

Risk of Impingement and Third-body Abrasion With 28-mm Metal-on-metal Bearings

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Topic

Hip

Abstract

Background

Concerns have been raised about the sequelae of metal-on-metal (MoM) bearings in total hip arthroplasty (THA). However, retrieval studies, which offer the best insight into the clinically relevant mechanisms of MoM wear, have followed predictable trends to date such as indicting cobalt-chromium (CoCr) metallurgy, cup design, high conformity between the head and cup, “steep cups,” “microseparation,” and “edge wear.”

Questions/purposes

We wished to evaluate a set of retrieved 28-mm MoM THA for signs of (1) cup-to-stem impingement; (2) normal wear pattern and concomitant stripe damage on femoral heads that would signify adverse wear mechanics; and (3) well-defined evidence of third-body scratches on bearings that would indicate large abrasive particles had circulated the joint space.

Methods

Ten 28-mm MOM retrievals were selected on the basis that femoral stems were included. Revision surgeries at 3 to 8 years were for pain, osteolysis, and cup loosening. CoCr stems and the MoM bearings were produced by one vendor and Ti6Al4V stems by a second vendor. All but two cases had been fixed with bone cement. We looked for patterns of normal wear and impingement signs on femoral necks and cup rims. We looked for adverse wear defined as stripe damage that was visually apparent on each bearing. Wear patterns were examined microscopically to determine the nature of abrasions and signs of metal transfer. Graphical models recreated femoral neck and cup designs to precisely correlate impingement sites on femoral necks to cup positions and head stripe patterns.

Results

The evidence revealed that all CoCr cup liners had impinged on either anterior or posterior facets of femoral necks. Liner impingement at the most proximal neck notch occurred with the head well located and impingement at the distal notch occurred with the head rotated 5 mm out of the cup. The hip gained 20° motion by such a subluxation maneuver with this THA design. All heads had stripe wear, the basal and polar stripes coinciding with cup impingement sites. Analysis of stripe damage revealed 40 to 100-µm wide scratches created by large particles ploughing across bearing surfaces. The association of stripe wear with evidence of neck notching implicated impingement as the root cause, the outcome being the aggressive third-body wear.

Conclusions

We found consistent evidence of impingement, abnormal stripe damage, and evidence of third-body abrasive wear in a small sample of one type of 28-mm MoM design. Impingement models demonstrated that 28-mm heads could lever 20° out of the liners. Although other studies continue to show good success with 28-mm MoM bearings, their use has been discontinued at La Pitie Hospital.

Level of Evidence

Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

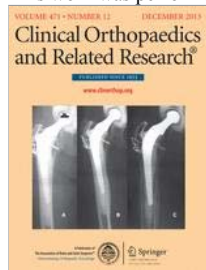
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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at the DARF Center, Colton, CA, USA.





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