A Comparison and Correlation of Clinical Outcome Metrics in Anatomic and Reverse Total Shoulder Arthroplasty

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Introduction: Anatomic (aTSA) and reverse (rTSA) total shoulder arthroplasty are the standard of care for various end-stage degenerative conditions of the glenohumeral joint. Worldwide, the usage of both aTSA and rTSA has increased significantly, due in part to the predictability of acceptable outcomes achieved with each prosthesis type for its respective indications. However, this perception of predictability may be influenced by the particular outcome measurement system used to evaluate treatment. Standardizing the methods by which healthcare professionals quantify treatment is a critical component of evidence-based medicine. Numerous outcome measurements are available to evaluate orthopaedic treatment in the shoulder; while each attempts to rate the quality of care, each varies by the method in which it quantifies success. To this end, this study quantifies outcomes with aTSA and rTSA using 5 different scoring metrics and compares results achieved for each indication using a single platform shoulder arthroplasty system. Pre-operative, post-operative, and pre-to-post-operative improvements were compared using 5 different metrics for 863 patients who received either a primary aTSA or rTSA for the treatment of degenerative arthritis or CTA/RCT/OA, respectively. Outcomes using each metric were normalized and correlated to facilitate a comparison of scoring systems for each treatment type.

Methods: 863 patients (69.2 ± 8.6 yrs) were treated by 12 orthopaedic surgeons using either aTSA or rTSA with one platform shoulder system (Exactech, Inc). 385 patients received aTSA (66.5 ± 8.7 yrs; 221 F/164 M) for treatment of degenerative arthritis and 478 patients received rTSA (71.4 ± 7.9 yrs; 294 F/184 M) for treatment of CTA/RCT/OA. Each patient was scored pre-operatively and at latest follow-up using the SST, UCLA, ASES, Constant, and SPADI metrics; active abduction, forward flexion, and active and passive external rotation with the arm at the side were also measured. The average follow-up for all patients was 35.8 ± 14.9 months (aTSA: 37.8 ± 17.5 months; rTSA: 34.2 ± 12.2 months). Improvements in outcome using each metric score were normalized on a 100 point scale, correlated, and compared. A Student’s two-tailed, unpaired t-test was used to identify differences in pre-operative, post-operative, and pre-to-post-operative improvements, where p<0.05 denoted a significant difference.

Results: Both aTSA and rTSA patients demonstrated significant improvements in each scoring metric following treatment, significant increases in strength and motion/function, and significantly decreases in pain following treatment of degenerative arthritis with aTSA and of CTA/RCT/OA with rTSA, respectively. 7 complications occurred in the aTSA cohort (1.8%) and 31 complications occurred in the rTSA cohort (6.5%). The average normalized pre-to-post-operative improvement for each treatment type is
presented in Figure 1. Preoperatively, rTSA patients had significantly lower scores as measured by 4 of the 5 metrics (SST, UCLA, ASES, and Constant), significantly lower active abduction, active forward flexion, and passive external rotation than aTSA patients. Postoperatively, rTSA patients had significantly lower scores as measured by 2 of the 5 metrics (SST and SPADI), significantly lower active abduction, active forward flexion, active external rotation, and passive external rotation than aTSA patients. However, rTSA patients were observed to have significantly larger improvements in outcome as measured by 2 of the 5 metrics (UCLA and Constant), significantly larger improvements in active forward flexion and significantly smaller improvements in active external rotation and passive external rotation than aTSA patients. As described in Figure 2, the ASES and UCLA metrics were the most highly correlated for measuring outcomes with aTSA; the ASES and SPADI metrics were the most highly correlated for measuring outcomes with rTSA. Conversely, the SST and UCLA metrics were the least correlated for measuring outcomes with aTSA; the UCLA and SPADI metrics were least correlated for measuring outcomes with rTSA.

Discussion: The results of this large clinical study demonstrate significant improvements in outcomes following treatment with both aTSA and rTSA using a single platform shoulder system at a mean follow-up of 35.8 ± 14.9 months. Comparing differences in outcomes for aTSA and rTSA yields some interesting observations: pre-operative measures were generally worse for rTSA patients, post-operative outcomes were generally superior for aTSA patients, and pre-to-post-operative improvements were generally superior for rTSA patients. The observed differences in improvement between metrics reflect the different scoring weights with each metric for pain, function, and strength and may also imply that each scoring metric has different sensitivities for what defines a “worse” patient and what defines a “good” outcome. Differences in scoring weights within each metric may inadvertently bias results and could potentially impact decision making for one type of treatment over another. Future work should attempt to better understand these differences, identify sensitivities, and attempt to create a standardized scoring metric/method to quantify outcomes with total shoulder arthroplasty.

Significance: Given that there is no standardized scoring system to quantify outcomes with shoulder arthroplasty, the results of this clinical study of 863 patients is significant because it provides the orthopaedic surgeon and clinical researcher an improved understanding of how 5 of the most commonly utilized scoring systems quantify functional outcomes with both aTSA and rTSA. Additionally, the results of this study also provides new information of how these clinical outcome metrics relate to one another for both aTSA and rTSA.