

The Glenoid Center Point: A Magnetic Resonance Imaging Study of Normal Scapular Anatomy

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Abstract

Using 10 normal cadaveric glenoids, Matsen and colleagues described the anatomic concept and clinical use of the glenoid centering point during shoulder arthroplasty. In the study reported here, we used magnetic resonance imaging scans of 50 patients with nonarthritic conditions of the glenohumeral joint to evaluate the relationship between the glenoid center line and the scapular neck. Results from this larger group of patients confirmed that a reproducible anatomic relationship of the glenoid centering line and the centering point on the anterior glenoid neck exists and can be used to restore normal anatomy in cases of posterior glenoid wear. An understanding of this anatomic relationship vis-à-vis shoulder arthroplasty may aid in recreating a normal glenoid version.

In osteoarthritis of the glenohumeral joint, the glenoid cartilage and subchondral bone typically wear posteriorly, leaving intact articular cartilage anteriorly. This pattern of wear creates excessive retroversion of the glenoid.¹⁻⁷ During total shoulder arthroplasty (TSA), it is important to recognize this abnormal glenoid retroversion in order to place the glenoid component in the proper version (Figures 1A, 1B). In the book *Practical Evaluation and Management of the Shoulder*, Matsen and colleagues⁴ introduced the anatomic concept and clinical use of the glenoid centering point during TSA. Their description of the glenoid centering point was based on their simple cadaveric study.^{4,5}

Initially, Matsen and colleagues^{4,5} chose the midpoint of 10 normal cadaveric glenoids. The glenoid center line was then defined as a line perpendicular to the face of the glenoid starting at the anatomic center of the glenoid. In each cadaveric specimen, a drill was then passed through the glenoid face along the glenoid center line. In all 10 specimens,

the drill exited from the anterior surface of the glenoid neck at the midpoint of the upper and lower crura of the scapular neck. Matsen and colleagues labeled this point of exit on the anterior glenoid neck the *glenoid centering point*.

In the study reported here, we used a larger population of patients to evaluate the anatomic relationship described by Matsen and colleagues and to ascertain an objective measure of the center line and exit point to aid in clinical restoration of normal glenoid anatomy.

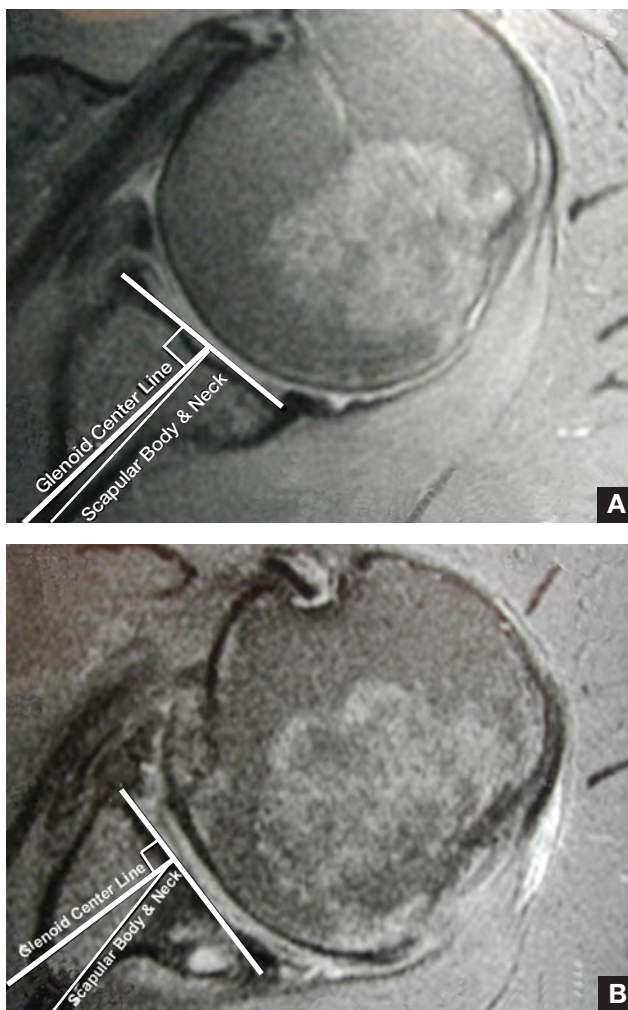


Figure 1. The normal relationship between the glenoid face and the scapular neck/body in a normal glenohumeral joint (A) in comparison with increased retroversion (perhaps subtle) of an arthritic glenohumeral joint (B). The arrows show the exit point in the glenoid neck of a line perpendicular to the glenoid face. For correction for posterior glenoid wear in Figure B, the exit point (glenoid center line) should more closely resemble that seen in Figure A.

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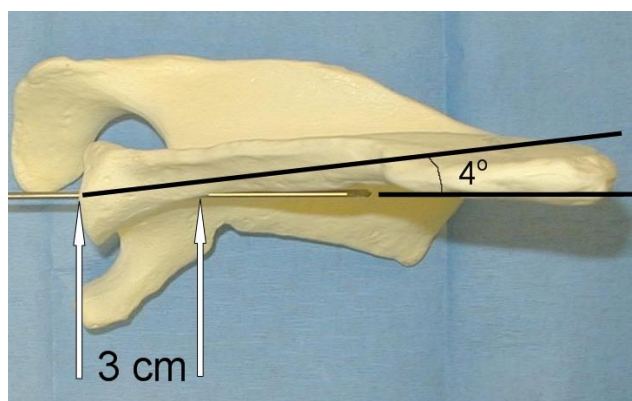


Figure 2. Centering line in relation to scapula body shows a mean of 4° of retroversion (range, 0°-9° in our study) in this example, viewed from below. The line perforates the anterior neck approximately 3 cm from the glenoid rim (Pacific Research Laboratories, Inc., Part #1021, Vashon, Wash).

METHODS

We selected 50 patients (28 men, 22 women) who were younger than 60 years (mean age, 40 years) and showed no clinical or radiographic evidence of glenohumeral osteoarthritis. Standard magnetic resonance imaging (MRI) scans were obtained of these patients' shoulders, and each scan was used in the study.

The scout film for each MRI was reviewed, and the axial image traversing the center of the glenoid face was selected in relation to the superior and inferior glenoid margins. The glenoid width between points selected on the anterior and posterior glenoid rim was measured on this image, and a point directly in the middle of the glenoid was selected. This point was defined as the anatomic midpoint of the glenoid surface. A line was drawn through this midpoint perpendicular to the face of the glenoid, and the relationship of the exit point of this line to the scapular neck was measured in each scan. This line was consistent with the glenoid center line defined by Matsen and colleagues,^{4,5} and the exit point was then considered the equivalent of the glenoid centering point. To ensure that our sample of patients represented a normal population, we measured the glenoid version in each scan according to the method described by Rockwood.⁵

RESULTS

The line representing the glenoid center line exited from the anterior surface of the glenoid neck in all 50 of our patients. The mean distance of exit of this point, measured from the face of the glenoid along the anterior surface of the glenoid neck, was 3.0 cm (range, 2.2-4.2 cm), and the range of glenoid retroversion was 0° to 9° (mean, 4°). Figures 2 and 3 show this retroversion in a Sawbones model (Pacific Research Laboratories, Inc., Part #1021, Vashon, Wash). The value is consistent with other authors' version measurements.^{1-3,5}

DISCUSSION

The results from our anatomic study confirm the relationship (found by Matsen and colleagues^{4,5}) between the center of the glenoid face and a point located on the anterior surface of the glenoid neck, and our sample size was larger. Selecting

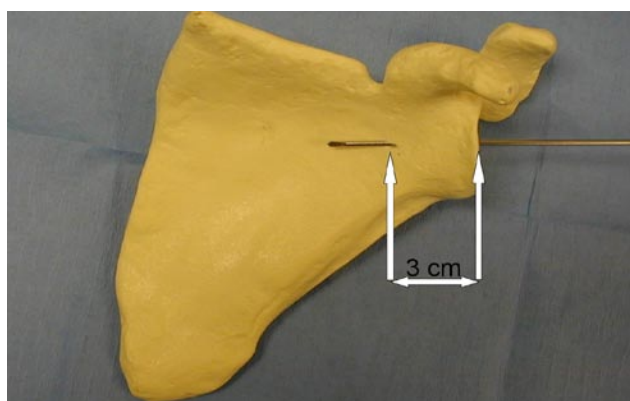


Figure 3. View from the anterior scapula shows the center line perforating the anterior scapula 3 cm from the anterior glenoid rim, perpendicular to the glenoid face (Pacific Research Laboratories, Inc., Part #1021, Vashon, Wash).

younger patients without clinical or radiographic evidence of glenohumeral arthritis allowed us to evaluate normal glenoid anatomy, which is likely the ideal in reconstructions of the glenoid during TSA or during resurfacing in hemiarthroplasty. The glenoid version measurements in our study were consistent with those of other larger patient populations, so our patient group likely represented a normal patient population.

Posterior glenoid wear is often present in the osteoarthritic shoulder. This wear pattern leaves intact articular cartilage and subchondral bone anteriorly, leading to increased retroversion of the diseased glenoid. Previous studies using computed tomography have demonstrated the posterior wear pattern associated with glenohumeral arthritis.^{1-3,6} Authors have emphasized the importance of recognizing and addressing posterior glenoid deficiency by augmenting the posterior glenoid rim with bone graft, altering the version of the humeral component, or reaming the glenoid to reestablish proper glenoid anatomy.^{4,5,7,8} Failure of the operating surgeon to recognize posterior wear during shoulder arthroplasty may lead to implantation of the glenoid component in excessive retroversion or reaming in a manner that will not correct posterior instability. An excessively retroverted component may lead to posterior instability of the implant or penetration of the pegs or keel of the glenoid component through the anterior surface of the glenoid neck.^{3-5,7,9-14}

Matsen and colleagues^{4,5} introduced the concept of the glenoid centering point to describe the relationship observed in their cadaveric study. They also introduced the clinical utility of this anatomic relationship in recreating normal glenoid anatomy during TSA. The technique involves exposing the glenoid surface and placing a template of the glenoid component with a centralized hole on the face of the glenoid. This template component is placed on the center of the glenoid face in relation to the anterior, posterior, superior, and inferior glenoid rims. The center hole of the glenoid template is then marked with electrocautery, and this point is considered the anatomic center of the glenoid face (the glenoid center point). The operating surgeon then places a finger over the anterior surface of the

glenoid neck and palpates the centering point in the sulcus between upper and lower crura of the scapula and the flare of the glenoid vault. A drill is advanced toward this point from the center of the glenoid face, creating a guide hole along the native glenoid center line. The normal glenoid center line connects the center of the glenoid face with the centering point as defined in the initial study by Matsen and colleagues.^{4,5} Given our study results, the glenoid center line should exit the anterior scapular neck approximately 3 cm from the anterior glenoid rim. Because the anterior glenoid rim is often normal and unaffected by the arthritic process, this is usually a reproducible and reliable landmark when coupled with the glenoid center point.

Reaming along the glenoid center line allows normalization of the glenoid anatomy and contouring of the glenoid face to match the back of the glenoid component. This results in increased bony support for the glenoid component and theoretical restoration of normal glenoid anatomy. In resurfacing during hemiarthroplasty, it allows for correction of posterior instability.

CONCLUSIONS

Our study in a larger patient population confirms the anatomic relationship described by Matsen and colleagues. Understanding this relationship may assist the operating surgeon in recreating glenoid version in the abnormally worn glenoid during shoulder arthroplasty.

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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