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CORR Insights

CORR Insights®: Does Humeral Component Lateralization in Reverse Shoulder Arthroplasty Affect Rotator Cuff Torque? Evaluation in a Cadaver Model

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Where Are We Now?

The current cadaveric study by Chan and colleagues highlights an area of increasing interest within the field of shoulder arthroplasty, namely improving active shoulder rotation following reverse total shoulder arthroplasty (RTSA) by increasing lateral offset and increasing modularity of the humeral component without simultaneously increasing deltoid tension and joint reaction forces.

The study by Chan and colleagues underscored prior clinical findings [1, 10], which showed unchanged or even decreased active external rotation following traditional Grammont-style RTSA, an implant that is characterized by a valgus neck-shaft angle of 155° and a medialized center-of-rotation. More recent studies, however, indicated that implant-specific changes meant to lateralize the center of rotation of the glenohumeral joint through the glenoid component improved active external rotation [2, 8]. Additionally, there is evidence that lateralization improves the tension within the subscapularis and teres minor and maintains their moment arms, thereby improving active rotation [4]. But increases in lateral offset of the glenosphere can cause more stress at the bone/baseplate interface [9, 11], and greater deltoid abduction forces [6]. Still, a previous study by some of the coauthors of the current study (GSA, JAJ, GDGL) [3] did not find concomitant increases in glenohumeral joint loads or deltoid tension with lateralization through the humeral component.

Where Do We Need To Go?

A previous computer model analysis of the rotator cuff moment arms and muscle lengths of various commercially available RTSA designs demonstrated that a lateralized humerus with a medialized center of rotation glenoid component resulted in the largest moment arm during external rotation

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[5]. But we still lack good information about clinical outcomes and complications associated with lateralized RTSA humeral components. While there have been a few computer-simulation models and cadaveric studies examining the effect of humeral component lateralization on the function and length of the rotator cuff [3, 5], we need clinical studies to determine whether the suggestions from that prior simulation research [5] about improved active shoulder rotation are borne out in vivo. And cadaveric studies simply cannot account for the degenerative changes often found in the rotator cuff musculature and tendons of the elderly. Our next step in clinical research should determine whether the long-term complication profile and prevalence following this design change differs when compared to currently used glenosphere and baseplate designs.

In the current study, Chan and colleagues demonstrated the increased torque within the posterior rotator cuff with the shoulder in the adducted position, but not in the abducted position. In particular, the need for improved active external rotation is most important in the overhead position and probably less so in the adducted position. The results of prior clinical studies have suggested that the posterior deltoid may play a role in external rotation in the abducted shoulder position [7].

Therefore, it is unclear at this time whether the anticipated increase in external rotation as a result of humeral lateralization cannot effectively be achieved through the "wrapping effect" of the posterior deltoid using our currently available implant systems. More generally, we do not yet know the effect of a lateralized humeral component on scapular notching, glenohumeral stability, shoulder motion, and tension within the deltoid muscle, when compared to a more medialized humeral component

How Do We Get There?

In our current cost-consciousness and value-based clinical decision-making environment, research efforts must focus on determining the added benefit of such an implant design change on patient outcomes and potential complications. As such, with the current modular designs of the RTSA, which already allow for glenoid-sided modularity and adaptability to our individual patient's needs, the burden falls upon the orthopaedic community to critically evaluate existing and future computer simulation models, finite element analyses, cadaveric studies, and ultimately, clinical studies to determine whether there is role for this implant design change in our armamentarium. Computer modelling and further biomechanical studies will serve as a means to compare and examine the relative contribution of the posterior deltoid and rotator cuff in powering external rotation between a lateralized and medialized humeral component, while holding other variables such as neck-shaft angle and glenosphere lateralization fixed. In particular, the improvement in external rotation should be demonstrated in the abducted shoulder. If a consistent benefit can be identified for shoulder rotation, longer-term clinical studies will be needed to determine whether this advantage is accompanied by any concomitant complications such as acromial stress fractures, scapular notching, or glenohumeral instability. Surgeons who perform a high volume of RTSAs will need to evaluate the benefits of humeral lateralization through the collection of prospective clinical data and patient-reported outcomes. To achieve these goals most efficiently, large registries that incorporate clinical data from multiple centers should be created and our specialty societies may be the ideal forum for maintaining and analyzing this crucial information.

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