The Effect of Axial Rotation on Shoulder Impingement

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Introduction

Background

- Shoulder pain is very common affecting 30-50% of the American population annually.
- Majority of these shoulder conditions improve, but there is a high rate of recurrence, with 54% of patients experiencing symptoms after 3 years.
- A common cause of shoulder pain is subacromial impingement between the rotator cuff (supraspinatus) tendon and the coracoacromial arch, which consists of the acromion process of the scapula and the ligament connecting the acromion and the coracoid processes on the scapula.
- Better understanding of how movement contributes to shoulder pain is required in order to plan the most effective interventions.

Purpose

- To determine whether long axis (axial) rotation significantly impacts the proximity and compression of the rotator cuff (supraspinatus) beneath the coracoacromial arch.

Materials and Methods

- MRI images were taken of twenty subjects (10 symptomatic, 10 asymptomatic)
- 3D models created using MIMICS software (Figure 1)
- The models were rotated throughout a range of extreme internal and external rotation by five degree increments (*Figure 3*).
- Minimum distances, areas within 2 mm proximity, and volumes of intersection were calculated for the supraspinatus.
- Two way ANOVA to statistically compare average minimum distance and average area within 2 mm.

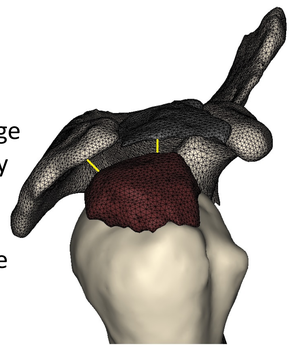

Figure 1. 3D Model of Shoulder Anatomy. Visual Representation of Minimum distance calculation

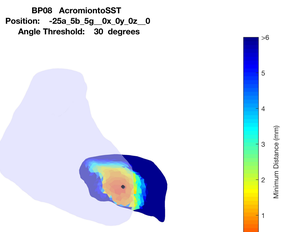

Figure 2. Color Map of Tendon proximity to Acromion opposing structure

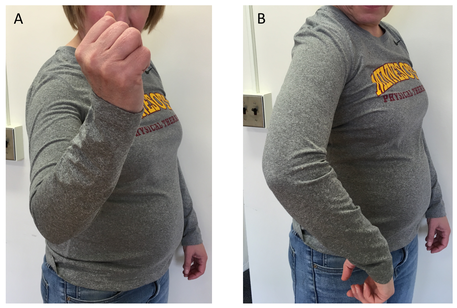

Figure 3. Range of External (A) and Internal (B) Rotations statistically analyzed.

Results

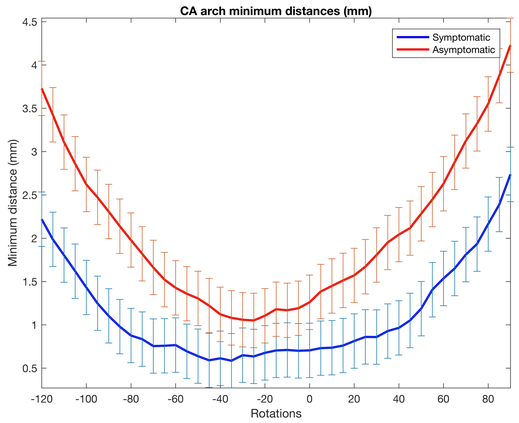

Figure 4. Average Minimum Distance between the Supraspinatus Tendon and the Coracoacromial Arch.

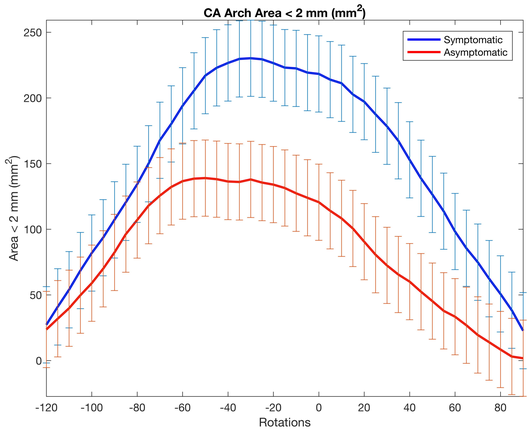

Figure 5. Average Area within 2 mm proximity of the Supraspinatus Tendon to the Coracoacromial Arch.

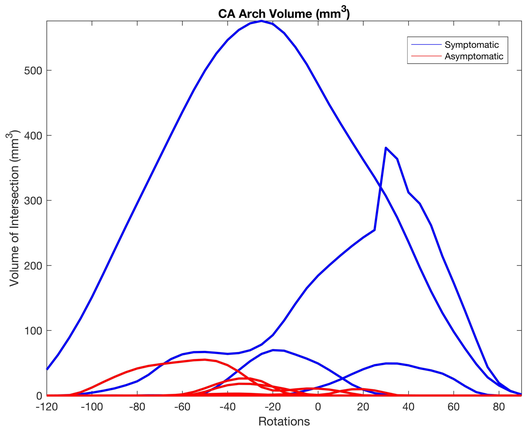

Figure 6. Volume of Intersection between the Supraspinatus Tendon and the Coracoacromial Arch for each subject in each group.

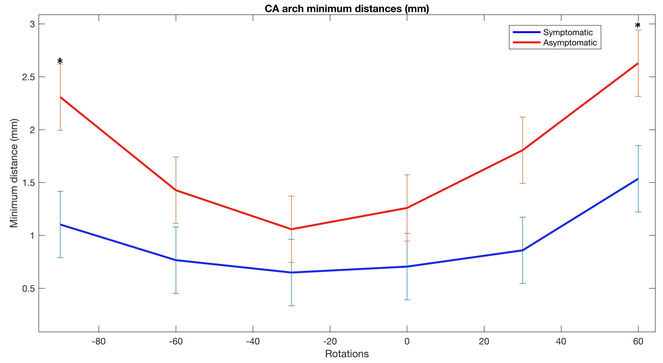

Figure 7. Average Minimum Distances of the angles statistically analyzed. (*) indicates statistical difference from neutral position (zero degrees axial rotation).

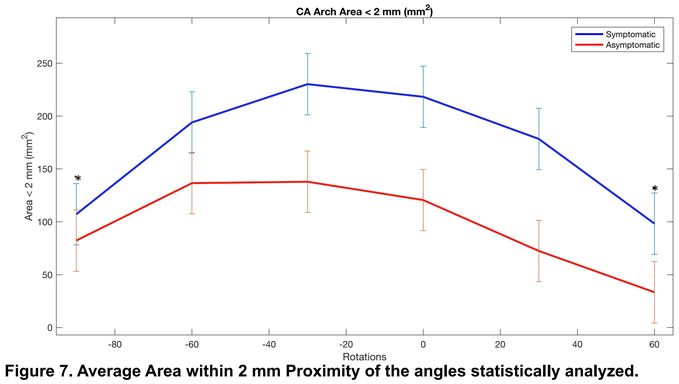

Figure 7. Average Area within 2 mm Proximity of the angles statistically analyzed.

Discussion

- The two groups (symptomatic/asymptomatic) were not statistically different, but the asymptomatic group tended to have larger minimum distances, and smaller areas within 2 mm proximity to the opposing structures.
- Statistically significant differences in both minimum distances and areas within 2 mm occurred between the end range rotations (-90 and 60 degrees) and the neutral position.

Limitations

- Small sample size
- Average motion
- Humeral head centrally positioned
- Only considering supraspinatus critical zone

References

1. Lawrence, Rebekah L. "Effect of Glenohumeral Elevation on Subacromial Supraspinatus Compression Risk during Simulated Reaching."Journal of Orthopaedic Research (2017).
2. Pappas, George P. "In Vivo Anatomy of the Neer and Hawkins Sign Positions for Shoulder Impingement." Journal of Shoulder and Elbow Surgery 15.1 (2006): 40-49.
3. Graichen, H. "Subacromial Space Width Changes during Abduction and Rotation -a 3-D MR Imaging Study." Surgical and Radiologic Anatomy 21.1 (1999): 59-64.