Clin Orthop Relat Res (2022) 480:1950-1951
DOI 10.1097/CORR.0000000000002388

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

CORR Insights

Published online: 26 August 2022

CORR Insights®: Reduced Revision Rates in Total Shoulder Arthroplasty With Crosslinked Polyethylene: Results From the Australian Orthopaedic Association National Joint Replacement Registry

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Where Are We Now?

The bearing surface of an arthroplasty is a key determinant of its survivorship. Polyethylene wear can result in particulate-induced osteolysis, bone loss, and subsequent implant loosening [2, 3, 5, 6]. Wear simulation research on reverse total shoulder arthroplasties found that ultra-high molecular weight polyethylene humeral liners demonstrated lower volumetric wear rates than conventional polyethylene did [5]. But because a glenoid prosthesis is exposed to sliding and rolling when the arm is taken through ROM, the muscle forces associated with the rotator cuff and deltoid can be very difficult to simulate accurately. Additionally, fixation methods, polyethylene geometry (pegged or keeled components), and whether or how cement is used for fixation may influence the longevity of the prosthesis. For those reasons, large studies from national registries are important tools to provide surgeons with real-world performance data on the shoulder arthroplasty implants we use.

In an article in this month's *Clinical Orthopaedics and Related Research®*, Page et al. [4] analyzed data from the Australian Orthopaedic Association's National Joint Replacement Registry to determine the association between the bearing surfaces used and revision rates after total shoulder arthroplasty. This study benefitted from the large sample size from this robust registry to explore several clinically relevant questions. The authors compared crosslinked polyethylene (XLPE) with non-XLPE in all-polyethylene glenoid components and evaluated the association of humeral head size with revision risk. The authors found that non-XLPE had a higher revision rate across all variables, including aseptic glenoid loosening, after 1.5 years. The findings of this study are important because they provide data to help surgeons advise patients on expectations and complication rates after anatomic total shoulder arthroplasty. Additionally, the authors' findings suggest that the use of XLPE will result in a lower risk of aseptic glenoid loosening.

Where Do We Need To Go?

Although it is important to study aseptic loosening caused by microparticle debris, which is a leading cause of revision in reverse total shoulder arthroplasty [3], there are several other important variables to consider when examining the survivorship of anatomic total shoulder arthroplasty. These factors include the status of the rotator cuff, presence of periprosthetic joint infection, and severity of a perioperative glenoid deformity.

This CORR Insights® *is a commentary on the article* "Reduced Revision Rates in Total Shoulder Arthroplasty With Crosslinked Polyethylene: Results From the Australian Orthopaedic Association National Joint Replacement Registry" *by Page and colleagues available at:* DOI: 10.1097/CORR.0000000000002293.

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It is unknown how the bearing surface material used on the glenoid directly influences the implant survivorship in anatomic total shoulder arthroplasty. Previous simulation and wear studies of polyethylene and shoulder arthroplasty were in the setting of reverse total shoulder arthroplasty [1, 3, 5]. The characteristics of loads on the bearing surface are very different, given the unconstrained biomechanics of an anatomic total shoulder implant. The glenoid component in anatomic total shoulder arthroplasty is exposed to rotation and sliding friction in both the AP and superior-inferior directions. Additionally, the status of the rotator cuff can increase translational loads, depending on which tendons are involved. Subscapularis ruptures result in instability and anterior subluxation with edge loading of the polyethylene, and supraspinatus or infraspinatus tears result in the "rocking horse" phenomenon with superior-inferior humeral translation and edge loading. These scenarios are known to increase the risk of aseptic glenoid loosening, as well as bone loss, polyethylene wear, and failure. What is unknown is whether the composition of the polyethylene protects against these effects if humeral subluxation, edge loading, wear, and eventual failure through loosening or dislocation occur.

How Do We Get There?

Biomechanical testing is needed to determine what, if any, effects XLPE has on these factors compared with non-XLPE. This testing should consist of cyclical edge loading of the glenoid implant with differing polyethylene crosslinking density to determine how this may impact wear, micromotion, and the structural integrity of a glenoid component.

The factors known to cause premature revision after anatomic total shoulder arthroplasty—such as the status of the rotator cuff, presence of periprosthetic joint infection, and severity of a perioperative glenoid deformity—must be investigated in multicenter, prospective cohort study designs to allow for the comparison of relevant variables, including different implants, infection prevention regimens, reconstructive approaches, or elements of aftercare. These studies should be adequately powered to answer these questions. Additionally, randomized trials comparing non-XLPE with XLPE that control for preoperative glenoid morphology, status of the rotator cuff muscle, and polyethylene design (pegged or keeled) might provide evidence about the clinical implications of the wear properties of these bearing surfaces. Although these studies can be difficult and expensive to perform, they would optimally provide many of the answers to these questions. Another means to answer these questions is to retrospectively examine how these implants perform over time.

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