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Development of a Predictive Equation to Estimate Strain at the Shoulder

C.W. Moore[1] and A.D. Nimbarte[2]

[1]JFAssociates, Inc.,
Vienna, VA, USA

[2]Industrial and Management Systems Engineering
West Virginia University
Morgantown, WV, USA

Corresponding author's Email: chrism@jfa-inc.com

Abstract: Musculoskeletal Disorders of the shoulder have a significant impact. Few ergonomic/biomechanical analysis methods exist that include the shoulder, and no methods exist that focus on the shoulder exclusively. The objective of this research was to develop a predictive equation that can estimate relative risk of shoulder injury for a single-handed lifting task based on the location of a load from the sternal notch. Five male participants were recruited to perform a series of right-handed lifting tasks throughout the working range of the right arm at 8" intervals (forward/backward, left/right, and up/down) from the sternal notch. After each trial, participants rated their perceived exertion on a 10-point Borg scale. Experimental trials were modeled in AnyBody Musculoskeletal Modeling System and the glenohumeral reaction force output was used as input into a previously developed strain index equation for the shoulder. Regression methods were used to develop regression equations that accurately predicted the strain index results with distances from the sternal notch to the load as predictors. These four regression equations were used to calculate predicted values for each trial and analyzed using correlation with strain index values and exertion rating and RMSE between the predicted values and the strain index values. The resulting predictive equation had 8 terms with an R2=75.68%, correlation with strain index of r=0.8783, correlation with perceived exertion rated or r=0.6244, and RMSE= 8.0029.

Keywords: Musculoskeletal Modeling, Shoulder, Musculoskeletal Disorders