Imaging vibration induced skin deformations with reference to psychophysics and primary somatosensory neurons activity in humans

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Abstract

Tactile mechanoreceptors consist of neurons whose afferents innervate end-organs embedded in the skin. The characteristics of human mechanoreceptors are usually inferred from the properties of stimuli acting on the skin surface. This means that current definitions of the mechanoreceptors' functional properties fail to account for how the stimulus is modified as it passes through the skin layers. Here we present a pre-registration plan for a project with the aim of determining the skin's role in mechanoreceptor activation and touch perception. We plan to measure sub-micrometre deformations of subcutaneous skin tissue with a novel imaging technique. We obtain phase-resolved measurements using an SD-OCT (spectral domain optical coherence tomography) system capable of tracking high frequency vibrations. The OCT system also enables us to identify specific landmarks in the skin indicating the expected locations of the end-organs.

Using microneurography we will measure frequency-dependent (5-500Hz) vibration thresholds of single primary afferent tactile neurons with receptive fields in human glabrous skin. With SD-OCT, we will measure the skin deformations below a receptive field "hot spot" at the expected location of the end-organ. In a separate psychophysics experiment, we will measure the frequency-dependent perceptual thresholds, and use SD-OCT to measure skin deformations. In both microneurography and psychophysical experiments skin deformations will be measured at amplitudes above and below neural and perceptual thresholds, respectively.
These experiments should reveal the amount of deformation required at the end-organ to reach neural and perceptual thresholds, and allow us to measure any mechanical filtering of tactile stimuli occurring in the skin.

Keywords: microneurography, OCT, skin deformation, frequency sensitivity

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