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CORR Insights®: How Does Wear Rate Compare in Well-functioning Total Hip and Knee Replacements? A Postmortem Polyethylene Liner Study

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Where Are We Now?

The wear of total hip and knee components retrieved at the time of revision has been measured extensively using caliper and coordinate measuring machine techniques. However, there is some concern that the factors leading to in vivo failures (such as osteolysis, loosening and malposition) may influence the wear rate of these components. Pourzal and colleagues

used a series of postmortems to determine wear rates and then compared the results with those from retrievals.

Postmortems can be more representative of “well-functioning” hip and knee bearings. On the other hand, the number available for measurement is small. Therefore, our ability to extrapolate the result from autopsy retrievals to the general population is limited. Further, in this paper, the hips and knees are all from one manufacturer and limited to one knee and two hip designs; we should not extrapolate these results to the many other avail-

able designs that were not studied directly.

Measurement of in vivo wear in cups can be performed radiographically with results that are similar to those measured by lab equipment at the time of retrieval [1]. Knee wear measurements are more challenging in vivo for two reasons: (1) The complex geometry of the polyethylene articular surfaces, and (2) the potential of backside wear from bearing and tibial tray motion. Neither surface is easily visualized on radiographs, making accurate radiographic measurements of volumetric wear impossible. Some researchers have identified backside wear as the predominate source of material loss in knees; by contrast, it does not appear to play a substantial role in contemporary metal-backed cups.

Wear rates in both hip and knee with gamma-sterilized polyethylene vary with some components demonstrating little wear, while others wear at rates well above the average. The introduction of crosslinked polyethylene

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has the goal of both reducing the average wear rates of both hip and knee bearings while at the same time reducing the variation in wear rates between individuals. In the current study, the authors provided detailed analysis of the wear surfaces and determined volumetric wear rates for these postmortems, which were of the same order of magnitude to those of retrievals published in a previous study [1] suggesting measuring crosslinked retrievals should provide an accurate assessment of the wear rates of these new materials.

Where Do We Need To Go?

The conclusion by Pourzal and colleagues that there is more articular wear in hips than knees seems well supported. However, extrapolating beyond the articular surfaces to conclude that the loss of material in the hip bearings is twice that of the knee inserts will need to be confirmed by future research, as the absence of measurements of the total thickness change in these components might

lead to the determination of a much greater material loss. Through thickness measurements of the tibial components is a requirement for determining volumetric wear and should be studied further.

Unfortunately, obtaining wear rates of knee bearings, even with through thickness measurements, is doubly difficult; the surfaces are complex geometries and the manufacturers rarely provide detailed drawings with measurements and tolerances for accurately measured wear on both the articular and nonarticular surfaces.

How Do We Get There?

The initial analysis of the wear of crosslinked hip bearings indicates that the expectations of much lower wear in the hip appear to be supported. Whether this will transfer to the knee, where the motion has less of a crossing pattern and where the backside articulation is often against a non-polished surface, is unclear. Initial evaluation of retrievals indicates that

the potential benefits of crosslinked polyethylene against a textured titanium tray appear to be overwhelmed by the presence of backside wear [2]. There is still the potential of obtaining reduced wear against a polished tray. While thickness changes can be measured with calipers and compared to unused components to get an approximation of the wear, accurate determination of volumetric wear will require surface profiling combined with through thickness measurements that can be compared to the manufacturer's original specifications. This will require the participation of the manufacturers.

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