Abstracts

Poster: 0112

Occupational Vibration Alters Neuromuscular Control in the Low Back

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Low back disorders are a NORA priority research agenda area. A NIOSH review of epidemiologic evidence for work-related musculoskeletal disorders has identified vibration and particularly whole body vibration as a risk factor for low back injury. Vibration has been associated with a higher incidence of low back disorders in occupations such as pilots, tractor drivers and heavy equipment operators. While research on vibration transmissibility in the low back is extensive, there is still little understanding of the mechanism by which the vibration may lead to injury. The purpose of this research has been to investigate how vibration alters neuromotor control of the low back in order to better understand a potential mechanism for vibration-induced low back injury.

In these studies, neuromotor control was assessed by examining sudden load response dynamics (the ability of a subject to respond to a sudden, unexpected perturbation) and position sense (the ability of a subject to reproduce a posture) before, during and after exposure to vibration either applied directly to the muscle or applied as a whole body vibration. A computation model of the low back was used to examine the relationship between these two measures and the potential underlying neuromotor changes that may be occurring.

Subjects were found to respond more slowly to a perturbation both during and after exposure to vibration applied either locally to the paraspinal musculature or applied in a more occupationally-relevant manner as a whole body vibration. This increased delay persisted for up to 30 minutes after removal of the vibration. With this delayed neuromuscular response, the perturbations resulted in increased trunk flexion and a decrease in trunk stabilization. A greater muscle force response was then required to return to an upright posture. Subjects were not found to change their preparatory behaviour.

Position sense was measured by examining the ability of the subject to reproduce a lumbar curvature target in an upright standing posture. Subjects were found to have greater error both during and after the vibration. While these errors demonstrated a directional bias during vibration, they did not have the same bias after vibration. This suggests that during vibration, the vibration results in a perception of muscle lengthening. After removal of the vibration, habituation to the vibration leaves the subject less able to sense their low back posture. Computational modelling of the low back stabilization illustrates how such sensory changes could result in increased response delays and loss in trunk stabilization.

By understanding how vibration increases low back injury risk, improved prevention methods may be developed. For example, since vibration induced changes in stability were observed to last approximately 30 minutes, it may be advisable to have truck drivers rest for 30 minutes before unloading their vehicles. In addition, vibration exposure could be reduced through appropriately designed seating. This seating should be designed not only to eliminate seat pan vibration transmission but also vibration that may be carried through the backrest as vibration applied directly and transversely to the low back had similar effects.

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