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ABSTRACT BOOK

FP.08.03

DO PATIENTS WITH POOR EARLY CLINICAL OUTCOMES AFTER ANATOMIC AND REVERSE TOTAL SHOULDER ARTHROPLASTY ULTIMATELY IMPROVE?

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Background: While most patients undergoing aTSA and rTSA have substantial improvement in pain and function at early follow-up, improvements occur more slowly during postoperative rehabilitation in some patients. We assessed a patient's risk of persistent shoulder dysfunction beyond the early postoperative period and identify risk factors for persistent poor function.

Methods: We identified 702 primary aTSAs for OA and 1,360 primary rTSAs for OA, CTA, RCT, between 2001-2022 with early (3- or 6-months) and 2-year follow-up from a multicenter database. Early poor performance was defined as a postoperative ASES score <20th percentile. Persistent poor performance was defined as failing to achieve the patient acceptable asymptomatic state (PASS) (aTSA=81.7, rTSA=77.3) at 2-year follow-up. We identified 144 aTSA and 292 rTSA early poor performers. Our primary outcome was the rate of persistent poor performance. Secondary, we identified risk factors for persistent poor performance.

Results: At 2-year follow-up, 74 aTSAs(51%) and 178 rTSAs(61%) had persistent poor performance. For aTSA, the rate of persistent poor performance did not differ based on whether patients were early poor performers at 3-month follow-up, 6-month follow-up, or both (50% vs. 49% vs. 56%,P=0.795). In contrast, 85% of rTSAs classified as early poor performers at both 3- and 6-months were persistent poor performers at 2-years versus 56% and 54% of poor performers at 3- or 6-month follow-up only (respectively; both P<0.001). For rTSA, early poor performers at both follow-up visits had a 29.8% [95%CI=18.6-41.0%] greater absolute risk and a 1.54 [95%CI=1.32-1.81] greater relative risk of persistent poor performance compared to rTSAs with poor performance at 3- or 6-month follow-up only (both P<0.001). On multivariable analysis, persistent poor performance was best predicted by a diagnosis of hypertension and diabetes for aTSA and prior shoulder surgery and poor preoperative ASES score for rTSA.

Conclusions: Half of aTSAs and nearly two-thirds of rTSAs with an ASES score <20th percentile at early follow-up will have persistent poor shoulder function at 2-years. Risk factors for persistent poor performance should be assessed in early poor performers to determine if there are implant-positioning errors that would benefit from revision or if continued targeted physical therapy should be pursued.

FP.08.04

CLINICAL OUTCOMES BASED ON FINAL BASEPLATE VERSION IN REVERSE TOTAL SHOULD ARTHROPLASTY

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Background: While surgeons attempt to place the baseplate of a reverse total shoulder arthroplasty (rTSA) close to neutral version, outcomes based on the final version remain unknown. The purpose of this study is to determine the clinical and radiographic outcomes of rTSA based on the amount of retroversion the baseplate is placed in to determine if increasing retroversion affects the outcomes.

Methods: All primary rTSA patients in a multicentered international database with a 2-year minimum follow-up implanted with computer navigation so the final baseplate version is known were included. A single medialized glenoid/lateralized humerus rTSA implant system was used. Patients were stratified by their final version: <0° (anteversion), 0 to 5° of retroversion, 6-10°, and >10°. Motion, outcome scores and radiographic outcomes were compared between groups using ANOVA with Tukey HSD post tests and chi square.

Results: Four hundred and fourteen patients (189 females/225 males) were identified, with a mean follow-up of 30 months. Demographics were similar between the 4 groups. The mean native version was 10.3°, and the mean postoperative version was 3.1°. Preoperatively, 46% were >10°, 25% 6-10°, 18% 0-5° and 11% anteverted. Postoperatively, 3% were >10°, 23% 6-10°, 68% 0-5° and 6% anteverted. Postoperatively, there were no significant differences between the 4 groups with regards to outcome scores or motion, except for abduction greater in the >10° retroversion group that exceeded the MCID. At follow-up, pain scores, patient satisfaction, notching and complications were similar between the groups.

Conclusions: This study demonstrated that computer navigation was highly efficacious, placing 97% of patient in 10° or less of retroversion or in anteversion. Except for abduction, there were no significant differences with regards to motion, pain relief, outcome scores, patient satisfaction or complications between the different groups based on the final implanted version. rTSA baseplates can be placed in anteversion or up to 10° of retroversion. The outcomes of patients left in 15° or greater retroversion could not be answered by this study since the use computer navigation left very few patients with postoperative retroversion >10°.

FP.22.01

CORRELATION OF RISK FACTORS WITH ODDS OF INSTABILITY AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: The goal of this clinical study is to better facilitate pre-operative identification of patients at-risk for instability after rTSA and to quantify the impact of accumulating risk factors on the occurrence of dislocation.

Methods: We retrospectively analyzed a multi-center database of a single shoulder prosthesis (Equinoxe; Exactech Inc, Gainesville, FL USA) and quantified the instability rate with this implant. Risk factors were based on prior work by Le et al. and included: male gender, < 67 years of age, not repairing the subscapularis, cemented humeral stem, expanded thickness glenosphere, and >40mm glenosphere. 8,301 patients (mean age: 71.9yrs) treated with primary rTSA between 2007 and 2022 were included with an average follow-up of 27.2 months (range: 0.1 to 173 months). We quantified the prevalence of instability risk factors and the instability rate for each category of risk factor number. We further calculated the odds ratio for each cohort to quantify the impact of accumulating risk factors on instability.

Results: 119 (45F/74M) of 8,301 primary rTSA patients (1.4%) experienced instability. Risk factors that resulted in significantly higher rates of instability included: males vs. female gender (2.3% vs. 0.9%, p<0.0001); patients <67 vs. >67 years (2.6% vs. 1.0%, p<0.0001); cemented vs. press-fit stems (2.7% vs. 1.3%, p<0.0001); glenosphere diameter >40mm vs. <40mm diameter (2.2% vs. 1.0%, p<0.0001); and expanded vs. standard offset glenospheres (3.2% vs. 1.3%, p<0.0001). 36.1% had 1 risk factor, 42.5% had 2 risk factors, 14.7% had 3 risk factors, 1.6% had 4 risk factors, and 0.2% had 5 risk factors. A higher prevalence of risk factors correlated with a higher rate of instability. Stratifying instability rate by multiple risk factors identified numerous cohorts with odds ratios >4, and 3 cohorts with odds ratios >15.

Conclusions: This study demonstrated that 1.4% of rTSA patients experienced instability with this implant. We demonstrated the impact of accumulating risk factors on incidence of dislocation. Doing so we identified that patients with the most pronounced risk of instability were males <67 years, without subscapularis repair. Patients considering rTSA with these risk factors should be made fully aware of this elevated complication risk.

OP.07.09

ASSESSING GLENOID ARTHROPLASTY COMPONENT POSITIONING FOR SURGEONS UTILIZING SURGICAL PLANNING SOFTWARE

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Background: Glenoid component positioning remains a challenge during total shoulder arthroplasty. While preoperative 3D planning software is widely available for most TSA systems today, the degree to which this software affects surgeon pre-operative and intra-operative decision making is unknown. The purpose of this study is to determine whether surgeons using 3D shoulder arthroplasty planning software adhere to glenoid component positioning principles shown to reduce complications and improve outcomes of anatomic TSA (aTSA) and reverse TSA (rTSA) and quantify the rate at which 3D preoperative planning results in concordant intraoperative plan execution.

Methods: A total of 695 consecutive, de-identified, planned surgeries using commercially available software were identified from the case registries of six fellowship trained shoulder arthroplasty surgeons. aTSA glenoid plans were evaluated for final implant position with less than 10° of retroversion, corrective reaming less than 15°, and avoidance of glenoid vault perforation. rTSAs were evaluated for final implant position with less than 15° of retroversion, glenosphere position in neutral or inferior tilt with at least 3 mm of inferior offset and 3 mm of posterior offset, and backside coverage of at least 50% of the baseplate on the native glenoid. ANOVA was performed to determine whether glenoid size resulted in selection of differing implant sizes and whether planned component size correlated with the actual implant size.

Results: 185 aTSAs and 510 rTSAs pre-operatively planned surgeries using commercially available software were analyzed. All planning principles were adhered to in 90% of all aTSA cases and 79% of all rTSA cases. The concordance between preoperative 3D planning implant selection and final implant selection was 90% for aTSA and 91% and 95% for rTSA baseplate and glenosphere implant selection, respectively. Implant size varied in accordance with glenoid size for both aTSA and rTSA ($p<0.001$).

Conclusions: Surgeons adhered to known principles in most TSA cases when utilizing 3D CT-based shoulder arthroplasty planning software. A high concordance was found between preoperative implant selection and the final glenoid component inserted. Native glenoid size affects surgeon selection of implant and glenosphere size. Understanding how orthopaedic surgeons utilize planning software can help lead to improvements in software design.

OP.08.08

IMPLANT UTILIZATION: A COMPARISON OF PREOPERATIVE PLANNING WITH AND WITHOUT COMPUTER ASSISTED NAVIGATION

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Background: Preoperative planning for anatomic and reverse total shoulder arthroplasty (aTSA and rTSA) is becoming increasingly common. While preoperative planning allows surgeons to determine individualized implant types, utilization of intraoperative navigation improves the accuracy of implant placement and may increase confidence in the preoperative plan. The purpose of this study was to evaluate and compare the rate at which surgeons utilize an implant different than their preoperative plan with and without the use of computer navigation.

Methods: A retrospective review of a multicenter prospectively-collected shoulder arthroplasty database was performed between 2016-2022. Inclusion criteria were primary aTSA or rTSA with an available preoperative plan and actual implant utilized. Change in implant was defined as a deviation in final implant from the preoperative plan in regard to backside shape (unaugmented vs augment or differing augment shape).

Results: We included 1,744 (462 aTSA, 1,282 rTSA) TSAs performed with preoperative planning and intraoperative navigation and 101 (33 aTSA, 68 rTSA) TSAs performed with preoperative planning alone. Overall, the final implant deviated from the preoperative plan less frequently when intraoperative navigation was used compared to preoperative planning alone (6.7%[n=116] vs. 13.9%[n=14], P=0.014; OR=2.3[95%CI=1.1-4.1]). When stratified by procedure, deviation from the preoperative plan occurred significantly less for rTSA when preoperative planning was used with intraoperative navigation versus planning alone (6.9%[n=90] vs. 17.6%[n=13], P=0.003; OR=2.9[95%CI=1.3-5.7]). There was no significant difference in plan deviation with and without intraoperative navigation for aTSA (5.8%[n=27] vs. 6.1%[n=2], P=1).

Conclusions: Use of intraoperative navigation is associated with increased adherence to the preoperative plan. It is possible that use of navigation increases surgeon confidence despite known limitations of glenoid visualization during this procedure. This may offer advantages in outpatient surgery centers and smaller hospitals where inventory space may be limited. Further studies are needed to examine the causes for intraoperative deviations.

EP.06.020

GLENOID COMPONENT PLACEMENT ACCURACY IN TOTAL SHOULDER ARTHROPLASTY WITH PREOPERATIVE PLANNING AND STANDARD INSTRUMENTATION IS NOT INFLUENCED BY SUPERO-INFERIOR GLENOID EROSION

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Background: Accurate glenoid component placement in total shoulder arthroplasty (TSA) is often difficult even with the use of preoperative planning. Computer navigation and patient-specific guides increase component placement accuracy, but which patients benefit most is unknown. We assessed surgeons' accuracy in placing a glenoid component in-vivo using 3-dimensional preoperative planning with standard instrumentation for different glenoid erosion patterns.

Methods: We retrospectively reviewed of 170 primary TSAs performed at a single institution. Commercially-available preoperative planning software was used in all arthroplasties with multiplanar 2-dimensional computed tomography and a 3-dimensional implant overlay. After registration of intraoperative bony landmarks to the navigation system, participating surgeons with knowledge of the preoperative plan were blinded to the navigation screen and attempted to implement their preoperative plan by simulating placement of a central-axis guide pin. 230 screenshots of surgeon's simulated guide pin placement were included (aTSA=66, rTSA=164). Displacement, error in version and inclination, and overall malposition from the preoperatively-planned target point were stratified by the Favard classification describing superior-inferior glenoid wear: E0(n=89)=superior humeral migration with no glenoid erosion; E1(n=81)=concentric glenoid erosion; E2(n=29)=glenoid erosion predominantly in the superior pole; E3(n=29)=global glenoid erosion more severe in the superior pole; E4(n=2)=glenoid erosion predominantly in the inferior pole. Components were considered malpositioned for version/inclination errors >10° or displacement from the starting point >4 mm.

Results: Overall, the mean displacement error was 3.5±2.7mm (aTSA=2.7±2.3mm, rTSA=3.8±2.9mm), version error was 5.7±4.7° (aTSA = 5.8±4.4°, rTSA = 5.7±4.8°), inclination error was 7.1±5.6 (aTSA = 4.8±4.8°, rTSA = 8.1±5.7°), and malposition rate was 53% (aTSA=38%, rTSA=59%). None of our outcomes differ based on Favard classification: displacement error (P=0.829; E0=3.5±3.0mm, E1=3.4±2.8mm, E2=3.2±1.9mm, E3=3.8±2.4mm, E4=2.0±0.4mm), version error (P=0.297; E0=6.0±4.9°, E1=6.2±5.0°, E2=4.6±3.7°, E3=4.6±3.7°, E4=4.5±4.9°), inclination error (P=0.764; E0=7.2±5.6°, E1=6.6±5.7°, E2=7.4±5.6°, E3=8.2±5.7°, E4=6.0±5.7°), and malposition rate (P=0.381; E0=53%, E1=51%, E2=48%, E3=66%, E4=0%). Additionally, outcomes did not differ when stratified by type of TSA.

Conclusions: Glenoid component displacement, version error, inclination error, and overall malposition did not differ based on supero-inferior glenoid morphology as defined by the Favard classification. Malposition was relatively high in our cohort, suggesting that surgeons should consider alternate techniques beyond preoperative planning and standard instrumentation when performing shoulder arthroplasty.

EP.06.068

CLINICAL OUTCOMES OF ANATOMIC VERSUS REVERSE TOTAL SHOULDER ARTHROPLASTY IN STIFF SHOULDERS WITH PRIMARY OSTEOARTHRITIS: A CASE CONTROL STUDY

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Background: The popularization of reverse total shoulder arthroplasty (rTSA) has begun to challenge the place of anatomic total shoulder arthroplasty (aTSA) as a primary procedure for rotator cuff intact glenohumeral osteoarthritis (RCI-GHOA). One purported benefit of aTSA is improved postoperative range of motion (ROM) compared to rTSA especially in internal rotation; however, patients with preoperative stiffness may require extensive soft tissue release predisposing to instability and have poorer subscapularis function. We compared clinical outcomes of aTSA and rTSA performed in stiff versus non-stiff shoulders for RCI-GHOA.

Methods: A retrospective review of an international shoulder arthroplasty database identified 1,608 aTSAs and 600 rTSAs performed for RCI-GHOA with minimum 2-year follow-up. Preoperative stiffness was defined as <=0° of passive ER. Subsequently, three cohorts were matched: stiff aTSAs (n=257) were matched 1:3 to non-stiff aTSAs, stiff rTSAs (n=87) were matched 1:3 to non-stiff rTSAs, and stiff rTSAs (n=87) were matched 1:1 with stiff aTSAs. We compared ROM, outcome scores, and the rate of complications and revision surgery at latest follow-up.

Results: Compared to non-stiff aTSAs, despite stiff aTSAs having poorer preoperative ROM and functional outcome scores for all measures assessed, only poorer postoperative active abduction, active ER, and passive ER persisted postoperatively. Similarly, stiff rTSAs had poorer preoperative ROM and functional outcome scores for all measures assessed compared to non-stiff rTSAs, but only poorer active abduction, active ER, and passive ER persisted. When comparing stiff rTSAs to matched stiff aTSAs, no significant differences in preoperative ROM or functional outcome scores were found. However, stiff aTSAs had greater postoperative active IR score, active ER, and passive ER. Postoperative outcome scores were similar across all matched cohort comparisons despite motion differences. The rate of complications and need for revision surgery did not differ between any group comparisons.

Conclusions: Patients with RCI-GHOA and preoperative rotational stiffness have poorer postoperative ROM compared with non-stiff patients following both aTSA and rTSA. Notably, preoperative limitations in passive ER do not appear to be a limitation to utilizing aTSA. Indeed, patients with limited preoperative ER treated with aTSA had greater postoperative rotation compared to those treated with rTSA.

EP.06.081

PREDICTING PAIN WHILE SLEEPING ON THE AFFECTED SHOULDER AFTER PRIMARY REVERSE SHOULDER ARTHROPLASTY

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Background: Preoperative pain is a primary motivating factor for patients to undergo shoulder arthroplasty. Specifically, pain at night is a common symptom for these patients and the ability to sleep comfortably while lying on the affected side after a reverse total shoulder arthroplasty (rTSA) is a common question of patients in the preoperative course. The purpose of this study is to evaluate mass index (BMI), patient demographics, and any implant specific factors in a large database of primary rTSA patients to determine any correlation with pain while lying on the affected side. We hypothesize that there will be no correlation between BMI or implant specifics with pain while lying on the affected side after a primary rTSA.

Methods: A prospectively collected international multi-center single-system shoulder arthroplasty database was reviewed for rTSA patients with 1-year follow-up. Shoulders with fractures, infection, sickle cell disease, or a complication or revision were excluded. Bivariable and multivariable tests were performed to identify the influence of demographics, comorbidities, and implant characteristics on preoperative, postoperative, and pre- to postoperative improvement in patient-reported pain when lying on the affected shoulder (scale 0-10).

Results: 3,259 patients were included. Bivariable analysis revealed significant effects of age (p=0.001), BMI (p=0.000), gender (p=0.000), and diabetes (p=0.001) on preoperative pain. Age, BMI, and gender remained significant factors in analyses of both postoperative pain (p=0.000, 0.012, and 0.035, respectively) and improvement (p=0.021, 0.018, and 0.000, respectively); however, there were no monotonically increasing or decreasing relationships. Postoperatively, heart disease (p=0.005), diabetes (0.000), tobacco use (0.004), and no comorbidities (0.033) were significantly different than groups without. Logistic regression showed that age (p=0.000; OR=0.98[95%CI=0.97-0.99]), female sex (p=0.045; OR=1.26[95%CI 1.01-1.59]), hypertension (p=0.032; OR=0.78[95%CI 0.63-0.98]), heart disease (p=0.048; OR=1.27[95%CI 1-1.6]), diabetes (p=0.007; OR=1.36[95%CI 1.09-1.71]), tobacco use (p=0.008; OR=1.55[95%CI 1.12-2.14]), combined offset of the liner/tray (p=0.014; OR=0.93[95%CI 0.88-1.09]), and preoperative pain (p=0.000; OR=1.21[95%CI 1.15-1.26]) were significant predictors of postoperative pain greater than or equal to 3.

Conclusions: This study demonstrates that in a large multicenter operative database, no significant correlation can be found to predict a patient's postoperative pain while sleeping on the affected side after rTSA besides their level of pain preoperatively.

EP.06.083

CORRELATION OF SUBJECTIVE WITH OBJECTIVE MEASURES OF OUTCOME IN SHOULDER ARTHROPLASTY

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Background: Patient-reported outcomes measures (PROMs) are becoming increasingly important in quantifying outcomes in shoulder arthroplasty. Multiple outcome scores have subjective elements as part of their overall value. We sought to determine the degree to which these subjective assessments correlate with objective measures of function.

Methods: We analyzed a multi-center international database of a single implant (Exactech, Inc, Gainesville, FL) that uses a standardized method of measuring shoulder arthroplasty outcomes using several outcomes tools that include a subjective, patient-reported component. These include: SST, Constant, ASES, UCLA, SPADI and Shoulder Arthroplasty Smart Score (SAS) as well as pain on a daily basis, and subjective assessment satisfaction. 2401 anatomic (ATSA) and 3915 reverse (RTSA) shoulders, all with minimum 2-year follow-up were included. Pearson correlation coefficients (CCs) were calculated for correlation between each of these subjective measures and objective measures of active forward elevation, abduction, external rotation and internal rotation score. Average correlation between each subjective score and the objective measures was then calculated to determine PROMs that best correlate with objective postoperative range of motion measures. A threshold of > 0.5 was set as moderate correlation.

Results: For ATSA, only the Constant Score and SAS Score achieved CCs above 0.5 (0.63 and 0.60 respectively). Daily pain had a negative CC (-0.34) and global assessment of satisfaction had a weak correlation of 0.37. Similarly, for RTSA, Constant and SAS score were the only PROMs to score above 0.5 (0.60 and 0.57 respectively). Postoperative daily pain and overall satisfaction also had either a negative or weak correlation with functional outcomes.

Conclusions: Collection of PROMs is increasingly important in the shift toward value-based care. This study demonstrates that the subjective component of several commonly used outcomes scores as well as assessment of residual pain and satisfaction have only a weak positive correlation with functional outcomes. This suggests that non-diagnosis-specific scores may fail to accurately capture a full picture of patient outcomes and may not fully reflect the value achieved by these procedures. Diagnosis-specific scores, like the SAS, achieved moderate positive correlation and may be considered a better alternative to other historical measures for shoulder arthroplasty.

EP.06.111

GLENOID BASEPLATE FAILURE IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: There is little data on the incidence and causes of baseplate failure with modern contemporary designs. The purpose of this study is to determine the incidence of aseptic glenoid baseplate failure following primary rTSA using a contemporary humeral-lateralized system and identify significant risk factors associated with failure.

Methods: Data from a prospectively collected multi-center shoulder database were analyzed. All 7,162 primary rTSA patients performed from 2007 to 2020 were included. Patients with aseptic glenoid baseplate loosening were identified and compared to all other primary rTSA without loosening, evaluating preoperative and postoperative range of motion (ROM), patient reported outcome metrics (PROM), pain, function, satisfaction scores, demographics, co-morbidities, Walch classification, and radiographic changes associated with risk of loosening. Statistical analyses were performed as was a multivariate logistic regression to determine parameters and odds ratios (OR) for baseplate failure after rTSA.

Results: Irrespective of minimum F/U, 53 of 7,162 primary rTSA shoulders experienced aseptic glenoid baseplate failure, for an overall rate of 0.74%. Posterior/superior augmented glenoid baseplates had a 4.7% failure rate compared to 0.6% in non-augmented ($p<.001$). 6mm offset glenospheres had a 2.0% failure rate versus the 0.9% rate associated with 2mm offset glenosphere ($p=0.0003$). Walch B3 glenoids had a 7.8% failure rate ($p<0.0001$), and Sirveaux E3 glenoids had a 5.3% failure rate ($p=0.007$), compared to the other Walch and Sirveaux glenoid classifications. Patients with a beta angle <70°, scapular notching and humeral radiolucent lines had an increased failure rate (all $p<0.0001$). At latest follow-up the baseplate failure group had significantly lower PROM, function, and ROM ($p<0.004$), as well as higher pain scores ($p<0.001$). Multivariate logistic regression analysis showed that Walch glenoid types B2 ($p=0.002$, OR= 4.513) and B3 ($p=0.002$, OR=14.804), use of expanded glenospheres ($p=0.025$, OR=2.57) and usage of augmented baseplates ($p=0.001$, OR=2.50) were significant risk factors.

Conclusions: The incidence of aseptic glenoid baseplate failure was 0.74%. Failure led to lower PROM, ROM, function, and patient satisfaction, as well as higher pain scores. Higher rates of failure were seen with posterior/superior augmented glenoids, 6mm offset expanded glenospheres, Walch B2 and B3 and Sirveaux E3 glenoids, beta angle <70°, scapular notching, and humeral radiolucent lines.

EP.06.113

HOW DOES PREOPERATIVE SHOULDER EXTERNAL ROTATION STIFFNESS INFLUENCE THE RATE OF MOTION RESTORATION AFTER TOTAL SHOULDER ARTHROPLASTY?

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Background: Although both aTSA and rTSA reliably improve pain and function, there is a subset of patients who lag behind their peers in regaining overhead motion. We compared the rate of recovery in motion after aTSA and rTSA in preoperatively stiff (passive external rotation [ER] <=0°) versus non-stiff (passive ER >0°) shoulders.

Methods: A retrospective review of a multi-institutional shoulder arthroplasty database was performed between 2001 and 2021. We identified 1,164 aTSAs performed for OA and 539 rTSAs for OA, RCT, CTA, with a minimum 2-year follow-up. Patients were excluded for a preoperative diagnosis of nerve injury, infection, or fracture. Postoperative complications that would affect motion were also eliminated. Included patients at minimum had a follow-up between 3-6 months, minimum 2-year follow-up, and a third visit at any other timepoint. Our primary outcome was the rate and period of recovery in ROM.

Results: Non-stiff aTSAs regained ROM faster than stiff aTSAs for abduction (14.0 vs. 4.9 °/month), IR (0.5 vs. 0.3 points/month), and ER (9.1 vs. 3.1 °/month). However, stiff aTSAs continued to improve over a longer period compared to non-stiff aTSAs for abduction (8.1 vs. 4.6 months), IR (6.8 vs. 4.5 months), and ER (8.7 vs. 4.0 months). FE improvement for stiff vs. non-stiff aTSAs was similar for rate (16.9 vs. 16.6 °/month) and length of improvement (4.4 vs. 4.3 months). Non-stiff rTSAs regained ROM faster than stiff rTSAs for active FE (13.1 vs. 6.6°/month), ER (5.0 vs. 1.0°/month) and abduction (12.4 vs. 3.5°/month). However, stiff rTSAs continued to improve over a longer period compared to non-stiff rTSAs for active FE (6.7 vs. 4.5 months), ER (16.3 vs. 5.0 months) and abduction (8.4 vs 4.2 months). IR improvement was similar for rate (0.2 vs. 0.2 levels/month) and length of improvement (8.4 vs. 8.3 months). Stiff rTSAs had slower ER recovery regardless of subscapularis repair and both stiff and non-stiff groups had slower recovery with repair.

Conclusions: Preoperatively stiff versus non-stiff shoulders had a slower rate of recovery but continued to improve over a longer period for abduction, IR and ER after aTSA and FE, ER, and abduction after rTSA.

EP.06.143

WHAT THRESHOLD OF RANGE OF MOTION IS ASSOCIATED WITH MINIMAL GAIN IN PATIENT-REPORTED OUTCOME SCORES AFTER TOTAL SHOULDER ARTHROPLASTY?

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Background: There may exist a minimum amount of range of motion (ROM) necessary to perform functional tasks after total shoulder arthroplasty (TSA), beyond which further ROM may provide no further benefit to patient-reported outcome measures (PROMs) or patient satisfaction. We aimed to identify whether there is a threshold of postoperative ROM after TSA after which there is minimal gain in PROMs at minimum 2-year follow-up.

Methods: A retrospective review of a multicenter international shoulder arthroplasty database was performed between 2001-2021 for patients undergoing aTSA or rTSA for primary OA with an intact rotator cuff with minimum 2-year follow-up. Shoulders were excluded for nerve injury or periprosthetic fracture. In total, 1,828 aTSAs and 623 rTSAs were included. Our primary outcome was to determine whether a threshold existed whereby an improvement in postoperative active ROM in abduction, FE, IR, and ER was associated with no additional significant improvement in outcome scores (SST, ASES, and SPADI). For each PROM and ROM pair, continuous two-segment linear regression models were fitted.

Results: For each ROM measure, the highest threshold value corresponding to minimal additional improvement in postoperative PROMs was 100° for abduction, 130° for forward elevation, 47° for ER, and L3 vertebral level for IR. Change in postoperative PROMs with increased postoperative ROM was significantly better before identified threshold values compared to after (early vs. late slope) for all ROM-PROM pairings. Improvement in postoperative PROMs with increased postoperative ROM beyond these identified thresholds was not statistically significant for all ROM-PROM pairings.

Conclusions: Our findings demonstrate threshold values for active abduction, forward elevation, and external rotation after which improvement in PROMs is minimal. Interestingly, improvement in PROMs with greater IR score did not significantly differ before versus after the identified threshold, suggesting that continued IR improvement correlates with improved PROMs and patient satisfaction even at high levels of IR. These results can help surgeons prioritize intraoperative decision-making and physical therapists tailor postoperative rehabilitation regimens to maximize satisfaction and quality of life.

EP.06.145

DIFFERENTIATION OF CLINICAL OUTCOMES BEFORE AND AFTER SHOULDER ARTHROPLASTY FOR ROTATOR CUFF INTACT OSTEOARTHRITIS USING THE WALCH CLASSIFICATION

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Background: The Walch classification is commonly utilized by surgeons when determining the treatment of osteoarthritis(OA). We assessed the prognostic value of the Walch classification on pre- and post-operative clinical states in total shoulder arthroplasty(TSA).

Methods: A prospectively-collected, multi-center database for a single-platform TSA system was queried for patients with rotator cuff-intact OA and minimum 2 year follow-up. Differences in active range of motion (ROM; abduction, forward elevation[FE], external/internal-rotation[ER and IR]), objective and patient-reported outcome scores (PROs; SST, Constant, ASES, UCLA, SPADI, VAS pain, Shoulder Function, and Shoulder Arthroplasty Smart[SAS] scores) were stratified by glenoid deformity according to the Walch classification. Outcomes were evaluated with one-way ANOVA and post-hoc Tukey correction for multiple comparisons.

Results: 979 TSAs were analyzed. The Walch classification was: A1=416 (aTSA=276, rTSA=140), A2=151 (aTSA=57, rTSA=94), B1=86 (aTSA=48, rTSA=38), B2=255 (aTSA=156, rTSA=99), B3=71 (aTSA=28, rTSA=43). Preoperatively for aTSA, outcomes that differed between groups were abduction(P=0.025), FE(P=0.006), ER(P<0.001), and SAS score(P=0.032); there were no significant differences in the rTSA cohort (P>0.05). Postoperatively for aTSA, the Constant(P=0.023) and SAS scores(P=0.047) differed based on Walch classification; however no differences persisted on post-hoc testing. Postoperatively for rTSA, only the VAS score differed based on Walch classification (P=0.007); on post-hoc testing, A2 glenoids had significantly less pain than A1 glenoids (0.6±1.3 vs. 1.4±2.1,P=0.017). For aTSA, improvement differed for abduction(P=0.005; B3>A1[67±30° vs. 46±38°,P=0.037]), FE(P=0.002; B2>A1 and B3>A1[46±32° and 55±29° vs. 35±34°, P=0.037 and P=0.036]), ER(P=0.001; A2>A1 and B3>A1[35±22° and 37±25° vs. 22±22°,P=0.006 and P=0.013, respectively]), Constant(P=0.012; B3>A1[37.0±15.2 vs. 23.2±18.9,P=0.025]),UCLA(P=0.030; no post-hoc differences), and SAS scores(P=0.001; B3>A1[39.2±8.8 vs. 28.5±13.9,P=0.031]). For rTSA, no differences in improvement for any outcomes where found.

Conclusions: We demonstrate a modest association between preoperative glenoid morphology and clinical state when evaluating patients undergoing aTSA for cuff-intact OA, with greater erosión and retroversión being associated with poorer preoperative state. However, these patients also demonstrated greater improvement after aTSA and achieve a similar clinical state postoperatively. The clinical outcome of patients undergoing rTSA is not associated with the Walch classification. Alternative glenoid classification systems or predictive models should be considered to provide more precise prognoses for patients undergoing TSA for rotator cuff-intact OA.

EP.06.166

UTILIZING RAND/UCLA APPROPRIATENESS CRITERIA TO EXAMINE OUTCOMES OF PRIMARY ANATOMIC TOTAL SHOULDER ARTHROPLASTY IN A US MULTICENTER RETROSPECTIVE COHORT

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Background: There has been limited quality evidence regarding efficacy or validated guidelines to determine appropriateness of total shoulder arthroplasty (TSA). A recent study used the RAND/UCLA method to determine appropriateness of TSA across a range of clinical characteristics and develop a decision tree to assist in clinical decision-making. The purpose of this study is to characterize prevalence rates of TSA surgeries, and to determine if outcomes following TSA vary across the three appropriateness classification groups.

Methods: Clinical data from a multicenter prospectively collected cohort were used. Patients were classified as either "appropriate," "inconclusive," "inappropriate," using a modified version of a validated appropriateness algorithm. Pre- and post-operative ASES, SST, VAS Pain Score, Constant score, UCLA, SPADI, and SAS score were examined using IBM SPSS Statistics to determine differences in outcome variable changes.

Results: 286 patients that underwent primary anatomic TSA, of which 107 had minimum 2- years follow-up, were included. The prevalence rates of appropriate, inconclusive, and
inappropriate were 22.4%, 57.3%, and 20.3% respectively. There was a statistically significant difference in both pre-operative outcome measures and improvement in outcome measures across groups that demonstrated worse symptomatology and greater improvement in the appropriate group versus the inappropriate group. There was no significant difference in post-operative outcomes amongst all included patients or patients with an average of 2 years follow-up.

Conclusions: There was statistically significant improvement in outcome measures across groups that demonstrated worse symptomatology and greater improvement in PROMs the appropriate group versus the inappropriate group regardless of time point. These data provide a convincing argument for consensus-building efforts to delineate eligibility criteria for anatomic TSA particularly in modern debates in surgical decision making for anatomic TSA versus Reverse TSA candidates. This may allow for a reduction in variability in patient selection and optimize outcomes, implant survivability, and cost-effectiveness.

EP.06.180

QUANTIFYING SUCCESS AFTER TOTAL SHOULDER ARTHROPLASTY: THE SUBSTANTIAL CLINICALLY IMPORTANT PERCENTAGE OF MAXIMAL POSSIBLE IMPROVEMENT

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Background: The percent maximal possible improvement (%MPI) as a means to assess patient outcomes after total shoulder arthroplasty (TSA) was introduced to mitigate ceiling effects, which limit the ability to differentiate success among high-functioning patients. However, score- and population-specific thresholds have not been defined and may not equal the 30% threshold first proposed. Our purpose was to (1) compared the percentage of patients achieving the substantial clinical benefit (SCB) and 30% MPI and (2) define %MPI thresholds associated with substantial clinical improvement following primary TSA.

Methods: We retrospectively reviewed a multicenter database for primary TSAs performed using a single implant system with minimum 2-year follow-up between 2003 and 2020. Pre- and postoperative outcome scores were evaluated. %MPI was calculated for each patient and outcome score as described by Matsen et al. The proportion of patients achieving the previously-reported SCB and 30% MPI were determined for each score. The substantial clinically important %MPI (SCI-%MPI) was determined using an anchor-based method comparing patients describing their treatment as "much better" compared to "worse" or "unchanged". Calculations were stratified by outcome score, prosthesis, age, and sex.

Results: 4,166 shoulders (1,593 aTSA, 2,573 rTSA) were evaluated at a mean age of 69 years (range, 27-96) (aTSA=66, rTSA=71, $p<0.001$). Average follow-up was 52 months (range, 24-217). Scores without ceiling effects (i.e., Constant and SAS) had a higher rate of patients achieving the SCB, but not the 30% MPI when compared to ceiling effect scores (SST, ASES, UCLA, SPADI). The SCI-%MPI thresholds for aTSA and rTSA by score were: SST: aTSA=47%, rTSA=48%; Constant: aTSA=35%, rTSA=39%; ASES: aTSA=50%, rTSA=53%; UCLA: aTSA=52%, rTSA=55%; SPADI: aTSA=47%, rTSA=50%; SAS: aTSA=45%, rTSA=42%. While the SCI-%MPI increased with age for aTSA, estimates were similar amongst patients >=60 years old for rTSA. The SCI-%MPI for all scores was greater for females except with the Constant score for aTSA and the Constant and SPADI scores for rTSA.

Conclusions: The %MPI judged relative to patient-reported substantial clinical improvement offers a simple method to quickly assess improvements in outcome scores. Given considerable variation, we recommend utilizing score-specific SCI-%MPI to gauge success when evaluating patients undergoing primary TSA.

EP.06.201

DO THRESHOLDS OF PREOPERATIVE FUNCTION PREDICT ACHIEVEMENT OF CLINICALLY-IMPORTANT BENCHMARKS OF IMPROVEMENT AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY?

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Background: The purpose of this study was to determine if there is a threshold of preoperative function that is predictive of achieving clinically-important success at minimum 2-year follow-up after reverse total shoulder arthroplasty (RTSA).

Methods: We retrospectively reviewed a multicenter database for patients that underwent primary RTSA. Outcomes evaluated were abduction, forward elevation, external and internal rotation, SST, Constant, ASES, UCLA, SPADI, and SAS scores. Clinically-important benchmarks (CIBs) evaluated include: Minimum Clinically Important Difference (MCID), Substantial Clinical Benefit (SCB), Patient Acceptable Symptomatic State (PASS), and the Minimal and Substantial Clinically Important Percent Maximal Possible Improvement (MCI-%MPI and SCI-%MPI); RTSA-specific CIBs were adopted from prior studies. Multivariable logistic regression was first performed to assess whether preoperative outcomes predicted achieving CIBs independent of age, sex, and BMI. Next, a ROC analysis was performed to determine the preoperative thresholds predictive of achieving CIBs per the Youden index; identified thresholds were applied to create contingency tables and compared with Fisher's Exact test.

Results: 3,205 RTSAs were included. Poorer preoperative ROM was associated with greater odds of achieving the MCID and SCB for all ROM measures except the MCID for forward elevation($P<=0.014$), but lower odds of achieving the PASS ($P<=0.001$). More favorable preoperative scores were associated with greater odds of achieving the PASS for all scores, but only for a few scores for other CIBs. Thresholds of preoperative ROM and outcome scores identified on ROC analysis were significant predictors of achieving the MCID, SCB, and PASS for all outcomes ($P<0.001$), but not the MCI-%MPI and SCI-%MPI. Preoperative thresholds that predicted achieving CIBs for ROM were lowest for the PASS and highest for the MCID, while for outcome scores they were lowest for the PASS and similar between the MCID and SCB. Preoperative ROM thresholds better-differentiated whether patients would achieve CIBs compared to outcome score thresholds. Variability in identified thresholds, respective AUCs, and predictiveness of achieving CIBs was minimal when stratified by age and sex.

Conclusions: Preoperative ROM and outcome scores can be utilized to predict the likelihood of achieving absolute CIBs of success (MCID, SCB, PASS) after RTSA, but not relative CIBs (MCI-%MPI and SCI-%MPI).

EP.06.203

DETERMINING THE PREVALENCE OF APPROPRIATE PRIMARY ANATOMIC TOTAL SHOULDER ARTHROPLASTIES USING A VALIDATED RAND/UCLA ALGORITHM

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Background: A recent study used the RAND/UCLA method to generate and validate appropriateness guidelines for primary anatomic TSA. There have been no clinical studies to our knowledge that specifically stratify real-world clinical TSA patient cases into appropriateness categories and characterize appropriateness classification groups. Given the rise in utilization, appropriateness criteria for TSA have the capability to be an exceptionally compelling tool for enhancing quality of care and controlling costs. Thus, we used a modified RAND/UCLA appropriateness classification scheme to calculate prevalence rates of appropriate, inconclusive, and inappropriate total shoulder arthroplasties (TSA) and to characterize patients within each group.

Methods: Baseline demographic information and pre-operative outcome scores from a multicenter, prospectively-collected cohort of patients undergoing primary anatomic TSA were examined using IBM SPSS Statistics. Patients were classified as either "appropriate," "inconclusive," or "inappropriate," using a modified version of a validated appropriateness algorithm.

Results: Data from 377 patients that had undergone TSA were assessed. 22.5% (95% CI [18%, 27%]) of patients were classified as appropriate, while 20.7% (95% CI [17%, 25%]) were classified as inappropriate. 56.8% (95% CI [52%, 62%]) were classified as inconclusive. The appropriate group demonstrated statistically significantly worse pre-operative pain and functional outcomes scores versus the inconclusive and inappropriate groups.

Conclusions: There was considerable variation in the characteristics of patients undergoing TSA, largely driven by age, symptomatology, and Walch classification. Approximately one-fifth of primary anatomic TSAs were determined to be inappropriate. A significant number of patients may be classified as "inconclusive." This may be secondary to worsening glenoid morphology and/or history of prior rotator cuff repair, which is consistent with modern debates to determine appropriateness for primary anatomic TSA versus reverse TSA candidates. Appropriate patients tended to have worse pre-operative function and pain scores than inconclusive and inappropriate patients. This study demonstrates the importance of further consensus development to address variation in patient demographics and to evaluate the relationship between pre-operative appropriateness and post-operative outcomes.

EP.06.244

COMPARISON OF ANATOMIC VERSUS REVERSE SHOULDER ARTHROPLASTY WITH GLENOID RETROVERSION GREATER THAN 15 DEGREES IN ROTATOR CUFF INTACT PATIENTS

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Background: Severe Glenoid deformity has been associated with inferior outcomes and higher complication rates. In patients with intact rotator cuffs, there is no clear consensus as to whether anatomic (aTSA) or reverse (rTSA) shoulder arthroplasty is the optimal implant to best address this issue. The purpose of this study was to compare outcomes of aTSA versus rTSA in glenoid deformities with greater than 15° retroversion.

Methods: A retrospective review of a large multicenter database was conducted. All patients who underwent either aTSA or rTSA with an intact rotator cuff and glenoid retroversion 15° or greater with minimum 2-year follow-up were included. Range of motion (ROM), revisions, and patient reported outcomes (PROs) including Constant Score, Simple Shoulder test (SST), American Shoulder and Elbow score (ASES), Arthroplasty Smart score (SAS) were collected for all patients pre- and post-surgery.

Results: Overall, 336 patients were included with 187 receiving an aTSA and 149 rTSA. Reverse patients overall had more comorbidities (82% vs 65% p=0.05) and were older (71 ± 7 years vs 66 ± 8 years $p < 0.001$). Average follow up for the anatomic group was 63 ± 38 months versus 41 ± 23 months ($p< 0.001$). Preoperative retroversion in the anatomic group averaged 21 ± 6 degrees vs 24 ± 8 in reverse patients ($P < 0.001$). Both groups demonstrated significant improvements in all PROs and ROM from pre- to post-surgery ($p<0.05$). At final follow-up aTSA patients had significantly better external rotation (50 ± 19 versus 38 ± 18 $p < 0.05$) but worse pain VAS (1.5 ± 2.3 vs 0.9 ± 1.9 $p = 0.016$). There was no significant difference in abduction or forward elevation or PRO's (Shoulder function, SST, Constant, ASES, or SAS). Overall revision rate (7% vs 1% p =0.004) was higher in aTSA.

Conclusions: ATSA and rTSA results in significant improvements patients with severe glenoid deformity. Anatomic TSA patient have better postoperative external rotation but demonstrated no other significant improvement in ROM or PRO. However, there was significantly higher rate of complications and revisions with short to midterm follow-up.

EP.06.245

DO THRESHOLDS OF PREOPERATIVE FUNCTION PREDICT ACHIEVEMENT OF CLINICALLY-IMPORTANT BENCHMARKS OF IMPROVEMENT AFTER ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: The purpose of this study was to determine if there is a threshold of preoperative function that is predictive of achieving clinically-important success at minimum 2-year follow-up after anatomic total shoulder arthroplasty (aTSA).

Methods: We retrospectively reviewed a multicenter database for patients that underwent primary aTSA. Outcomes evaluated were abduction, forward elevation, external and internal rotation, SST, Constant, ASES, UCLA, SPADI, and SAS scores. Clinically-important benchmarks (CIBs) evaluated include: Minimum Clinically Important Difference (MCID), Substantial Clinical Benefit (SCB), Patient Acceptable Symptomatic State (PASS), and the Minimally- and Substantially-Clinically Important Percent Maximal Possible Improvement (MCI-%MPI and SCI-%MPI); aTSA-specific CIBs were adopted from prior studies. Multivariable logistic regression was first performed to assess whether preoperative outcomes were predictive of achieving CIBs independent of age, sex, and BMI. Next, a ROC analysis was performed to determine the preoperative thresholds predictive of achieving CIBs per the Youden index; identified thresholds were applied to create contingency tables and compared with Fisher's Exact test.

Results: A total of 2,041 aTSAs were included. For all ROM measures, poorer preoperative ROM was associated with greater odds of achieving the MCID and SCB, but lower odds of achieving the PASS ($P<0.001$). More favorable preoperative scores were associated with greater odds of achieving the PASS for all scores, but only for a few scores for other CIBs. Thresholds of preoperative ROM and outcome scores identified on ROC analysis were significant predictors of achieving the MCID, SCB, and PASS for all outcomes ($P<0.001$ for all), but not the MCI-%MPI and SCI-%MPI. For outcome scores, preoperative thresholds that predicted achieving CIBs were lowest for the PASS and highest for the SCB; no trends were identified for ROM. Preoperative ROM thresholds better differentiated whether patients would achieve CIBs compared to outcome score thresholds. Variability in identified thresholds, respective AUCs, and predictiveness of achieving CIBs was minimal when stratified by age and sex.

Conclusions: Preoperative ROM and outcome scores can be utilized to predict the likelihood of achieving absolute CIBs of success (MCID, SCB, PASS) after aTSA, but not the relative CIBs (MCI-%MPI and SCI-%MPI).

EP.06.251

DIFFERENTIATION OF SHOULDER FUNCTION BEFORE AND AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY FOR CUFF TEAR ARTHROPATHY USING THE WALCH AND SIRVEAUX CLASSIFICATIONS

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Background: The Walch and Sirveaux classifications are utilized by surgeons to classify glenoid bone loss in cuff tear arthropathy (CTA). While helpful for understanding glenoid morphology, it is unclear if they correlate with patient clinical state.

Methods: A prospectively-collected, multi-center database for a single-platform TSA system was queried for patients with CTA and minimum 2-year follow-up. Differences in active range of motion (abduction, forward elevation[FE], external/internal-rotation[ER and IR]) and outcome scores (SST, Constant, ASES, UCLA, SPADI, VAS pain, Shoulder Function, and Shoulder Arthroplasty Smart[SAS] scores) were stratified by glenoid deformity according to Walch and Sirveaux classifications. Outcomes were evaluated with one-way ANOVA and post-hoc Tukey correction for multiple comparisons.

Results: 210 rTSA (89 A1, 54 A2, 21 B1, 16 B3, 30 B2; 83 E0, 48 E1, 36 E2, 43 E3) were analyzed. Preoperatively, IR (p=0.007) differed amongst Walch Glenoid Types. On post hoc analysis, A1glenoids had significantly more IR than B2 glenoids (3.9 +/-1.8 vs 2.9+/-1.9; p=0.025). Postoperatively, Abduction (p=0.043; A1>B2 [127+/-32 vs 121+/-25, p=0.014]) and FE (p=0.015; A1>B1 and A1>B2 [145+/-24 vs 131+/26 and 135+/-20, p=0.024 and p=0.009, respectively]) differed significantly. Regarding improvement after rTSA, only IR (p=0.002) differed significantly amongst Walch glenoid types. Post hoc analysis demonstrated B2 (2.0+/-1.9 vs 0.2+/-2.1; p=0.039) and B3 (2.2+/-1.7 vs 0.2+/-2.1; p=0.006) had greater improvement in IR than A1 glenoids. When Sirveaux classification was analyzed preoperatively no differences existed for any outcome metric. Postoperatively, significant differences were found for VAS pain (p=0.002; E0>E1[2.2+/-2.7 vs 07+/-1.7,p=0.004), Shoulder Function (p=0.007; E1>E0[8.7+/-1.7 vs 7.5+/-2.1,p=0.026), and ASES (p=0.024; E1>E0[84.9+/-16.2 vs 73.7+/-24.7, p=0.038) scores. Regarding improvement after rTSA, there were no significant differences between Sirveaux glenoid classification types.

Conclusions: We demonstrate a weak association between preoperative glenoid morphology and clinical state when evaluating patients undergoing rTSA for CTA. Improvement after surgery was greater with more advanced Walch glenoid classification type but only pertaining to IR; however,clinical function was not associated with Sirveaux classification type before or after surgery. Alternative glenoid classification systems or predictive models should be considered to provide more precise prognoses for patients undergoing rTSA for CTA.

EP.06.297

COMPARISON OF HUMERAL HEAD RESURFACING VERSUS STEMLESS HUMERAL COMPONENTS IN ANATOMIC TOTAL SHOULDER ARTHROPLASTY: A MULTICENTER INVESTIGATION WITH MINIMUM TWO YEAR FOLLOW UP

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Background: The purpose of this investigation was to compare minimum two-year outcomes of anatomic total shoulder arthroplasty (aTSA) performed with humeral head resurfacing (HHR) versus stemless implants.

Methods: A retrospective review of a large multicenter database was conducted. All patients who underwent aTSA with either HHR or stemless implants with minimum two-year follow-up were evaluated. Range of motion (ROM) and patient reported outcomes (PROs) including Constant Score, Simple Shoulder test (SST), American Shoulder and Elbow score, University of California Los Angeles shoulder score, Shoulder Pain and Disability Index and Shoulder Arthroplasty Smart score were collected for all patients pre- and post-surgery. Radiographic data was collected to determine the presence of radiolucent lines as well as evaluation of implant sizing and anatomic shoulder restoration.

Results: Overall, 127 patients were included with 49 receiving HHR and 78 stemless aTSA. The HHR group were significantly older (69.3±8.6 versus 64.3±8.7, $P<0.01$), had a lower BMI (27.7±4.3 versus 31.5±7.2, $p<0.01$) and a higher percentage were females (87.8% versus 35.9%, $p<0.01$) compared to the stemless group. Both groups demonstrated significant improvements in all PROs and ROM from pre- to post-surgery ($p<0.05$). At final follow-up the stemless group had significantly greater active abduction (148.5±27.7 versus 115.6±22.4, $p<0.01$), forward flexion (154.3±20.6 versus 140.6±15.3, $p<0.01$) and external rotation (52.14±14.9 versus 34.4±19.8, $p=0.01$). The stemless group exhibited better scores on the SST (10.4±2.0 versus 9.5±1.9, $p=0.01$), but no other PROs demonstrated significant difference. Radiographic evaluation of HHR patients demonstrated overstuffing, oversizing, and lucent lines around the glenoid component in 8.7%, 39.1%, and 13.0% of implants, respectively. Radiographic evaluation of stemless patients demonstrated radiolucent lines around humeral component and glenoid component in 4.2% and 18.8% of implants, respectively. One patient in the stemless aTSA group required a revision surgery for aseptic glenoid loosening, otherwise no other major complications were reported.

Conclusions: Anatomic TSA performed both with stemless implants and HHR resulted in significant improvements in ROM and multiple PROs at minimum two year follow up with a low complication rate. The HHR group had significantly worse pre-operative ROM and PROs which lead to greater magnitudes of improvement at final follow up.