LOAD-INDUCED SCAPULA ROTATION AFTER ROTATOR CUFF TEARS DURING A 30° ARM ABDUCTION MOVEMENT

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Introduction

Rotator cuff tears are commonly associated with age and glenohumeral joint instability [1]. However, the mechanisms underlying glenohumeral motion are not fully understood. A superior glenohumeral translation is also likely to occur after a rotator cuff tear, however, scapula rotations might also be affected, and influence glenohumeral biomechanics and the measurement of the glenohumeral translation. This study aimed to explore scapula rotation after rotator cuff tears during an abduction movement with additional handheld weights.

Methods

Twenty-five patients with unilateral rotator cuff tears (64.3±10.2 years), 24 asymptomatic control subjects (55.5±8.2 years) and 25 healthy control subjects (26.1±2.3 years) participated in this study. Single plane fluoroscopy images were acquired for each shoulder during a 30° abduction and adduction movement in the scapular plane with and without additional handheld weights (0, 2 and 4 kg). Images were labelled with an automatic landmark detection algorithm [2] and scapula rotations were measured during the entire motion considering the rotation of the glenoid cavity. A linear mixed model (loads, shoulders) with random effects (subjects) was applied to the scapula rotations measured during abduction and adduction (with the dominant side of healthy subjects as reference).

Results

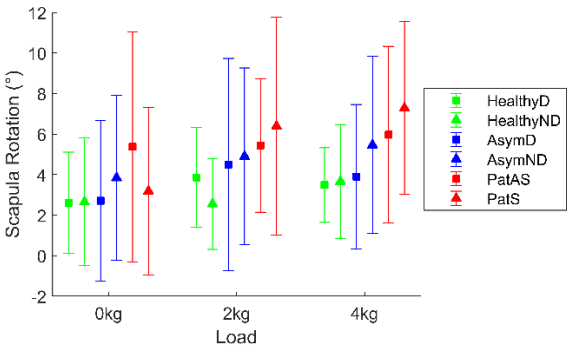

Figure 1: Upward scapula rotations measured during abduction for the dominant (D) and non-dominant (ND) sides of healthy and asymptomatic (Asym) subjects, and for the asymptomatic contralateral (AS) and symptomatic (S) side of patients (Pat).

Figure 1 shows the upward scapula rotations for all shoulders during abduction. Analogous values but downward scapula rotations were observed during adduction.

During abduction, we found a significant main effect for the asymptomatic side of patients ($p=0.033$) and a significant interaction effect of load for the symptomatic side of patients ($p=0.002$). Post-hoc tests showed significant differences for scapula rotations during abduction at 2 kg between the symptomatic side of patients and the non-dominant side of healthy subjects ($p=0.007$), at 4 kg between the symptomatic side of patients and both sides of healthy subjects (non-dominant $p=0.005$, dominant $p=0.003$), and for the symptomatic side of patients between 0–2 kg, and 0–4 kg ($p<0.001$).

During adduction, a significant main effect for load was observed in scapula rotation ($p=0.046$). Differences were found for scapula rotations during adduction for the non-dominant side of healthy subjects between 0–4 kg ($p=0.049$), for the dominant side of asymptomatic subjects between 0–2 kg ($p=0.009$) and 0–4 kg ($p=0.043$), and for the symptomatic side of patients between 0–2 kg ($p<0.001$) and 0–4 kg ($p<0.001$).

Discussion

The results presented herein show that the kinematics of the glenohumeral joint is load-dependent and load-induced scapula rotations are greater in symptomatic rotator cuff tears and increase with increasing handheld weight. This implies that scapula rotation is involved in the compensation mechanisms of rotator cuff tears, particularly in more demanding tasks. Without accounting for scapula rotation, apparent glenohumeral translations might be measured and misinterpreted. Further investigations of load-dependent joint stability are necessary to gain a better understanding of glenohumeral motion and biomechanics during activities of daily living.

References

1. Yamaguchi et al, J. Shoulder Elb Surg, 9:6-11, 2000.
2. Hess et al, ISG meeting 2022.

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