

CORR Insights®: What Factors are Associated with Revision or Worse Patient-reported Outcomes after Reverse Shoulder Arthroplasty for Cuff-tear Arthropathy? A Study from the Danish Shoulder Arthroplasty Registry

Jason E. Hsu MD

Where Are We Now?

Reverse shoulder arthroplasty has transformed our treatment of numerous shoulder problems. In this Danish registry study by Baram and colleagues [3], the 10-fold

This CORR Insights® is a commentary on the article "What Factors are Associated with Revision or Worse Patient-reported Outcomes after Reverse Shoulder Arthroplasty for Cuff-tear Arthropathy? A Study from the Danish Shoulder Arthroplasty Registry" by Baram and colleagues available at: DOI: 10.1097/CORR.0000000000001176.

The author (JEH), or a member of his or her immediate family, has received or may receive royalties, during the study period, an amount of less than USD 10,000 from DJO Surgical (Lewisville, TX, USA).

The author (JEH) has also received or may receive payments or benefits as a consultant, during the study period, an amount of less than USD 10,000 from DJO Surgical (Lewisville, TX, USA).

The opinions expressed are those of the writer, and do not reflect the opinion or policy of CORR® or The Association of Bone and Joint Surgeons®.

J. E. Hsu MD (✉), University of Washington, Department of Orthopaedics, 1959 NE Pacific Street, Seattle, WA 98195, USA, Email: jehsu@uw.edu

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.

increase in utilization of this operation that they observed in patients with cuff-tear arthropathy during a 10-year period serves as a barometer of the success of the reverse prosthesis for this indication.

Indications for reverse shoulder arthroplasty have, of course, expanded beyond cuff tear arthropathy to include irreparable cuff tears, proximal humeral fractures and sequelae, chronic glenohumeral instability, revision arthroplasty, and glenohumeral arthritis with an intact cuff. It is not surprising that the overall utilization of the reverse prosthesis has grown so quickly in the past decade. For many, the use of the reverse design is outpacing that of anatomic designs, even for indications that have typically been treated successfully with anatomic arthroplasty [2].

Despite successes of the reverse arthroplasty, some studies found [5, 10] a relatively high risk of revision and complications; the problems observed in patients who have undergone reverse shoulder arthroplasty generally differ from those associated with anatomic total shoulder arthroplasty.

J. E. Hsu, University of Washington, Department of Orthopaedics, Seattle, WA, USA

Rather than glenoid component loosening and cuff tears as primary complications, reverse total shoulder arthroplasty has been associated with a higher risk of instability, component breakage, and disengagement, scapular notching, and acromial fractures, among others.

The risk of infection also may be higher after reverse arthroplasty than after anatomic shoulder replacement [8]. In the current study [3], prosthetic joint infection accounted for 32% of revisions, and two interesting findings related to revision risk and infection stand out. First, the Delta Mark III (Depuy, Leeds, UK) had a higher risk of revision compared to the Delta Xtend (Depuy, Leeds, UK), primarily due to infection (8.5% versus 1.2%) and loosening (2.8% versus 0.4%), findings which may go hand-in-hand. Second, men were noted as an independent risk factor for revision surgery, and one of the major drivers of this was infection. This finding matches other registries including the Nordic registry that reported a 3.8 times higher risk of revision in men compared to women [6] and the Australian registry which noted a higher rate of revision in men compared to women (1.7% versus 0.7%, respectively) due to infection. Interestingly, this was only present in

reverse shoulder arthroplasty and not in anatomic arthroplasty [2]. The reasons why infection is higher with certain arthroplasty models and in men are not entirely clear.

Where Do We Need To Go?

As the use of reverse arthroplasty continues to expand, so does the need to refine indications, improve patient-reported outcome scores and decrease the frequency of revision surgery, and ensure that the prostheses are durable and continue to perform well over the longer term. While this Delta Mark III is no longer on the market, the higher revision rate compared to the Delta Xtend underscores the value of regular reporting from national registries and other databases. Longer-term reports from the Danish registry are still needed to determine if the estimated 8.5% cumulative revision rate may change over time and if new risk factors for worse patient-reported outcomes declare themselves over time. Further reports from this registry will certainly provide useful data regarding the longer-term impact of patient characteristics and prostheses on patient-reported outcomes scores and implant survivorship.

The reason for higher revision rates of reverse shoulder arthroplasty in men compared to women deserves further investigation. It is well-known that men have higher loads of *Cutibacterium* around the shoulder than women patients [7] and that this bacteria can subsist in the avascular sebaceous glands underneath the skin surface. This allows the bacteria to evade our usual means of surgical prophylaxis (prep solutions applied to the skin surface, intravenous and oral antibiotics) and can lead to inoculation of deeper implants and tissue during surgery.

Innovative methods of prophylaxis against common skin commensals living under the skin surface are needed to decrease this risk of infection.

In addition to improving prophylactic measures, the question needs to be asked if certain prosthetic design features could contribute to a higher risk of infection. For what reasons would we see a higher risk in certain arthroplasty models such as that seen in the Delta Mark III in this study—could it be material composition, surface roughness, technical aspects required to insert the prosthesis?

How Do We Get There?

Continuing to establish new shoulder arthroplasty registries and maintaining regular reporting of databases similar to the Danish registry will provide non-commercial, generalizable information about indications, utilization, successes, and problems that may not be revealed in reports from individual high-volume surgeons or institutions. Reporting to a mandatory database can often reveal distinct failure mechanisms that may not be revealed otherwise due to publication bias [10]. As an example, the Australian Orthopaedic Association releases an annual report, which generates valuable information regarding the impact of patient characteristics, prosthetic designs, and technical aspects of surgery on patient-reported outcomes and revision rates [2]. Notably, national joint registries such as this have been first in identifying prostheses that have a higher than anticipated rate of revision [4, 9]. Once an arthroplasty model with a higher revision rate is identified, characteristics of that particular prosthetic design that led to failure can be studied and avoided in future design iterations. These registries certainly have potential to have a

global influence on surgical practices, prosthetic design considerations, and reducing rates of revision.

Antimicrobial prophylaxis in patients undergoing shoulder arthroplasty needs to be aimed at the sebaceous glands under the skin surface where normal surgical skin preparation solutions cannot reach. So far, initial studies on benzoyl peroxide gel demonstrate promise in decreasing, but not eliminating, bacterial load [6]. These studies are time-zero investigations, focused primarily on decreasing the culture positivity of the skin and deep tissues immediately after treatment. Larger scale studies reporting clinical followup, specifically revision related to infection, are needed. It is becoming apparent that not all *Cutibacterium* strains are the same, and the presence of more virulent strains on a patient's skin could put him or her at higher risk of prosthetic infection [1]. As we work towards understanding these strains more, our ability to risk-stratify patients and target pathogenic strains can potentially decrease the rates of prosthetic infection.

References

1. Aubin GG, Lavigne JP, Foucher Y, Delliere S, Lepelletier D, Gouin F, Corvec S. Tropism and virulence of *Cutibacterium* (formerly *Propionibacterium*) acnes involved in implant-associated infection. *Anaerobe*. 2017;47:73-78.
2. Australian Orthopaedic Association National Joint Replacement Registry. 2019 annual report. Available at <https://aoanjrr.sahmri.com/>. Accessed January 31, 2020.
3. Baram A, Ammitzboell M, Brorson S, Olsen BS, Amundsen A, Rasmussen JV. What factors are associated with revision or worse patient-reported outcome after reverse shoulder arthroplasty for cuff-tear arthropathy? A study from the danish shoulder arthroplasty registry. *Clin Orthop Relat Res*. [Published online ahead of print December 26, 2019]. DOI: 10.1097/CORR.0000000000001114.

4. de Steiger RN, Hang JR, Miller LN, Graves SE, Davidson DC. Five-year results of the ASR XL Acetabular System and the ASR Hip Resurfacing System: An analysis from the Australian Orthopaedic Association National Joint Replacement Registry. *J Bone Joint Surg Am.* 2011;93:2287-2293.
5. Ernstbrunner L, Suter A, Catanzaro S, Rahm S, Gerber C. Reverse total shoulder arthroplasty for massive, irreparable rotator cuff tears before the age of 60 years: Long-term results. *J Bone Joint Surg Am.* 2017;99:1721-1729.
6. Lehtimäki K, Rasmussen JV, Mokka J, Salomonsson B, Hole R, Jensen SL, Aarimaa V. Risk and risk factors for revision after primary reverse shoulder arthroplasty for cuff tear arthropathy and osteoarthritis: A Nordic Arthroplasty Register Association study. *J Shoulder Elbow Surg.* 2018;27:1596-1601.
7. MacNiven I, Hsu JE, Neradilek MB, Matsen FAI. Preoperative skin-surface cultures can help to predict the presence of propionibacterium in shoulder arthroplasty wounds. *JBJS Open Access.* 2018; 3:e0052.
8. Richards J, Inacio MC, Beckett M, Navarro RA, Singh A, Dillon MT, Sodl JF, Yian EH. Patient and procedure-specific risk factors for deep infection after primary shoulder arthroplasty. *Clin Orthop Relat Res.* 2014;472: 2809-2815.
9. Smith AJ, Dieppe P, Howard PW, Blom AW. Failure rates of metal-on-metal hip resurfacings: Analysis of data from the National Joint Registry for England and Wales. *Lancet.* 2012; 380:1759-1766.
10. Somerson JS, Hsu JE, Neradilek MB, Matsen FA, 3rd. Analysis of 4063 complications of shoulder arthroplasty reported to the US Food and Drug Administration from 2012 to 2016. *J Shoulder Elbow Surg.* 2018;27: 1978-1986.