small diameter heads. If wear debris can be reduced, large diameter heads could potentially be a better alternative than small diameter heads in THA cases at risk for instability. This multicenter, prospective, randomized study demonstrated no significant difference in clinical results and measurable wear of either 26 mm or 32 mm diameter femoral heads that articulated with HXPE liners at the five years postoperatively. Additionally, there was no difference in radiographic evidence of acetabular or femoral component fixation in either group. Dislocation, however, was more prevalent in the 26 mm femoral head group (n = 3 dislocations).

In conclusion, 26 mm and 32 mm heads articulating with HXPE liners demonstrated similar clinical and radiographic outcomes. At five years postoperative, large diameter heads articulating with an HXPE liner has demonstrated safety and efficacy. Long-term follow-up is needed to evaluate long-term clinical and radiographic results of THA cases implanted with large femoral heads that articulate with HXPE liners.

REFERENCES: