The influence of scapular orientation on the Medial Scapula Corpus Angle in Snapping Scapula Syndrome

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INTRODUCTION: Snapping scapula syndrome (SSS) can result in crepitus during shoulder abduction and painful scapulae during overhead arm motion. Although often attributed to concave curvature of the superomedial aspect of the scapula, it may arise from any anatomic variation that disturbs smooth motion of the scapula over the ribs. When not responsive to conservative therapies, treatment consists of bursectomy with or without superomedial angle resection. Measurement of the medial scapula corpus angle (MSCA), a measure of scapula blade curvature, has been used to diagnose the condition. The MSCA is measured on transverse plane images of the scapula, immediately below the scapula fossa. While previous studies found SSS patients tend to have a more concave scapulae, the MSCA varies up to 70° in both healthy control groups and SSS patients. This likely stems from anatomic variation and/or differences in 3-dimensional (3D) viewing angle caused by patient positioning and bony orientation during volumetric imaging. The objective of this study was therefore to quantify these sources of variability and their influence on the MSCA.

METHODS: Computed tomography scans from 10 healthy control and 8 SSS patients were used to create 3D scapula models. The value of the MSCA as well as the scapula type was determined on an idealized reference imaging plane (ML) (Figure 1). The models were then reoriented to create 32 imaging planes representing the range of possible imaging planes due to measurement technique, patient positioning, and scapular orientation. These planes were created as inferior and superior translations from ML (ML- and ML+, respectively), rotation about the lateral edge (L- and L+), rotation about the medial edge (M- and M+) and anterior and posterior tilt (T+ and T-). Statistical analyses compared the MCSA on these altered imaging planes to the gold standard MSCA on the reference plane, as well as between healthy control and SSS patients within each altered imaging plane. Interclass coefficients were calculated both between raters as well as at a two-month interval for a single rater.

RESULTS: The MSCA varied nearly 90° within each subject depending on the imaging plane used to make the measurement, far exceeding the differences in MSCA observed between SSS and non-SSS patients from previous studies (Figure 2). The difference in MSCA between the imaging planes and gold standard MSCA measurement were significant for several imaging planes. Only 4 imaging planes yielded statistically significant differences in MSCA between healthy controls and SSS patients. There were also several instances of difference classifications in scapula types from plane to plane within the same patient. Interclass variability for MSCA measurement was .954 interobserver and .643 intraobserver.

DISCUSSION: The imaging plane dramatically affects the MSCA measured in each patient, and there is currently no control for patient positioning and scapular orientation relative to the imaging system. Therefore, clinicians do not know which imaging plane they are viewing when measuring MSCA from a typical volumetric scan. Even with simple linear offset of the idealized imaging plane, anatomic variability contributed variability in MSCA up to 90°. Although the MSCA was previously shown to differentiate healthy controls from SS patients, the drastic variability in MSCA due to imaging planes alone suggests specificity and sensitivity for detecting SSS is highly dependent on scapular orientation. Further studies accounting for variable scapular posture, upright 3D imaging of the scapula relative to the ribs, or analyzing kinetic motions could be helpful in diagnosing SSS.

CLINICAL RELEVANCE:
MSCA is currently utilized in the clinic as a factor in diagnosing SSS, and thus plays a role in determining the need for bursectomy and superomedial scapula resection. These results suggest that MSCA measurement is highly sensitive to scapular posture, perhaps even more so than the presence of SSS. This demonstrates the need for more research into consistent imaging and MSCA measurement, as well as caution in relying on this measurement.

FIGURES:

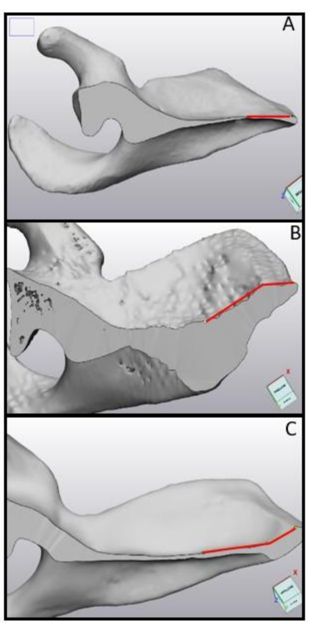

Figure 1: Scapula types with MSCAs shown in red. (A) Type 1 (straight) has a small MSCA, within +/- 10 degrees and can either be concave (+) or convex (-). (B) Type 2 S has a convex (-) MSCA angling away from the thorax, and (C) Type 3 concave (+) has an MSCA angling toward the thorax.

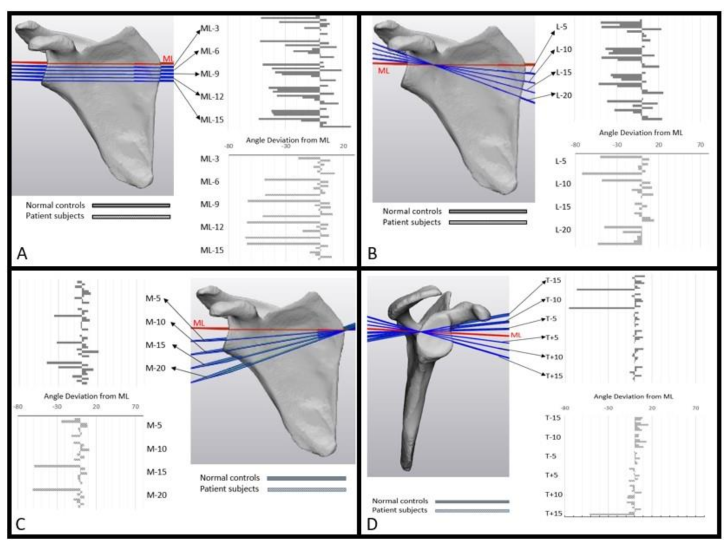

Figure 2: MSCA deviation from ML plane standard for ML- (A) T (B) L-(C) and M-(D) planes in healthy controls and SSS patients. Here each bar represents an individual subject (N=8 for SSS patients, N=10 for healthy controls) and bars are presented by subject in the same order for each figure.