Comparison of Wear Resistance of Crosslinked UHMWPE in THA: 32 mm vs. 28 mm CoCr Heads

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INTRODUCTION:
First generation crosslinked polyethylene (XLPE) has been in clinical use in total hip arthroplasty (THA) for ten years. The objective of this study was to determine femoral head penetration rates of XLPE liners with 28mm and 32mm diameter femoral bearings using a validated wear software program (1).

METHODS:
All primary THAs in this IRB-approved retrospective study were performed at our institution by two senior authors (MJK, VMG) using the cementless Trilogy Acetabular System with Longevity Crosslinked Ultra-High Molecular Weight Polyethylene (Zimmer, Inc., Warsaw, IN). Patients who had 32 mm or 28 mm CoCr heads with Versys Cemented, Versys Cemented Plus or Versys Heritage stems (Zimmer, Inc., Warsaw, IN) were evaluated. For inclusion, the patient had to have had at least a 4 week (first postoperative) AP pelvis radiograph and approximate 2 year follow-up (f.u.) radiograph available. Using these criteria, there were 48 patients (51 hips) in the 32mm group and 33 patients (34 hips) in the 28mm group. The surgeries for the 32mm group were performed between Aug. 2000 and Sept. 2005 and between Nov. 1999 and Dec. 2000 for the 28mm group. The average f.u. was 3.04±0.94 yrs (1.74-5.60 yrs) for the 32mm group and 5.16±1.18 yrs (2.91-7.42 yrs) for the 28mm group. The average age was 74.23±6.79 yrs (62.23-87.90 yrs) for the 32mm group and 73.73±6.46 yrs (61.25-85.80 yrs) for the 28mm group. The average weight was 77.65±16.53 kg (36-116 kg) for the 32mm group and 72.03±11.11kg (50-102 kg) for the 28mm group.

Femoral head penetration (FHP) was measured with Hip Analysis Suite v.8.0.4.1 (University of Chicago, Chicago, IL). Two methods described by Bragdon et al (2), were used to evaluate FHP rates. First method: Overall FHP rate for each group was calculated using the linear wear magnitude from the first post-op radiograph compared to the latest f.u. and divided by the total number of years between them. Also, Steady State FHP rate for each group was calculated using the linear wear magnitude from the latest f.u. compared to the latest f.u. This accounts for “bedding-in”, which is thought to occur within the first 6 months to 1 year of use (2,3). 28 hips in the 32mm group and 24 hips in the 28mm group had a 1 year f.u. radiograph available to calculate Steady State FHP rate. A Mann-Whitney test (p < 0.05) was used to compare the Overall and Steady State FHP rates between the two groups. Second method: Overall and Steady State FHP rates were calculated using the first post-op radiograph (for Overall FHP rate) or the 1 year (for Steady State FHP rate) and each f.u. interval. Scatter plots of femoral head penetration (mm) vs. time from surgery (yrs) were constructed where the slope of the linear regression represents the FHP rate. Regression analysis was used to compare the slopes (FHP rates) of the two groups (p < 0.05). Presence or absence of osteolysis was also visually assessed using the latest f.u. radiographs in accordance with the guidelines of the Hip Society.

RESULTS:
There were no statistically significant differences in average age or weight between the 2 groups. The 28mm group had a statistically significant longer f.u. than the 32mm group. Using the first method, there was no statistically significant difference between the groups in either Overall or Steady State FHP rate. Overall FHP rate (first postoperative to last f.u.) was 0.01±0.097 mm/yr for the 32mm group and 0.01±0.060 mm/yr for the 28mm group. Steady state FHP rate (1 yr to last f.u.) was 0.01±0.0171 mm/yr for the 32mm group and 0.005±0.101 mm/yr for the 28mm group (Fig.1). Using the second method, the overall and steady state femoral head penetration rates were not significantly different (Fig. 2 and Fig. 3). No evidence of osteolysis was observed on any of the latest f.u. radiographs.

DISCUSSION:
Regardless of the method of assessment, both groups showed extremely low FHP rates that are substantially below the accepted wear rate of 0.05mm/yr that has been suggested as the threshold for osteolysis (4). Consistent with this, there were no cases of osteolysis in this study.

Radiographic evidence of osteolysis is however, uncommon in the first 5 years following THA (5). The findings of this study support the hypothesis that XLPE can reduce bearing surface wear in both 32mm and 28mm diameter THA liners compared to conventional (sterilized in air) polyethylene (2). Our observations regarding the relationship between liner diameter and FHP are consistent with reports from another institution (6).

There was a longer f.u. in the 28mm group compared to the 32mm group because of the change in relative usage of these implants during the study period. Prior to the introduction of XLPE, it was our typical practice to use 28mm heads with conventional polyethylene liners due to its association with lower wear rates in comparison with 32mm heads. As a result, after initial introduction of XLPE, our usage of 28mm continued for several years until use of larger femoral heads with XLPE became more widely accepted. Longer f.u. is needed to evaluate the long-term performance of XLPE liners in 28 and 32mm hip cup designs.

REFERENCES:

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