SCAPULAR KINEMATIC ALTERATIONS FOLLOWING SERRATUS ANTERIOR FATIGUE

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INTRODUCTION

Serratus anterior is positioned to control upward rotation, posterior tipping and external rotation of the scapula on the thorax during arm elevation. For individuals with subacromial impingement, altered scapular kinematics including decreased posterior tipping, increased internal rotation and decreased upward rotation have been identified. One potential mechanism for these alterations is serratus anterior fatigue. Individuals with high exposure to repetitive overhead activities are at risk for serratus fatigue.

At the present time, no clinical test is available to test for the fatigability of serratus anterior or to measure the consequences of such fatigue on scapular kinematics. The present study was designed to determine whether a task sufficient to produce serratus anterior fatigue in normal volunteers would lead to altered scapular kinematics consistent with the deficits seen in patients with impingement.

METHOD

Seven healthy subjects without a history of shoulder pathology volunteered to participate. The fatiguing task consisted of holding a push-up plus position with the feet elevated 30cm until no longer able to continue. This task approximates one previously demonstrated to fatigue serratus anterior. Measured variables during the fatiguing task included time to failure (sec), and self-report of fatigue (Borg scale). Three-dimensional motion data of the humerus, scapula and trunk of the dominant arm were also collected on each subject during five repetitions of active arm elevation before and after the fatiguing task using the Flock of Birds electromagnetic system.

Scapular orientation angles relative to the trunk were determined at humerus to trunk angles of 60°, 90°, and 120° before and after the fatiguing task. The arm elevation and arm lowering phases were considered separately. A repeated measures Analysis of Variance was used to determine the effect of the fatiguing task on scapular orientation for each phase, with time (before and after) and angle (60°, 90°, and 120°) the within subject variables.

RESULTS/DISCUSSION

The mean time to failure during the task was 84.5 sec (SD 27.8), and the mean change in Borg score was 5.5 (SD 2.1). During arm elevation, there was a statistically significant interaction effect between time and angle (P<0.001) for scapular tipping. Post-hoc testing revealed that there was significantly more scapular anterior tipping at 120° after the task (-7.2°) than before the task (-3.9°). There were no other statistically significant results during arm elevation.

During arm lowering, there continued to be a significant interaction effect for tipping (P<0.01) with more anterior tipping after the
task (3.0° greater at 120°; 3.1° greater at 90°) than before the task. There were also statistically significant main effects of the fatiguing task on scapular upward rotation (P<0.05) and tipping (P<0.05). There was 2.3° less upward rotation and 2.5° more anterior tipping after the task.

Other authors have examined scapular kinematics following fatiguing tasks and have also demonstrated kinematic alterations. These studies, however, did not specifically isolate serratus anterior during their fatigue task. The current findings describe a direct effect of serratus anterior fatigue on scapular kinematics.

This task has potential for use as a clinical test for serratus function. It appears to adequately fatigue serratus and result in scapula kinematic alterations in a young, healthy sample. The task may be able to provide clinicians with a tool to assess scapular stability and a patient’s ability to return to repetitive activities using the arms. Further testing on a larger sample is necessary to establish normative data. In addition, testing on individuals with shoulder impingement is needed to determine whether they perform differently on this task, and whether their scapular kinematics are differentially affected by fatigue.

SUMMARY/CONCLUSIONS

Performing a task designed to fatigue serratus anterior resulted in altered scapulothoracic kinematics in healthy subjects. Scapular posterior tipping was decreased during both elevation and lowering the arm, while scapular upward rotation was decreased during arm lowering only.

REFERENCES