Analysis of the glenohumeral and scapula-thoracic motions ratio in controls and after reverse shoulder arthroplasty

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Aim/Background

The recovery of complete ranges of motion (ROM) after reverse shoulder arthroplasty (RSA) remains challenging. Shoulder kinematics depend on gleno-humeral (GH) and scapulo-thoracic (ST) joint interactions. Post-RSA kinematics, specifically GH/ST contributions to ROM, are not well analyzed. Understanding the GH/ST motion ratio may guide rehabilitation strategies and improve outcomes. RSA patients are expected to have reduced GH/ST ratios, indicating greater scapulo-thoracic contribution to elevation and abduction movements.

Methods

A retrospective analysis of upper-limb motion capture data was performed, focusing on thoraco-humeral (TH), GH, and ST motions during abduction (ABD) and anterior elevation (AE). GH/ST ratios for protraction, internal rotation (IR), and scapular tilt were calculated. Baseline characteristics were recorded for 7 RSA patients and 18 controls. For RSA patients, GH/ST ratios were correlated with patient-reported outcomes.

Results

Controls showed significantly greater TH ABD, AE, and GH AE.

Median GH/ST-protraction ratios for controls *vs.* RSA patients were 2.2 [-14.2–35.2] *vs.* 5.9 [3.4–18.1] (ABD) and 16.0 [4.7–23.0] *vs.* 6.7 [3.6–18.7] (AE), with p-values of 0.731 and >0.999.

GH/ST-IR ratios for controls *vs.* RSA were 3.0 [2.7–3.6] *vs.* 2.8 [2.1–3.2] (ABD) and 3.3 [2.7–3.9] *vs.* 2.9 [2.3–3.6] (AE), with p-values of 0.315 and 0.364. ST tilt was posterior in controls and anterior in RSA patients for both ABD and AE, though not statistically significant. GH/ST-tilt ratios were 15.3 [4.8–22.7] *vs.* -7.5 [-10–20.8] (ABD) and 9.0 [4.5–34.8] *vs.* -8.0 [-13.4–12.4] (AE), with p-values of 0.536 and 0.193.

In RSA patients, moderate negative correlations (Spearman) were observed between tilt and outcomes during ABD ($\rho = -0.60$, $p = 0.065$) and AE ($\rho = -0.58$, $p = 0.080$). A moderate negative correlation was also found between GH/ST-IR ratios in AE and ASES scores ($\rho = -0.48$, $p = 0.243$). Other correlations were weak and non-significant.

Conclusion

RSA patients showed significantly reduced thoraco-humeral and glenohumeral abduction and elevation compared to controls, highlighting post-surgical shoulder mobility limitations. GH/ST ratios tended to be lower in RSA patients, particularly in protraction and posterior tilt, though differences were not statistically significant. The moderate negative correlation between tilt and outcomes suggest altered shoulder mechanics may influence recovery.