

# ***Vibration Analysis of Finger Using Non-linear FEM to Understand HAV Syndrome***

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Exposure to excessive vibration causes Musculoskeletal Disorders (MSD). It is one of the most costly occupational diseases that cost ranging \$13-\$52 billion annually [1]. Hand-arm vibration syndrome (HAVS) is one of the major MSD which affects constructions workers and miners. Reduction of blood flow and blanching of the skin are a few of many direct effects of vibration induced injuries. Epidemiological studies show onset of vibration white finger (VWF) disease, which is mostly initiated at the tips of the index and middle fingers of affected worker, is associated with mechanical vibration [2]. Although the precise injury mechanism is not yet clear, it is known that remodeling of peripheral nerves to nerve tear can be caused by exposure to a high level dynamics shear load. [3]. Current HAVS guidelines have been developed mainly relying on population studies and empirical tests. Such studies have been very limited because high-level exposure test of human subjects is very difficult. Especially for hand and fingers, a direct animal test is not a practical option. A technique for a detailed numerical modeling is very useful for this reason in HAVS research. This research is to develop an advanced procedure and related techniques for computational analysis of hand and arm vibration responses. Purpose of this study is to investigate characteristics of static and dynamic responses of the fingertip (with soft tissue). Both static and dynamic motions will be considered with a special attention to the effects of static deformation on the vibration responses of fingertips. The numerical model will be developed as a two-dimensional (2-D) in-plane stress finite element model. A special modeling technique will be used to reflect the three-dimensional anatomical structure in the 2-D model. Nonlinear material behavior of soft tissue will also be considered. Sensitivity of the response of the main components of the finger, the fingertip tissue, tendon and bone to vibration will be studied. Frequencies characteristics in relation with natural modes in conjunction with vibration energy absorption at the fingertip will be studied. This study will lead to better understanding of the epidemiology of HAVS.



**University of Cincinnati  
10th Annual  
Pilot Research Project  
Symposium  
October 1-2, 2009**

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Hosted by: The University of Cincinnati Education and Research Center Supported by: The National  
Institute for Occupational Safety and Health.  
(NIOSH) Grant #: T42/OH008432-05

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Produced by Kurt Roberts Department of Environmental Health  
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