



TACTILE STIMULATION DEVICE FOR TRAINING HUMAN AMPUTEES TO RECOGNIZE ACTIVATION OF DIFFERENT SENSORY AFFERENTS DURING UTAH SLANTED ELECTRODE ARRAY STIMULATION

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There is a need for better prosthetic devices in the market that can provide sensory feedback. In recent studies, the Utah Slanted Electrode Array (USEA) has been implanted into the peripheral arm nerves of amputees to electrically stimulate remaining axons of sensory receptors. Although it is extraordinary to provide sensations of the amputated hand, it is difficult to interpret subjective descriptions of these sensations to help determine which sensory receptor subtypes are activated by each electrode of the USEA. A common vocabulary of sensation descriptions, and a method to train subjects to assign this vocabulary to the appropriate sensations, is needed. This research focuses on creating a tactile stimulation device that can mechanically activate the skin and evoke the sensory percepts expected for USEA stimulation of 3 major cutaneous mechanoreceptor subtypes: Slowly Adapting type 1 receptors (SAI), Rapidly Adapting type 1 receptors (RAI) and Rapidly Adapting type 2 (RAII). Specifically, the expected perceptual responses of SAIs, RAIs and RAIIs in response to USEA stimulation are evoked for 3 conditions of tactile stimulation: constant pressure, ~1-25 Hz vibration and ~25-200Hz vibration. We designed, built and tested a device which: a) outputs sinusoidal mechanical vibrations of 0-250 Hz, b) has multiple probe sizes for stimulating various areas of skin and c) operates as both a handheld instrument and as an attachable component of a stereotaxic manipulator. This tactile stimulation device is important for creating a common, agreed-upon vocabulary between the subject and investigator for each sensation. One human subject underwent tactile stimulation training prior to implantation of two USEAs. In addition to proprioceptive percepts, the subject identified 21 USEA-evoked percepts as having a quality of constant pressure, 6 percepts as having a quality of tapping/flutter and 8 percepts as having a quality of vibration/buzzing, likely corresponding to activation of SAI, RAI and RAI afferents, respectively. By understanding the descriptions of sensations given by the subject through both mechanical and electrical stimulation, the investigator may also obtain insight on what type of axon is activated during USEA stimulation.

