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CORR Insights®: Oxidized Zirconium Head on Crosslinked Polyethylene Liner in Total Hip Arthroplasty: A 7- to 12-year In Vivo Comparative Wear Study

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Where Are We Now?

Hip surgeons and material scientists agree that while reducing bearing-surface wear after THA is important, the real

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goals are to prevent osteolysis and aseptic loosening. Most hip replacements are performed using highly crosslinked polyethylene (XLPE) liners, since many surgeons are concerned about problems associated with ceramic-on-ceramic and metal-on-metal (MoM) bearings, including squeaking and ceramic fractures for the former [1], and elevated serum ion levels from (MoM) couplings with the latter [6].

However, although a metaanalysis of randomized trials confirmed that XLPE decreased linear and volumetric wear rates [11], it remains unclear whether XLPE actually reduces the likelihood of aseptic loosening after THA [10].

Recommended as an alternative bearing surface, oxidized zirconium was developed to reduce the wear rates of cobalt-chrome heads against polyethylene bearings. The linear wear rate

for oxidized zirconium with XLPE liners has been shown to be 4 µm/year [4]. However, in a 5-year followup of a randomized controlled trial, no difference in wear rates was noted between cobalt-chrome and oxidized zirconium heads with XLPE [9]. Crosslinked polyethylene liners seem to make a larger difference in wear than does the head surface against which the polyethylene is placed.

Where Do We Need To Go?

With the number of primary and revision THAs rising, it is crucial that we produce reliable implants with excellent long-term durability and biocompatibility. Further study on the long-term data associated with oxidized zirconium on XLPE bearings is warranted. In their paper, Karidakis and colleagues report lower wear rates of oxidized zirconium heads on XLPE liners when compared to ceramic heads. We need solid long-term data reflecting not only the survival of the

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implant and the wear rates of bearing surfaces, but also the effects of the wear debris on our patients' bodies.

Because some reports have found that XLPE liners produce wear particles in the submicron range, which can be phagocytosed by human monocytes and so may over longer time periods yet result in osteolysis [12, 14], longer-term studies are needed. The production of rather round shaped submicron wear particles by XLPE liners is a concern that has not been adequately addressed by in vivo studies. Phagocytosed wear particles have the capability to get to the liver, spleen, and other organs [13]. As orthopaedic surgeons, we often rely on radiographs to follow our patients; while perhaps adequate to identify major problems like wear or loosening, I believe we have to do a better job of considering the impact of orthopaedic implants on the whole patient, and not just the hip. We need to learn more about the systemic effects of the arthroplasties we perform.

How Do We Get There?

To get these answers, we need carefully conducted, long-term clinical followup studies that evaluate THA bearings. Digitized radiographs with computer-aided wear analysis or radiostereometry [5, 10] can provide

us with data about the rate of wear at the hip, but as I have suggested here, we need to begin to answer some larger questions about corrosion products and wear debris created by THAs in vivo.

Ideally, future investigations will develop methods that can properly identify the fate of these wear particles. Autopsies of patients with THA could provide us with sections of liver, spleen, and other organs. Previous studies [2, 3, 13] have shown mostly metal but also ultrahigh molecular weight polyethylene particle dissemination to those organs. The detected polyethylene particles were in the submicron range. The increased production of such wear particles by XLPE calls for more and larger post-mortem studies in order to rule out accumulation of wear debris in parenchymatous and lymphoreticular tissues. Flow cytometry could be a tool to identify monocytes loaded with polyethylene particles in vivo. Laser-scanning microscopy could potentially identify human monocytes containing wear particles. Wear debris from orthopaedic implants is present in lymphoreticular tissue. An increase in wear particle load of human monocytes could reduce the capacity of the immune system. Therefore, we must check the immune system for activity of interleukins, interferone, and tumor necrosis factor, as XLPE wear

particles have been shown to induce an increased inflammatory response in vitro [7, 8].

We still have a great deal to learn about the wear particles generated by oxidized zirconium heads on XLPE liners, both at the local and systemic levels.

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