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CORR Insights®: Proximal Humerus Tumors: Higher-than-Expected Risk of Revision With Constrained Reverse Shoulder Arthroplasty

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Where Are We Now?

Orthopaedic surgeons sometimes use highly constrained implants to treat patients who undergo massive soft tissue resections of the stabilizing muscles in the shoulder [5, 6]. We generally perform such techniques following tumor operations, in the setting of prosthetic joint infection (PJI) treatment, and for complex revision arthroplasty.

For reverse total shoulder arthroplasties, impingement occurs when the rim of the constrained humeral component impinges on the scapula, which effectively decreases the available ROM and places increased stress on the components [4]. Depending on pullout strength of the constrained shoulder, this will predispose the patient to dislocation, loss of fixation, or wear and debris reaction.

In the current study by Ayvaz et al. [1], we learn that nearly one in five patients who received a highly constrained total shoulder arthroplasty reconstruction following a tumor resection underwent revision at short-term follow-up. The authors used the implant to try to prevent instability, but given these results, they questioned whether the constraint resulted in high implant-bone stresses to the humeral component-bone interface, resulting in loosening. They suspect that any similarly constrained implant will likely have a similar problem, and I agree. This study is important because I think surgeons should use a larger head in the glenosphere, in addition to lateralizing the glenosphere, if possible, to minimize the occurrence of instability in this specific patient population.

Where Do We Need To Go?

Constrained total shoulder implants are most commonly used in the treatment of PJI, where the rotator cuff is damaged, or in tumor procedures, where the cuff is resected. It would be beneficial if composite allografts that include bone and rotator cuff tendons could be made more reliable, but these have limitations like high infection rates, allograft rejection at later dates, and joint subluxation. Future studies therefore should investigate better constraining mechanisms and the use of spherocentric joints.

Much more work needs to be done in terms of allografts with prosthetic devices so surgeons can avoid constrained prostheses in favor of semi-constrained implants. Additionally, more designs need to be tested to reduce the stress imposed by constrained reverse total shoulder by scapular impingement. Spherocentric humeral component designs, for example, could decrease the risk of humeral

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impingement by internally and externally rotating within the humeral component. Such a design effectively increases the ROM before scapular impingement occurs. It is possible that larger head sizes of the glenosphere will allow for more ROM before scapular impingement occurs. However, future studies will need to explore the possible tradeoffs associated with implant changes like these.

How Do We Get There?

Glenospheres, with lateralization away from the scapula, could potentially increase ROM with spherocentric humeral component designs and larger head sizes of the glenosphere. With modern technology allowing precision engineering, on the level of hundreds of microns, new multilayered microporous coatings for integration for soft tissue may soon be available. Different porosities are critical to structural designs, as they can improve the soft-tissue attachments in total joints. If fibrous ingrowth leading to improved soft-tissue attachments is possible for shoulder stabilization, then perhaps the different porosities can be used in semiconstrained reverse arthroplasties. Early results show the larger pore size somewhere around 800 microns with smooth multilayered texturing need to be used [3].

A prospective study should examine the ROM imposed by the constraining mechanism, determine whether there is improved soft tissue in-growth to the proximal humerus, and use spherocentric constrained designs. By utilizing a prospective study, one would be able to track the study group over an extended period of time to accurately determine the success of the various prosthetic designs, in addition to potentially identifying various risk factors for the etiology of implant failure. Such a study should also include patient satisfaction and functional scores based on the Musculoskeletal Tumor Society (MSTS) standards. The MSTS scoring guidelines [2] are an internationally accepted grading system used to determine overall limb function and resultant necessity for limb salvage or amputation procedure. In a patient with upper an extremity implant, the scoring system involves six categories: Pain, function, emotional acceptance, hand-positioning, dexterity, and lifting ability. This scoring system provides a balanced, patient-centric evaluation of the efficacy of a prosthetic, which is critical when evaluating implant quality. In order to get enough patients to satisfy the proposed study, this work should be reserved for tertiary facilities where this specific pathology and surgical technique is commonplace.

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