DESIGN AND VALIDATION OF A PORTABLE VIBRO-TACTILE THRESHOLD TESTER FOR WORKPLACE SCREENING OF CARPAL TUNNEL SYNDROME

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ABSTRACT

Carpal tunnel syndrome (CTS) occurs when the median nerve, which runs from the forearm into the hand, becomes pressed or squeezed at the wrist. The symptoms of CTS, which include pain and numbness in the arm and wrist, have been widely recognized. The costs associated with the diagnosis and treatment of CTS have been reported to have a major impact on the health care and worker's compensation expenditure. However, the diagnosis using the gold standards, like Nerve Conduction Velocity (NCV) testing and the more qualitative and observational tests, like Phalen's and Tinel's tests, often require expensive equipments and extensive training. Moreover, NCV testing requires the use of electrode to pass mild electric impulses to ascertain the electrical activity of the nerve and the extent of nerve damage in a patient which may result in discomfort.

In order to reduce the cost of training and equipment and the time required to test an individual at a workplace, this proposed research will result in a new portable vibro-tactile threshold tester (PVTT) that will be used to screen for CTS. The vibro-tactile threshold is the smallest sinusoidal amplitude applied to the middle finger (innervated by the median nerve) that can be detected by the patient, and has been previously demonstrated to correspond to progression of median nerve damage associated with CTS.

The PVTT consists of a voice coil connected to a probe with a tip, centered in a firm surround; the subject's middle finger rests on the firm surround. The voice coil provides the sinusoidal displacement forcing function to move the probe, and the resulting displacement is measured by an optical sensor. The system is controlled by a program written in LabView (on a laptop), which allows customization of the frequency, amplitude, and testing protocol, and maintains the desired displacement. The subject triggers an input to the system when the vibration is felt. The vibro-tactile threshold, like NCV, correlates with age as it is directly evaluating the performance of the nerve. The major goal of this study will be to redesign the existing PVTT for robustness and easy implementation along with validation of this new design with the existing design.