

## **Altered Scapular Muscle Activation in Individuals with Shoulder Pathology Exist During Functional Shoulder Exercises**

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**Background:** Alterations in scapular muscle activation affect dynamic stability of the shoulder and often occur in conjunction with shoulder pathology. Functional shoulder rehabilitation exercises seek to re-establish coordinated and balanced scapular activation of both individual muscles and force couple relationships for stability of the scapula through whole body kinetic chain movements.

**Purpose:** To determine if scapular force couple activation ratios and individual muscle activity [upper trapezius (UT), middle trapezius (MT), lower trapezius (LT), and serratus anterior (SA)] differ between functional exercises in healthy controls and glenohumeral (GH) pathology subjects.

**Design and Setting:** Repeated-measures design. Laboratory setting.

**Participants:** Thirty-two subjects [Healthy control:  $n=16$  (7 male, 9 female), age =  $24.38 \pm 2.78$  years, height =  $174.32 \pm 9.36$  cm, mass =  $74.87 \pm 16.30$  kg; GH pathology:  $n=16$  (9 male, 7 female), age =  $23.44 \pm 2.85$  years, height =  $171.45 \pm 11.66$  cm, mass =  $76.06 \pm 13.14$  kg].

**Methods:** Subjects in both groups performed four functional exercises [Bow and Arrow (BA), External rotation with scapular squeeze (ERSS), Lawnmower, and Robbery] in which muscle activation properties (area and ratios) were measured in the UT, MT, LT, and SA using surface electromyography. Muscle activation properties [area, ratios (UT/LT, UT/MT, UT/SA)] were calculated.

**Results:** A significant exercise main effect for UT/MT and UT/LT activation ratios was similar during BA and robbery ( $p=.359$  and  $.836$ , respectively), and both of these exercises were greater than the lawnmower ( $p < .05$ ) and ERSS ( $p < .05$ ). A significant exercise x group interaction for UT/SA activation ratio found trend for higher ration in GH pathology subjects during the Robbery ( $p=.047$ ). A significant exercise by group interaction for UT and MT found more activation in GH pathology subjects during the Robbery ( $p=.001$  and  $.018$ , respectively). A significant exercise x group interaction for LT ( $p < .001$ ) found a trend for less LT activity during Lawnmower ( $p=.053$ ) in GH pathology subjects. A significant exercise main effect for SA found more activity during ERSS than Robbery ( $p=.001$ ) and BA ( $p=.007$ ).

**Conclusions:** Generally, our findings of increased UT and decreased LT activation are consistent with previous research in pathologic subjects, as evidenced by altered scapular force couple activation ratios.

**Clinical Relevance:** Scapular stability in pathologic individuals may be compromised due to altered UT, LT, and SA activation, which may affect overall GH function. The Lawnmower and ERSS functional exercises elicit less UT activation while promoting MT, LT, and SA in all three scapular force couples (UT/MT, UT/LT, and UT/SA).