Early Wear Of 36 Mm Compared With 28 Mm Metal On Highly Cross-linked Polyethylene Total Hip Replacements

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Introduction:
36 mm metal on highly cross-linked polyethylene (HXLPE) articulations in total hip arthroplasty (THA) have been shown to reduce the incidence of dislocation at one year, compared with 28 mm articulations.1 However, there are few reports in the literature that compare in vivo wear between 36 mm and 28 mm articulations. This study was a post hoc analysis of radiographic wear in primary THA patients enrolled into a multi-centre randomised controlled trial (RCT) examining the effect of articulation size on dislocation. All THAs were undertaken through a posterior approach. The THA prosthesis comprised an uncemented acetabular component with screw fixation, a HXLPE liner and a cemented cobalt-chrome femoral stem.

Methods: Postoperative antero-posterior and lateral radiographs of patients enrolled in the RCT were analysed using Polyware Pro 3D Rev 5 software (Draftware, Vevay, Indiana, USA) which has a reported precision of .09 mm.2 To be eligible for analysis, patients required a series of radiographs which included, at minimum, an early post-operative as well as a one-year and post one year set of radiographs (at a minimum of 2 year and maximum of 5 years follow-up). Statistical analyses were completed using SAS 9.3 (SAS Institute Inc, Cary, NC, USA). The data were analysed using a linear mixed effects model, with patients treated as a random factor. 2D femoral head penetration (FHP in mm) was recorded and estimated volumetric wear was calculated according to Charnley and Halley’s study.3 These data were log transformed prior to analysis in order to meet the distributional assumptions of a linear mixed effect model and were transformed back to the original scale prior to reporting.

Results: 577 primary THA patients were initially enrolled in the RCT of which 326 (56.5%) patients, 164 with 28mm articulations and 162 with 36mm articulations, were eligible for radiographic analysis based upon having a sufficient set of radiographs as described above. There were no significant demographic and component placement differences between patients eligible for inclusion in the radiographic study in the 28mm and 36mm cohorts with respect to mean age, BMI, sex distribution, years of radiographic followup, outer diameter of acetabular shell or acetabular component abduction and anteversion angles. There were no statistically or clinically significant differences in annual linear wear rates between cohorts (p=.36). Bedding-in has been reported to be complete by one year after THA and this assertion was supported by no effect of time on femoral head penetration in our data after one year. The magnitude of bedding-in (FHP at one year) was higher in the 36mm cohort with a mean and median of 0.52mm and 0.45mm respectively compared to 0.50 and 0.38 in the 28mm articulation cohort (p for mean=.0009). The mean and median annual steady-state (post bedding-in) linear wear rates were -.015mm/year and .002mm/year for 28mm and -.03 mm/year and .005mm/year for 36mm articulations respectively. The median steady-state annual volumetric wear was 1.93mm³ and 5.0mm³ for 28mm and 36mm cohorts respectively.

Discussion: 36mm metal on HXLPE articulations in THA at early follow-up demonstrate higher 'bedding-in' magnitude but no significant differences in annual steady-state linear or estimated volumetric wear rates, proportion of patients exceeding the ‘osteolysis threshold’ or proportion of outlier patients, compared with 28mm articulations.
Significance: The results of this study suggest that historic concerns about increased volumetric wear and osteolysis from the use of larger metal on traditional polyethylene articulations are not translated to 36 mm metal on HXLPE articulations, at least up to five years following THA. While further long-term follow-up is recommended, these results support the use of larger articulations in patients who are at increased risk of dislocation.

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References:
2D Femoral Head Penetration Rate

FHP rate (mm/yr)

28°  36°
Median Linear Femoral Head Penetration

Linear FHP (mm)

3 months 1 year 2 years 3 years 5 years

28 36
Volumetric Wear Rate

Box plot with interquartile ranges, median and outlier bars.

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