Regression Analysis of Pectoralis Major Muscle Electromyography To Estimate Anterior Thoracic Cage Forces

LaPier, Ansel (School: Central Valley High School)

Restricted arm force during activity is often required following bone disruption (iatrogenic or traumatic) to facilitate osteogenesis, but measuring patient force is challenging, especially in the axial skeleton. My project developed a technique to predict anterior thoracic cage forces using Pectoralis Major (Pec) electromyography (EMG) and other variables to monitor patients recovering from thoracic surgery/trauma. Pec EMG measures the number of muscle fibers activated and therefore might be a good indirect indicator of lateral anterior thoracic cage forces. I used pooled Pec EMG and force data obtained simultaneously during upper extremity weight-bearing at 5, 10, 20, and 30 lb. Statistical analyses included Simple Linear Regression (SLR), Multivariate Linear Regression (MLR), and Random Forest (RF) modeling to predict anterior thoracic forces ($P<0.05$). I used R-squared to assess regression model strength. With SLR, the highest R-squared values were found when using all data points and breaking the data into old (0.343) and young (0.293) cohorts. Adding demographic and functional variables along with EMG using MLR strengthened the model for both the old (0.519) and young (0.402) cohorts. Finally, RF analysis did not improve R-squared (0.100) over the SLR, so further RF modeling was not pursued. In conclusion, MLR using Pec EMG and resting heart rate, Timed-Up-and-Go, body mass index, and handgrip strength produced the most robust prediction model. Therefore, patients' anterior thoracic force can be reasonably estimated using Pec EMG. Ultimately this EMG technique may help hospitalized patients transition to home safely, especially those who may not have access to follow-up services.

Awards Won: