

Poster: 0102

Mechanisms of Repetitive Strain Injury in an Aging Model

RG Cutlip (1) presenting, KB Geronilla (1), BA Baker (1), RR Mercer (1), M Hollander (1), SE Alway (2)

NIOSH Health Effects Laboratory Division, Morgantown, WV, United States (1), West Virginia University Laboratory of Muscle Biology and Sarcopenia, Morgantown, WV, United States (2)

There are approximately 700,000 lost time incidents per year in the United States construction, mining, agriculture and manufacturing sectors that are due to musculoskeletal overexertion and repetitive strain injury. In addition, credible epidemiological evidence suggests a higher incidence of pain, injury, and lost time from work in jobs that require high levels of physical exposure. Of additional concern, the 55-64 year old demographic is now the fastest growing sector of the labor force in the United States. It is projected by 2006 that 20% of the labor force will be comprised of workers over the age of 55. However, a research gap exists regarding soft tissue injury mechanics and the effect of aging on injury susceptibility and adaptation to repetitive physical exposures. Thus, we propose to conduct studies that characterize the quantitative dose-response of skeletal muscle due to repetitive mechanical exposures, particularly in an aging model via functional, physiological, and molecular changes.

Goal: The goal of this research is to investigate the conditions which increase susceptibility to occupationally-related repetitive motion injuries and to identify how those conditions are altered by aging.

Methods: In the present study, an animal model for aging was used to study chronic contraction-induced adaptation and injury to quantify muscle performance changes associated with repeated exposures of repetitive muscle actions. We have developed an in vivo animal model to study the effects of work exposures (i.e., muscle force, type of muscle action, velocity, number of repetitions, work-rest cycles, and duration of exposure) on resultant histopathology and biochemical responses in the muscle tissue, and have refined this model to study response to chronic exposures involving repetitive muscle contractions in a highly-controlled fashion. Dorsiflexor muscles of young (12 weeks) and old (30 months) male F344xBN F1 rats were exposed three times per week for 4.5 weeks to a protocol of 80 maximal stretch-shortening cycles per exposure in vivo. Twenty-four hours after the final exposure, the rats were euthanized and the tibialis anterior was excised for analyses. The analyses included morphological and histological changes, biomarkers of oxidative stress, inflammation, and apoptosis.

Results: Results from this study have shown that age profoundly affects the ability to adapt to repetitive mechanical exposures via changes in skeletal muscle performance and biological changes. Young animals exhibited an adaptive response to the chronic exposure of repetitive physical loading with a ~30% increase in static and dynamic performance and a 15% increase in muscle mass. Old animals, however, exhibited a mal-adaptive effect via a ~30% loss of static and dynamic muscle performance, loss of muscle mass, increased levels of oxidative stress and apoptotic markers as compared to their younger cohorts during the 4.5 week exposure period. Morphological changes in the old animals were also indicative of a mal-adaptive response.

Significance: The findings from this study suggest that aging impairs the ability to adapt to repetitive physical exposures. We plan to investigate the biological mechanisms that cause aging-related mal-adaptation to repetitive physical exposures. Understanding those mal-adaptive mechanisms is integral to developing preventative strategies to reduce musculoskeletal injuries in an aging workforce.

NORA Symposium 2006

Research Makes a Difference

April 18-20, 2006

L'Enfant Plaza Hotel

Washington, DC

NORA

