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CORR Insights®: What Are Risk Factors for Intraoperative Humerus Fractures During Revision Reverse Shoulder Arthroplasty and Do They Influence Outcomes?

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Where Are We Now?

The frequency of shoulder arthroplasty in today's population has increased, in part due to the growing number of older

patients with degenerative and traumatic disorders of the shoulder, as well as the extension of arthroplasty solutions to younger patients who feel they have exhausted reasonable nonsurgical alternatives. As a consequence, more revision shoulder arthroplasties should be anticipated.

From its introduction for narrow indications into the United States more than a decade ago, reverse shoulder arthroplasty has emerged as the preferred treatment, in many instances, for failed shoulder arthroplasties that require prosthetic revision. However, the severity and frequency of complications with this approach are well described. It also is clear that patients undergoing reverse shoulder arthroplasty as part of a revision shoulder arthroplasty do not do as well as those undergoing reverse total shoulder arthroplasty for cuff-tear arthropathy,

failed rotator cuff repairs, and post-traumatic sequelae. Part of this difference may derive from the need, in many instances, to remove the existing humeral prosthesis. The paper by Wagner et al. supports this idea; 16% (36 of 230) patients undergoing revision to a reverse total shoulder arthroplasty experienced an intraoperative humerus fracture, and most of these fractures occurred during removal of the humeral component.

While the authors mention that the frequency of intraoperative fractures was higher during revision arthroplasty with a reverse versus anatomic component, the reader is left to speculate the reasons for the difference. Curiously, only in the presence of hemiarthroplasty, as opposed to total shoulder arthroplasty, was the risk of intraoperative fracture increased. Perhaps the majority of hemiarthroplasties were performed for fracture treatment, and resulted in variable patterns and degrees of tuberosity union, all of which may add complexity and risk to component explantation.

This CORR Insights® is a commentary on the article "What Are Risk Factors for Intraoperative Humerus Fractures During Revision Reverse Shoulder Arthroplasty and Do They Influence Outcomes?" by Wagner and colleagues available at: DOI: [10.1007/s11999-015-4448-x](https://doi.org/10.1007/s11999-015-4448-x).

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Where Do We Need To Go?

With nearly four decades of experience with shoulder arthroplasty at their institution, the authors are much better prepared than most surgeons to mitigate the occurrences and effects of intraoperative complications of shoulder arthroplasty, such as periprosthetic fractures of the humerus during revision reverse shoulder arthroplasty as reported in this paper. It would benefit the reader to know what technical measures the authors routinely undertook to minimize the risk of humeral fracture during revision reverse shoulder arthroplasty.

Several questions regarding the risk factors associated with intraoperative humerus fractures during revision reverse shoulder arthroplasty remain, including (1) What alternate humeral implant removal techniques, some previously described but not used by the authors in this study, could prevent certain intraoperative periprosthetic humerus fractures? (2) What prophylactic options are available to reduce the chances of humeral fracture during the phases of implantation? (3) What characteristics did untreated greater tuberosity fractures (~90%) have in common and how did they differ from the ones that underwent adjunctive fixation? (4) How did prior instability, a complication often attributable to multiple causes, emerge as a

significant risk factor for intraoperative humerus fracture? (5) What are the influences of instability direction and reducibility? It seems intuitive that the explantation of a terminally incarcerated cemented or cementless humeral prosthesis should have a higher rate of humerus fracture than one that is loose or less securely fixed. (6) Depending upon the composition of the cohort of patients under study, is it possible that the fracture rate, outcomes, and even risk factors might be at variance with the present study? (7) What factors other than porosity of bone render the female sex at higher risk for intraoperative fractures of the humerus during revision reverse shoulder arthroplasty? (8) Is it possible to take advantage of the humeral prosthesis for fracture fixation, and if so, what are those opportunities?

How Do We Get There?

A number of aspects of management and effect on outcomes should be elucidated. The authors have generously shared their results and established their institutional benchmark for the incidence and outcome of a particular complication of revision reverse shoulder arthroplasty. At this point, the risk factors that have been exposed are, at best, only superficially understood. Demographics, diagnosis,

tissue properties and the postsurgical pathological state are immutable. A clearer picture of risk will hopefully emerge with a better understanding of their interrelationships in this setting. While an accounting of details of the surgical technical method is vital to the understanding of iatrogenic humerus fracture, the influence of the intangible virtues of patience, anticipation, caution, and judgment cannot be overlooked. For example, an investigation of intraoperative periprosthetic greater tuberosity fractures might take into account not only their location, pattern, intrinsic stability, soft-tissue attachments, and opportunities to optimize fixation to the bone and the adjacent prosthesis but also how particular treatment decisions are synthesized.

Superior prosthetic instability usually accompanies shoulder prosthetic failures resulting from irreparable rotator cuff tear and is probably the most common instability pattern encountered during prosthetic revision. It is important that future investigations seeking to corroborate the results of the present study more clearly define the direction and status of prosthetic instability and how it may come to bear on the incidence and influence of intraoperative periprosthetic fractures. Humeral bone preservation at the time of revision reverse shoulder arthroplasty is

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the key to successful implantation of the revision humeral prosthesis. While aseptic prosthetic humeral loosening is rare, many current humeral prostheses for cemented and cementless usage are equipped with design geometry and surface enhancements to facilitate long-term fixation. Additional information will be gained from investigations that take into account specific features of the humeral prosthesis and the collateral damage to the humerus anticipated coincident to its explanation. Likewise, future studies should evaluate the utility of the so-called platform humeral prosthesis, which can be implanted at the time of the index (anatomic) total shoulder arthroplasty, but which can be converted later to a reverse total shoulder arthroplasty should the need arise. Such an implant potentially obviates the necessity for entire humeral component removal perhaps with less risk to the structural integrity of the humerus in the revision setting.