Clin Orthop Relat Res (2016) 474:372–373 / DOI 10.1007/s11999-015-4365-z

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

CrossMark

Published online: 30 May 2015

CORR Insights

CORR Insights®: Wear and Osteolysis of Highly Crosslinked Polyethylene at 10 to 14 Years: The Effect of Femoral Head Size

James A. D'Antonio MD

Where Are We Now?

Polyethylene has been in use as a bearing surface for hip arthroplasty for more than 60 years and many past attempts to alter its structure and improve performance have been met with complications and controversy. Increased wear of conventional polyethylene, associated periprosthetic bone loss, and the need for revision surgery peaked in the 1990s. This was in part due to younger and more active patients receiving THA, the use of larger diameter femoral heads, and also related to issues with first-generation cementless sockets. It has been generally accepted that reducing liner wear below 0.1 mm and volumetric wear below 80 cubic mm per year reduces the risk of osteolysis and can increase the longevity of hip arthroplasty. First-generation highly crosslinked polyethylenes (HXLPEs) were developed to increase abrasive wear resistance and address these issues. The major controversies and concerns with these new materials include decreased polyethylene fatigued strength, potential for in vivo oxidation, implant fracture with thin or mapositioned liners, the use of larger diameter femoral heads, and polyethylene particulate size and shape. While simulator studies predicted substantial wear reductions, including low wear for larger diameter femoral heads, the ultimate test for implant performance and survivorship remains in vivo analysis.

Where Do We Need To Go?

The current study agrees with preclinical bench testing predictions that HXLPEs would substantially reduce polyethylene wear debris. The current study at minimum 10-year followup found low linear wear for all head diameters, higher volumetric wear for 36 to 40 mm head diameters, and no liner fractures. While the largest-diameter heads had higher volumetric wear, it did not correlate with osteolysis and was below the 80 cubic mm threshold, below which osteolysis typically is not found. However, the early recognition of osteolysis is of some concern. To be determined is whether the occurrence of osteolysis is related to increasing wear with time, particulate size and

This CORR Insights® *is a commentary on the article* "Wear and Osteolysis of Highly Crosslinked Polyethylene at 10 to 14 Years: The Effect of Femoral Head Size" *by Lachiewicz and colleagues available at:* DOI: 10.1007/s11999-015-4319-5.
The author certifies that he, or any member of his immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.
All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request.
The opinions expressed are those of the writers, and do not reflect the opinion or policy of *CORR*® or the Association of Bone and Joint Surgeons®.
This *CORR* Insights® comment refers to the article available at DOI: 10.1007/s11999-015-4319-5.

J. A. D'Antonio MD (✉)
Greater Pittsburgh Orthopaedic Associates, 725 Cherrington Parkway, Suite 200, Moon Township, PA 15108, USA
e-mail: dantonioja@me.com

CORR Insights

patient response related to the method of preparation, or oxidation. In addition, this study reported no liner fractures despite the use of large diameter heads and a remelted HXLPE with reduced mechanical properties. Longer-term studies are required to determine whether the low wear will continue, osteolysis will not become an important issue, and perhaps most importantly, whether reduced fatigue strength and or oxidation will lead to implant failure.

How Do We Get There?

Continued prospective clinical studies of first-generation HXLPEs will determine the wear, incidence of osteolysis, and future modes of failure. Second-generation HXLPEs have been developed to try to address issues of fatigue strength and in vivo oxidation. Bench testing suggests that these newer materials may be superior, and clinical studies are currently underway [1–4]. Randomized trials comparing the performance of first and second-generation HXLPEs to look at linear and volumetric wear, incidence of osteolysis, and implant survivorship will determine the ultimate benefits of second-generation materials. In addition, retrievals of failed liner implants will further elucidate the issues and importance of oxidation, particle size, maintenance of mechanical properties, and modes of failure. Longer clinical followup is mandatory to determine future failure mechanisms of all HXLPEs.

References

1. D'Antonio JA, Capello WN, Ramakrishnan R. Second-generation annealed highly cross-linked polyethylene exhibits low wear. *Clin Orthop Relat Res*. 2012;470:1696.
2. Dumbleton JH, D'Antonio JA, Manley MT, Capello WN, Wang A. The basis for a second-generation highly cross-linked UHMWPE. *Clin Orthop Relat Res*. 2006;453:265.
3. Oral E, Wannomae KK, Rowell SL, Muratoglu OK. Diffusion of vitamin E in ultra-high molecular weight polyethylene. *Biomaterials*. 2007;28:5225.
4. Sillesen NH, Greene ME, Nebergall AK, Nielsen PT, Laursen, MB Troelsen A, Malchau H. Three year RSA evaluation of vitamin E diffused highly crosslinked polyethylene liners and cup stability. [Published online ahead of print February 18, 2015]. *J Arthroplasty*. DOI: 10.1016/j.arth.2015.02.018.