

## **Scapular Kinematics During Resistive Shoulder Scaption Exercise**

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**Background:** It has been known that scapular kinematics is altered during external resisted arm elevation; however, far too little attention has been paid to scapular kinematics during exercise with individual level of resistance with frequently used rehabilitation tools such as elastic bands.

**Purpose:** To analyze the scapular kinematics during shoulder scaption exercise with elastic band.

**Design and Setting:** Controlled laboratory study, pre-test post-test design.

**Patients or Other Participants:** Thirty-two healthy males without a history of shoulder pathology or pain in both shoulders participated in the study (mean±SD age, 23.13±1.17 years; height, 1.76±0.05 m; mass, 72.3±9.85 kg). The inclusion criteria were no limitation in shoulder range of motion, no prior surgery or injury related to shoulder complex, showing no positive sign of impingement or instability screening evaluation. Subjects were excluded if they suffer from any known systemic or neurological problems and have repetitive shoulder movements due to occupational or sports activities.

**Methods:** Individual level of elastic band resistance was determined by three repetitions maximum for each subject on a separate day prior to kinematic recording. Three-dimensional kinematic data from scapula, humerus and thorax were collected via the electromagnetic tracking device interfaced with the Motion Monitor software program. All subjects performed bilateral scaption exercise on both unresisted (gravity force only) and resisted (with elastic band) condition. Scapular internal-external rotation, upward-downward rotation and anterior-posterior tilt were analyzed at 30°, 60°, 90° and 120° of humerothoracic elevation and lowering based on International Society of Biomechanics recommendations. Student-t test was used for statistical comparison.

**Results:** Strong evidence of increased scapular internal rotation and downward rotation were found at 30°, 60° of elevation and 90°, 60°, 30° lowering when the external load was applied to scaption ( $p<0.05$ ). Also, there was increased scapular anterior tilt at 90°, 120° elevation and at all stages of lowering during resisted scaption on non-dominant side ( $p<0.05$ ).

**Conclusions:** This study showed that scapular kinematics altered during resisted scaption exercise with elastic band. It may be considered that these alterations are normal response of reorganized neuromuscular system to maintain the optimal position of the glenoid fossa against individual level of resistance in healthy subjects. Although the alternations were statistically significant, they were relatively small ( $<5^\circ$ ). Therefore this exercise may be considered to be safe and recommended to use in healthy shoulders. However, scapular kinematics changes during resistive shoulder exercise in pathological shoulders are uncertain.

**Clinical Relevance:** To observe scapular motions during scaption exercise with elastic band and considering scapular control rather than muscular strength is recommended. By improving scapular neuromuscular control priorly, it is possible to make shoulder girdle exercises such as scaption safer.