

Lateralization in Reverse Total Shoulder Arthroplasty: Comparison of Glenoid versus Humeral Lateralization

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INTRODUCTION:

A majority of modern reverse total shoulder arthroplasty (RTSA) implants feature a lateralized center of rotation (COR) compared to the original Grammont design. Less scapular notching and improvement of internal/external rotation is the expected benefit of lateralization. Though this is done by either lateralizing the glenoid or the humeral, no study yet has directly compared the two means of lateralization.

METHODS:

This retrospective, cohort study was conducted with 73 patients that underwent RTSA using either one of the following two lateralized implants - manufacturer 1 (n=42, Group LG) with glenoid lateralization or manufacturer 2 (n=31, Group LH) with humeral lateralization. Radiologically, acromiohumeral distance (AHD), lateral humeral offset (LHO), acromial fracture, and scapular notching were analyzed. Clinical parameters including the range of motion (ROM) and muscle strength in forward elevation (FE), external rotation (ER) / internal rotation (IR) at the side were evaluated. Outcome measures University of California Los Angeles score, American Shoulder and Elbow Surgeons score, Simple Shoulder Test, Constant-Murley score, and pain visual analogue scale were also compared between the groups.

RESULTS:

Demographic data, preoperative radiologic, clinical parameters, and follow-up period (LG vs. LH: 29.3±17.1 months vs. 23.9±13.5 months, $P=0.154$) were comparable between the groups. Group LG demonstrated a significantly less decrease in ER ROM (LG vs. LH: $-0.9\pm 27.2^\circ$ vs. $-15.8\pm 28.6^\circ$, $P=0.045$), greater increase in ER strength (LG vs. LH: $12.9\pm 10.3N$ vs. $3.5\pm 15.5N$, $P=0.012$), less arm lengthening as measured by the postoperative change in AHD (LG vs. LH: $22.5\pm 8.2mm$ vs. $29.8\pm 8.3mm$, $P<0.001$), and less incidence of scapular notching (LG vs. LH: 2.4% vs. 38.7%, $P<0.001$). However, in last follow up, group LH showed a greater FE ROM (LG vs. LH: $132.0\pm 21.2^\circ$ vs. $143.2\pm 14.8^\circ$, $P=0.010$), and a higher Constant score (LG vs. LH: 60.3 ± 18.8 vs. 70.7 ± 16.1 , $P=0.015$). Yet, the proportions of patients who exceeded the minimal clinically important difference in each clinical score were comparable between the groups.

DISCUSSION AND CONCLUSION:

Though both means of global lateralization in RTSA were able to achieve a satisfactory outcome, glenoid lateralization offered advantages in ER and less scapular notching. However, a greater FE ROM could be achieved through humeral lateralization. Implant selection based on such findings may produce better patient satisfaction.

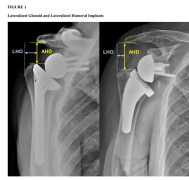


Figure 1. Lateralized humeral and lateralized glenoid humeral views. The left image shows the lateralized humeral view, and the right image shows the lateralized glenoid view. Labels 'LHO' and 'AHD' indicate the lateral humeral offset and acromiohumeral distance, respectively.

TABLE 1
Demographic Data

Parameter	Lateralized Glenoid	Lateralized Humeral	P-value
Age, mean ± SD	68.65 ± 10.51	73.34 ± 14.48	0.021
Body mass index (BMI)	23.2 ± 3.11	23.8 ± 3.12	0.504
Sex ratio	5/36	8/25	0.606
Acromioclavicular joint degeneration	31/42	21/31	0.607
Rotator cuff tear	30/42	22/31	0.606

TABLE 2
Range of Motion

Parameter	Lateralized Glenoid	Lateralized Humeral	P-value
Range of motion (ROM)	40.40 ± 10.20	40.20 ± 10.10	0.925
Range of motion (ROM) at 10°	32.1 ± 10.2	32.5 ± 10.3	0.925
Range of motion (ROM) at 20°	24.2 ± 10.3	24.6 ± 10.4	0.925
Range of motion (ROM) at 30°	16.3 ± 10.4	16.7 ± 10.5	0.925
Range of motion (ROM) at 40°	8.4 ± 10.5	8.8 ± 10.6	0.925
Range of motion (ROM) at 50°	0.5 ± 10.6	0.9 ± 10.7	0.925
Range of motion (ROM) at 60°	-7.4 ± 10.7	-7.8 ± 10.8	0.925
Range of motion (ROM) at 70°	-15.3 ± 10.8	-15.7 ± 10.9	0.925
Range of motion (ROM) at 80°	-23.2 ± 10.9	-23.6 ± 11.0	0.925
Range of motion (ROM) at 90°	-31.1 ± 11.0	-31.5 ± 11.1	0.925
Range of motion (ROM) at 100°	-39.0 ± 11.1	-39.4 ± 11.2	0.925
Range of motion (ROM) at 110°	-46.9 ± 11.2	-47.3 ± 11.3	0.925
Range of motion (ROM) at 120°	-54.8 ± 11.3	-55.2 ± 11.4	0.925
Range of motion (ROM) at 130°	-62.7 ± 11.4	-63.1 ± 11.5	0.925
Range of motion (ROM) at 140°	-70.6 ± 11.5	-71.0 ± 11.6	0.925
Range of motion (ROM) at 150°	-78.5 ± 11.6	-78.9 ± 11.7	0.925
Range of motion (ROM) at 160°	-86.4 ± 11.7	-86.8 ± 11.8	0.925
Range of motion (ROM) at 170°	-94.3 ± 11.8	-94.7 ± 11.9	0.925
Range of motion (ROM) at 180°	-102.2 ± 11.9	-102.6 ± 12.0	0.925

TABLE 3
Muscle Strength

Parameter	Lateralized Glenoid	Lateralized Humeral	P-value
Range of motion (ROM)	30.00 ± 10.00	30.00 ± 10.00	0.925
Range of motion (ROM) at 10°	22.1 ± 10.1	22.5 ± 10.2	0.925
Range of motion (ROM) at 20°	14.2 ± 10.2	14.6 ± 10.3	0.925
Range of motion (ROM) at 30°	6.3 ± 10.3	6.7 ± 10.4	0.925
Range of motion (ROM) at 40°	-1.6 ± 10.4	-2.0 ± 10.5	0.925
Range of motion (ROM) at 50°	-9.5 ± 10.5	-9.9 ± 10.6	0.925
Range of motion (ROM) at 60°	-17.4 ± 10.6	-17.8 ± 10.7	0.925
Range of motion (ROM) at 70°	-25.3 ± 10.7	-25.7 ± 10.8	0.925
Range of motion (ROM) at 80°	-33.2 ± 10.8	-33.6 ± 10.9	0.925
Range of motion (ROM) at 90°	-41.1 ± 10.9	-41.5 ± 11.0	0.925
Range of motion (ROM) at 100°	-49.0 ± 11.0	-49.4 ± 11.1	0.925
Range of motion (ROM) at 110°	-56.9 ± 11.1	-57.3 ± 11.2	0.925
Range of motion (ROM) at 120°	-64.8 ± 11.2	-65.2 ± 11.3	0.925
Range of motion (ROM) at 130°	-72.7 ± 11.3	-73.1 ± 11.4	0.925
Range of motion (ROM) at 140°	-80.6 ± 11.4	-81.0 ± 11.5	0.925
Range of motion (ROM) at 150°	-88.5 ± 11.5	-88.9 ± 11.6	0.925
Range of motion (ROM) at 160°	-96.4 ± 11.6	-96.8 ± 11.7	0.925
Range of motion (ROM) at 170°	-104.3 ± 11.7	-104.7 ± 11.8	0.925
Range of motion (ROM) at 180°	-112.2 ± 11.8	-112.6 ± 11.9	0.925

TABLE 4
Outcome Measures

Parameter	Lateralized Glenoid	Lateralized Humeral	P-value
University of California Los Angeles score	42.1 ± 11.2	42.5 ± 11.3	0.925
American Shoulder and Elbow Surgeons score	33.2 ± 11.3	33.6 ± 11.4	0.925
Simple Shoulder Test	24.3 ± 11.4	24.7 ± 11.5	0.925
Constant-Murley score	15.4 ± 11.5	15.8 ± 11.6	0.925
Pain visual analogue scale	3.5 ± 11.6	3.9 ± 11.7	0.925
Range of motion (ROM)	26.5 ± 11.7	26.9 ± 11.8	0.925
Range of motion (ROM) at 10°	18.6 ± 11.8	19.0 ± 11.9	0.925
Range of motion (ROM) at 20°	10.7 ± 11.9	11.1 ± 12.0	0.925
Range of motion (ROM) at 30°	2.8 ± 12.0	3.2 ± 12.1	0.925
Range of motion (ROM) at 40°	-5.1 ± 12.1	-5.5 ± 12.2	0.925
Range of motion (ROM) at 50°	-13.0 ± 12.2	-13.4 ± 12.3	0.925
Range of motion (ROM) at 60°	-20.9 ± 12.3	-21.3 ± 12.4	0.925
Range of motion (ROM) at 70°	-28.8 ± 12.4	-29.2 ± 12.5	0.925
Range of motion (ROM) at 80°	-36.7 ± 12.5	-37.1 ± 12.6	0.925
Range of motion (ROM) at 90°	-44.6 ± 12.6	-45.0 ± 12.7	0.925
Range of motion (ROM) at 100°	-52.5 ± 12.7	-52.9 ± 12.8	0.925
Range of motion (ROM) at 110°	-60.4 ± 12.8	-60.8 ± 12.9	0.925
Range of motion (ROM) at 120°	-68.3 ± 12.9	-68.7 ± 13.0	0.925
Range of motion (ROM) at 130°	-76.2 ± 13.0	-76.6 ± 13.1	0.925
Range of motion (ROM) at 140°	-84.1 ± 13.1	-84.5 ± 13.2	0.925
Range of motion (ROM) at 150°	-92.0 ± 13.2	-92.4 ± 13.3	0.925
Range of motion (ROM) at 160°	-99.9 ± 13.3	-100.3 ± 13.4	0.925
Range of motion (ROM) at 170°	-107.8 ± 13.4	-108.2 ± 13.5	0.925
Range of motion (ROM) at 180°	-115.7 ± 13.5	-116.1 ± 13.6	0.925

TABLE 5
Scapular Notching

Parameter	Lateralized Glenoid	Lateralized Humeral	P-value
Scapular notching	4/42	12/31	0.001
Scapular notching at 10°	0/42	0/31	0.925
Scapular notching at 20°	0/42	0/31	0.925
Scapular notching at 30°	0/42	0/31	0.925
Scapular notching at 40°	0/42	0/31	0.925
Scapular notching at 50°	0/42	0/31	0.925
Scapular notching at 60°	0/42	0/31	0.925
Scapular notching at 70°	0/42	0/31	0.925
Scapular notching at 80°	0/42	0/31	0.925
Scapular notching at 90°	0/42	0/31	0.925
Scapular notching at 100°	0/42	0/31	0.925
Scapular notching at 110°	0/42	0/31	0.925
Scapular notching at 120°	0/42	0/31	0.925
Scapular notching at 130°	0/42	0/31	0.925
Scapular notching at 140°	0/42	0/31	0.925
Scapular notching at 150°	0/42	0/31	0.925
Scapular notching at 160°	0/42	0/31	0.925
Scapular notching at 170°	0/42	0/31	0.925
Scapular notching at 180°	0/42	0/31	0.925

TABLE 6: Acromioclavicular Joint Degeneration and Rotator Cuff Tear

Parameter	Lateralized Glenoid	Lateralized Humeral	P-value
Acromioclavicular joint degeneration	31/42	21/31	0.607
Rotator cuff tear	30/42	22/31	0.606

TABLE 7: Range of Motion (ROM) at Various Angles

Angle	Lateralized Glenoid	Lateralized Humeral	P-value
10°	32.1 ± 10.2	32.5 ± 10.3	0.925
20°	24.2 ± 10.3	24.6 ± 10.4	0.925
30°	16.3 ± 10.4	16.7 ± 10.5	0.925
40°	8.4 ± 10.5	8.8 ± 10.6	0.925
50°	0.5 ± 10.6	0.9 ± 10.7	0.925
60°	-7.4 ± 10.7	-7.8 ± 10.8	0.925
70°	-15.3 ± 10.8	-15.7 ± 10.9	0.925
80°	-23.2 ± 10.9	-23.6 ± 11.0	0.925
90°	-31.1 ± 11.0	-31.5 ± 11.1	0.925
100°	-39.0 ± 11.1	-39.4 ± 11.2	0.925
110°	-46.9 ± 11.2	-47.3 ± 11.3	0.925
120°	-54.8 ± 11.3	-55.2 ± 11.4	0.925
130°	-62.7 ± 11.4	-63.1 ± 11.5	0.925
140°	-70.6 ± 11.5	-71.0 ± 11.6	0.925
150°	-78.5 ± 11.6	-78.9 ± 11.7	0.925
160°	-86.4 ± 11.7	-86.8 ± 11.8	0.925
170°	-94.3 ± 11.8	-94.7 ± 11.9	0.925
180°	-102.2 ± 11.9	-102.6 ± 12.0	0.925

TABLE 8: Muscle Strength (N) at Various Angles

Angle	Lateralized Glenoid	Lateralized Humeral	P-value
10°	22.1 ± 10.1	22.5 ± 10.2	0.925
20°	14.2 ± 10.2	14.6 ± 10.3	0.925
30°	6.3 ± 10.3	6.7 ± 10.4	0.925
40°	-1.6 ± 10.4	-2.0 ± 10.5	0.925
50°	-9.5 ± 10.5	-9.9 ± 10.6	0.925
60°	-17.4 ± 10.6	-17.8 ± 10.7	0.925
70°	-25.3 ± 10.7	-25.7 ± 10.8	0.925
80°	-33.2 ± 10.8	-33.6 ± 10.9	0.925
90°	-41.1 ± 10.9	-41.5 ± 11.0	0.925
100°	-49.0 ± 11.0	-49.4 ± 11.1	0.925
110°	-56.9 ± 11.1	-57.3 ± 11.2	0.925
120°	-64.8 ± 11.2	-65.2 ± 11.3	0.925
130°	-72.7 ± 11.3	-73.1 ± 11.4	0.925
140°	-80.6 ± 11.4	-81.0 ± 11.5	0.925
150°	-88.5 ± 11.5	-88.9 ± 11.6	0.925
160°	-96.4 ± 11.6	-96.8 ± 11.7	0.925
170°	-104.3 ± 11.7	-104.7 ± 11.8	0.925
180°	-112.2 ± 11.8	-112.6 ± 11.9	0.925

TABLE 9: Outcome Measures (Mean ± SD)

Measure	Lateralized Glenoid	Lateralized Humeral	P-value
UCLA score	42.1 ± 11.2	42.5 ± 11.3	0.925
ASES score	33.2 ± 11.3	33.6 ± 11.4	0.925
SST score	24.3 ± 11.4	24.7 ± 11.5	0.925
Constant-Murley score	15.4 ± 11.5	15.8 ± 11.6	0.925
Pain VAS score	3.5 ± 11.6	3.9 ± 11.7	0.925
ROM (°)	26.5 ± 11.7	26.9 ± 11.8	0.925
ROM (°) at 10°	18.6 ± 11.8	19.0 ± 11.9	0.925
ROM (°) at 20°	10.7 ± 11.9	11.1 ± 12.0	0.925
ROM (°) at 30°	2.8 ± 12.0	3.2 ± 12.1	0.925
ROM (°) at 40°	-5.1 ± 12.1	-5.5 ± 12.2	0.925
ROM (°) at 50°	-13.0 ± 12.2	-13.4 ± 12.3	0.925
ROM (°) at 60°	-20.9 ± 12.3	-21.3 ± 12.4	0.925
ROM (°) at 70°	-28.8 ± 12.4	-29.2 ± 12.5	0.925
ROM (°) at 80°	-36.7 ± 12.5	-37.1 ± 12.6	0.925
ROM (°) at 90°	-44.6 ± 12.6	-45.0 ± 12.7	0.925
ROM (°) at 100°	-52.5 ± 12.7	-52.9 ± 12.8	0.925
ROM (°) at 110°	-60.4 ± 12.8	-60.8 ± 12.9	0.925
ROM (°) at 120°	-68.3 ± 12.9	-68.7 ± 13.0	0.925
ROM (°) at 130°	-76.2 ± 13.0	-76.6 ± 13.1	0.925
ROM (°) at 140°	-84.1 ± 13.1	-84.5 ± 13.2	0.925
ROM (°) at 150°	-92.0 ± 13.2	-92.4 ± 13.3	0.925
ROM (°) at 160°	-99.9 ± 13.3	-100.3 ± 13.4	0.925
ROM (°) at 170°	-107.8 ± 13.4	-108.2 ± 13.5	0.925
ROM (°) at 180°	-115.7 ± 13.5	-116.1 ± 13.6	0.925

TABLE 10: Scapular Notching (Number of Patients)

Angle	Lateralized Glenoid	Lateralized Humeral	P-value
10°	0/42	0/31	0.925
20°	0/42	0/31	0.925
30°	0/42	0/31	0.925
40°	0/42	0/31	0.925
50°	0/42	0/31	0.925
60°	0/42	0/31	0.925
70°	0/42	0/31	0.925
80°	0/42	0/31	0.925
90°	0/42	0/31	0.925
100°	0/42	0/31	0.925
110°	0/42	0/31</	