

Characterization of Glenoid Superior Inclination in Primary Glenohumeral Osteoarthritis

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INTRODUCTION:

Descriptions of glenoid deformities in glenohumeral osteoarthritis (GHOA) have focused largely on retroversion. In particular, posterior glenoid erosion associated with posterior humeral head subluxation and asymmetric rotator cuff muscle degeneration has received substantial attention. Although inclination values in normal glenoids may vary from three degrees of inferior tilt to twenty-one degrees of superior tilt, this range expands widely in the setting of GHOA and little is known regarding the morphology of arthritic glenoids with higher amounts of superior inclination. Current acceptable parameters for anatomical glenoid reconstruction include superior inclination values of less than ten degrees, but evidence guiding appropriate management of inclination when performing anatomic total shoulder arthroplasty is sparse. The purpose of the present study was to provide a detailed assessment of glenoid morphology and rotator cuff muscle degeneration in patients with GHOA identified to have glenoid superior inclination values of ten degrees or greater.

METHODS:

A retrospective query was performed to identify all patients with GHOA indicated for primary arthroplasty over a six-year period who had a computed tomography (CT) scan of the operative shoulder performed within three months of their surgical date. These images were uploaded to a validated three-dimensional imaging software system for automated measurement of glenoid parameters and modeling of the pre-morbid glenoid. Glenoids with ten degrees or greater of superior tilt were considered to have a superior inclination deformity, and those with fifteen degrees or greater of retroversion were considered to have a retroversion deformity. Glenoids meeting both of these criteria were considered to have a biplanar deformity. Glenoid type according to the Walch classification was determined through three-surgeon consensus using radiographs and two-dimensional CT images. All cases of Walch type C glenoid deformities were excluded. Rotator cuff muscle cross-sectional area was measured on sagittal reconstructions of CT scans using a previously validated method. Fatty infiltration of the rotator cuff musculature was graded according to the Goutallier classification. All measurements were performed by one of three fellowship-trained shoulder and elbow surgeons.

RESULTS:

Computed tomography imaging of 284 shoulders in 262 patients was included for analysis, with an average age of 64.7 years (range: 21-84) of whom 86 (36.2%) were female. Of these, 97 cases (34.1%) had a superior inclination deformity greater than 10°, averaging 15.0° (range: 10-27). The mean version among these cases was 18.3° of retroversion (range: 11° anteversion – 41° retroversion). The composite vector of deformity was in the posterior-superior quadrant in 77% of cases, most commonly localizing to the 1:30 position of a left shoulder or the 10:30 position of a right shoulder. Patients with an inclination deformity were younger (62.8 versus 65.6 years; $p=0.02$) and more likely to be female (41.2 versus 27.8%; $p=0.02$). An inclination deformity was not more prevalent in Walch B2 (33.3%; 47/141; $p=0.80$) or B3 (27.7%; 13/47; $p=0.40$) type glenoids. As well, patients with inclination deformities did not have greater associated retroversion (18.9° versus 19.6°; $p=0.59$), glenohumeral subluxation (76.5% versus 76.1%; $p=0.83$), rotator cuff fatty infiltration, or rotator cuff atrophy. Patients with biplanar deformities were younger than those without (62.5 versus 65.2 years; $p=0.04$). However, biplanar deformities were not associated with differences in gender (28.3% versus 33.3%; $p=0.45$). Patients with biplanar deformities had similar cross-sectional area of the rotator cuff musculature. However, biplanar deformities were less frequently associated with Goutallier grade 2 or greater fatty infiltration in the subscapularis (12% versus 19.7%; $p=0.08$) or teres minor (21.7% versus 34.8%; $p=0.05$). Relative to the pre-morbid state, patients with inclination deformities demonstrated little pathologic change in glenoid inclination (mean 1.2 ± 0.84°; $p=0.06$) while acquiring 8.9 ± 1.8° of retroversion ($p<0.001$).

DISCUSSION AND CONCLUSION:

A superior inclination deformity is common in patients undergoing primary total shoulder arthroplasty for glenohumeral osteoarthritis. Superior inclination deformity in the symptomatic arthritic shoulder was associated with younger age and female sex. Based upon validated statistical shape modeling, inclination deformities may be developmental, in contrast to retroversion deformities which are more commonly acquired. Patients with biplanar deformities demonstrated less rotator cuff fatty infiltration in the teres minor and subscapularis.