

Title: THE EFFECT OF OVERHEAD DRILLING POSITION ON SHOULDER MOMENT AND ELECTROMYOGRAPHY

Send correspondence to: lead author **fax:** (319) 335-4631 **e-mail:** daniel-anton@uiowa.edu

Authors: Dan Anton University of Iowa
Biomechanics and Ergonomics Facility
100 Oakdale Campus #158 IREH
Iowa City, IA 52245
e-mail: daniel-anton@uiowa.edu phone: (319) 335-4618 fax: (319) 335-4631

Lee Shibley

Nate Fethke

Jennifer Hess

Thomas Cook

John Rosecrance

Abstract:

A high prevalence of upper extremity work-related musculoskeletal disorders in construction workers in the pipe trades is well documented and it has been suggested that overhead work is a risk factor for disorders such as shoulder tendonitis. Moving the work closer to the worker or using lift platforms instead of stepladders have been recommended as interventions in limiting these disorders. However, there is a paucity of objective information documenting the physiological effect of overhead work on the upper extremity. The purpose of this study was to document changes in electromyographic (EMG) activity and shoulder moment resulting from changes in overhead work posture of the upper extremity. An additional purpose was to examine the relationship between EMG and shoulder moment with these changes.

Twenty healthy subjects without a history of shoulder disorders participated in this study. Subjects grasped a 2.27 kilogram portable hand drill while simulating an overhead drilling task by pressing upwards with a 22.3 N force into a horizontal beam. The simulation was performed using a close, middle, and far reach position while standing on either a lower or a higher step of a stepladder. Anterior deltoid, biceps, and triceps mean amplitudes were determined from root-mean-square-sampled surface EMG signals. EMG median frequency was also evaluated to identify fatigue and shoulder moment was calculated using cinematography and biomechanical analysis. Results indicated significant main effects of both ladder step height and reach position in the anterior deltoid EMG amplitude ($p < 0.001$). For the biceps EMG, there was a significant interaction between ladder step height and reach position ($p < 0.0025$). Triceps EMG levels were generally too low to determine an effect. There was no significant change noted in median frequency suggesting that fatigue was not a significant factor during the testing. There were significant effects due to both reach position and ladder step height on shoulder moment. Regression analysis describing the relationship between shoulder moment and mean EMG amplitude supports findings from other studies that shoulder moment and EMG activity increases with shoulder elevation. The significant findings of increased moment and EMG amplitude at the lower step height and with a far reach provide objective evidence that platform lifts may be beneficial in decreasing the stress on the shoulder during overhead work.

