

Impact of Small Stature on Reverse Shoulder Arthroplasty Outcomes in Women: A Matched Cohort Analysis

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INTRODUCTION:

As the incidence of reverse total shoulder arthroplasty (rTSA) has grown with expanding indications, the challenge of managing variations in patient size has become more appreciated. This has spurred innovations in implant design and available sizing options. However, it is unclear whether the current implant systems offer options most appropriate for patients with smaller stature, even with recent design line-expansions with smaller implant sizes. The difficult placement of standard-sized components has been reported in smaller anatomy, historically associated with particular racial and ethnic backgrounds. Female patients of small stature represent the cohort of patients where implant size limitations may be most impactful. The purpose of this study was to evaluate the impact small female stature has on reverse shoulder arthroplasty outcomes.

METHODS:

A retrospective query of our institution's shoulder and elbow surgery repository identified patients treated with an inlay design rTSA by a single fellowship trained shoulder and elbow surgeon between 11/2006 and 3/2022. Patients were included if they were female and had a minimum two-year follow-up. Patients were stratified by stature according to height utilizing age-based CDC percentile thresholds into either small (less than 15th percentile of height, for their respective age range), normal (between 25th and 75th percentile of height, for their respective age range), or large (greater than 85th percentile of height, for their respective age range). Patients with small stature were matched (1:2) to patients with normal stature by age (within ± 1 year) and indication for surgery. A cohort analysis was conducted evaluating: demographics, patient reported outcome measures (PROMs), satisfaction, range of motion (ROM), strength, and complications. Additionally, differences in implants such as humeral component shell diameter were investigated between cohorts.

RESULTS:

A total of 61 small-stature female patients were included, matched 1:2 to average-stature female patients. At most recent follow-up, patients of small stature demonstrated a lower SANE ($P = 0.011$), SST ($P = 0.041$), and VAS Function ($P = 0.015$), but no difference in ASES and VAS Pain scores. Small-stature patients also demonstrated lower forward elevation at the most recent follow-up (128 vs. 140; $P = 0.29$), but no other differences in shoulder ROM or strength were found. The small stature cohort sustained a higher complication rate (11.5% versus 9.0%; $P=0.585$), all being acromion-scapular spine fractures. Within the small stature cohort, those who received small-sized rather standard-sized humeral shell rTSA implants reported a higher SANE score (92 vs. 79, $P = 0.051$) but also a higher acromion fracture rate (20% vs. 7.3%; $P = 0.203$), and were otherwise unremarkably different in outcomes. All acromion fractures in both cohorts occurred in patients 5'4" or shorter.

DISCUSSION AND CONCLUSION:

Female patients of small stature experience inferior outcomes in several PROMs, despite similar shoulder ROM/strength as average-stature females following rTSA. Notably, small-stature patients experienced a higher rate of acromion-scapular spine fracture when compared to those of average stature. Further innovation and line expansion of rTSA design may be needed to match smaller patient size, maximize outcomes, and avoid complications.

	Small Stature (n=61) Mean ± SD or N (%) or Median (IQR)	Average Stature (n=122) Mean ± SD or N (%) or Median (IQR)	OR (95% CI)*	P
SANE	80 (48-93)	90 (70-95)	0.98 (0.97-0.99)	.011
ASES	77 (56-93)	83 (60-93)	0.99 (0.98-1.01)	.247
SST	7 (3-10)	8 (5-10)	0.90 (0.82-0.99)	.041
VAS Function	8 (6-9)	9 (7-10)	0.85 (0.75-0.97)	.015
VAS Pain	0 (0-2)	0 (0-2)	1.05 (0.91-1.21)	.517
Range of Motion				
Elevation	128 (101-144)	140 (120-145)	0.99 (0.98-0.99)	.029
Abduction	90 (71-100)	90 (85-100)	0.98 (0.97-1.00)	.057
External Rotation	40 (20-50)	40 (30-50)	0.98 (0.97-1.00)	.051
Internal Rotation**	4 (4-8)	6 (4-8)	0.93 (0.83-1.05)	.228
Strength				
Deltoid	5 (5-5)	5 (5-5)	1.15 (0.24-5.58)	.857
Supraspinatus	5 (4-5)	5 (5-5)	0.75 (0.35-1.58)	.446
External Rotation	5 (4-5)	5 (4-5)	0.94 (0.52-1.71)	.851
Internal Rotation	5 (5-5)	5 (5-5)	1.09 (0.26-4.67)	.903
Satisfaction				
Excellent	33 (55.0)	79 (64.8)	0.90 (0.24-3.41)	.874
Good	14 (23.3)	25 (20.5)	1.16 (0.38-4.82)	.839
Satisfactory	9 (15.0)	10 (8.2)	1.88 (0.38-9.32)	.442
Unsatisfactory	4 (6.7)	8 (6.5)	-	-
Same surgery again? (yes)	47 (79.7)	100 (82.0)	.90 (0.41-1.96)	.789
Complications	7 (11.5)	11 (9.0)	1.34 (0.47-3.84)	.585

*Odds Ratio (OR) with 95% Confidence Interval (CI) comparing small stature (cases) to average stature (controls)
 **Internal rotation was scored on a 10-point scale using the following conversions: buttock/greater trochanter=2, sacrum-L4=4, L1-L3=6, T8-T12=8, T1-T7=10.
 SD, Standard Deviation; IQR, Interquartile Range; OR, Odds Ratio; SANE, Single Assessment Numeric Evaluation; ASES, American Shoulder and Elbow Surgeons; SST, Simple Shoulder Test; VAS, Visual Analog Scale.

Patient	Height (in)	BMI	Age at Surgery (yrs)	Follow-up (yrs)	Complication	Standard or Small Shell?	Osteoporosis? (Y/N/x)	Inflammatory Arthritis? (Y/N/x)
Small Stature (n=7)								
1	56	19.1	84	4.6	Type 2A ASF	Standard	Y	N
2	58	32.4	78	2.7	Type 3 ASF	Standard	N	Y
3	58	21.3	80	2.9	Type 2A ASF	Small	Y	N
4	59	17.0	75	3.0	Type 2B ASF	Small	Y	N
5	59	21.4	79	3.1	Type 2A ASF	Small	Y	N
6	60	24.0	71	8.9	Type 2A ASF	Standard	N	N
7	60	31.2	79	2.0	Type 1 ASF	Small	Y	N
Average Stature (n=11)								
1	60	26.4	80	2.8	Type 3 ASF	Standard	N	Y
2	60	20.6	84	2.1	Type 1 ASF	Standard	N	Y
3	61	31.2	76	7.0	Type 2B ASF	Standard	N	N
4	61	26.1	76	6.0	Type 1 ASF	Standard	x	x
5	62	29.1	72	5.2	Type 2B ASF	Small	Y	N
6	63	26.9	67	3.1	Type 1 ASF	Small	N	N
7	64	27.5	73	2.8	Type 2A ASF	Small	N	N
8	64	19.7	76	1.9	Type 1 ASF	Small	N	N
9	64	23.9	77	7.9	Type 3 ASF	Standard	x	x
10	64	27.6	79	2.0	Type 3 ASF*	Standard	N	N
11	64	20.9	79	2.1	Type 3 ASF*	Small	N	Y

*Treated by ORIF (Dual Plates), all other reported ASFs managed non-operatively
 ASF, acromial stress fracture. Y, Yes. N, No. x, not documented.