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CORR Insights

CORR Insights®: Backside Wear Is Not Dependent on the Acetabular Socket Design in Crosslinked Polyethylene Liners

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Where Are We Now?

The interface between the liner and the metallic acetabular shell of a THA is a potential source of polyethylene (PE) particles, in a process called backside wear. Its role in periprosthetic osteolysis is not as well established as those of the bearing surface. Although a high frequency of retroacetabular osteolysis and poor survivorship have been reported with uncemented implants in certain modular cup designs [4], no correlation could be established between backside damage scores and acetabular or femoral osteolysis [3]. Highly crosslinked PE (HXLPE) for THA has been shown to decrease wear of the articular surface at 10 years and more in many studies, but the study here by Bali et al. is interesting because it looked carefully at backside wear. This group analyzed the backside surface of 233 retrieved acetabular conventional (CPE) and HXLPE liners from two different socket designs. HXLPE liners exhibited higher resistance to backside changes compared to CPE, including in the liner group from shells with a roughened inner surface and a suboptimal locking mechanism.

The work by Bali et al. reports innovative clinical data, showing that backside surface damage could be dramatically improved in HXLPE liners. The lack of control and heterogeneous times of implantation represent the main limitations of the study. Also, no quantitative evaluation of PE wear and osteolysis was performed, making impossible to define an osteolytic threshold related to backside wear. However, the current data support the possibility of an isolated liner revision using a HXLPE insert where a well-fixed socket might be retained.

Where Do We Need To Go?

The long-term success of a THA is dependent on the reduction of periprosthetic osteolysis due to particulate wear debris. The paper by Bali and colleagues accords with the general finding that HXLPE offers greater performance to mechanical degradation, including from the nonbearing (backside) surface. However, some important questions remain. First, the nature of backside wear is not fully understood. Numerous parameters, such as the

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particle size, the mode of diffusion of the particles from the interface to the surrounding joint, the role of mechanical factors, and the influence of material oxidation have not been as well investigated on the backside as for the bearing surface. As importantly, the magnitude of wear from the backside surface remains controversial and needs clarification. Using a finite-element model, Kurtz et al. [6] reported that backside wear was at least three orders of magnitude less than bearing surface rates. Conversely, Krieg et al. [5] found that backside volumetric change could be at least 10 times larger in a retrieval analysis using a stereomicroscopic technique. Ultimately, we would like to know whether nonbearing surface wear is an important cause of aseptic loosening. Weiss et al. [9] analyzed data from the Swedish Arthroplasty Register and found no superiority of monoblock cups—where backside wear is virtually eliminated—compared to modular cups, in terms of risk of revision for aseptic loosening. If this is the case, then perhaps modern locking mechanisms have rendered this topic less important, but we need more data before we can reach this conclusion.

How Do We Get There?

Exploring the characteristics of backside wear of HXLPE liners and its consequences on the periprosthetic environment require both experimental and retrieval studies. This mode of wear is difficult to model in a hip simulator, which probably led to the disagreement among some reports published thus far. For instance, in vitro studies [8] failed to reproduce the favorable role of polishing of the inner surface of modular sockets, in contrast to the current and other retrieval analyses [1, 7]. In my opinion, we need more comprehensive models of nonbearing surface damage in THA, combined with precise methods of surface wear measurements. Conditt et al. [2] proposed a quantitative method to estimate the volume removed from the backside surface of PE tibial inserts based on a scanning electron microscopy combined with a laser surface profilometer. Interestingly, these authors highlighted the predominant role of wear over creep or cold flow in the material backside volume lost. This technique could help to improve our understanding of backside wear in acetabular inserts.

Since there is no method to evaluate backside wear in situ, the potential reduction of backside damage in HXLPE liners necessarily will be determined from retrieval analyses. In parallel, the corresponding incidence of osteolysis will be determined from close monitoring of THAs. This should include randomized clinical trials, meta-analysis and joint registries. Ideally, a precise evaluation of osteolysis, as provided by CT scan, should be performed in clinical trials. Continued longer-term studies are warranted to confirm crosslinking technology will reduce, if not eradicate, all potential sources of wear debris and, ultimately, aseptic loosening.

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