MEASURING THE TACTILE SENSE

CORTICAL MECHANISMS AND CLINICAL APPLICATIONS OF TACTILE DIRECTION DISCRIMINATION

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin vid Göteborgs Universitet kommer att offentligen försvaras i Aulan, Sahlgrenska Universitetssjukhuset, Blå stråket 5, Göteborg, fredagen den 8 april 2011 kl. 09.00

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Avhandlingen baseras på följande delarbeten:

I. Löken LS, **Lundblad LC**, Elam M, Olausson HW. Tactile direction discrimination and vibration detection in diabetic neuropathy. *Acta Neurol Scand*. 2010 May; 121(5):302-8. Epub 2009 Oct 5.

II. Backlund Wasling H, **Lundblad L**, Löken L, Wessberg J, Wiklund K, Norrsell U, Olausson H. Cortical processing of lateral skin stretch stimulation in humans. *Exp Brain Res*. 2008 Sep; 190(2): 117-24. Epub 2008 Jun 24.

III. **Lundblad LC**, Olausson HW, Malmeström C, Backlund Wasling H. Processing in prefrontal cortex underlies tactile direction discrimination: an fMRI study of a patient with a traumatic spinal cord lesion. *Neuroscience Letters*. 2010 Oct 15;483(3):197-200. Epub Aug 11.

IV. **Lundblad LC**, Olausson HW, Hermansson A-K, Backlund Wasling H. Cortical processing of tactile direction discrimination based on spatiotemporal cues in man. *Manuscript*

Göteborg 2011

UNIVERSITY OF GOTHENBURG

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Abstract

Most of the studies aiming to investigate the human tactile sense are done on the glabrous skin. Still, there is a need for a quantitative method for evaluating nervous function of the hairy skin. Tactile direction discrimination, the ability to determine the direction of movement across the skin provides a clinical method to quantify tactile function of the hairy skin in humans. The method is easy-to-use, rapid, and inexpensive but has not been compared to vibration detection which is considered as the standard method for psychophysical examination of peripheral neuropathy. The peripheral neural mechanisms for tactile direction discrimination have been extensively studied, as well as the ascending pathways in the spinal cord. Nevertheless, the supraspinal mechanisms are imperfectly known. In this study we have compared the clinical test for tactile direction discrimination with vibration detection in a group of patients with diabetic neuropathy. We have also thoroughly studied the cortical processing of tactile direction discrimination. The results are presented in four separate papers.

The results showed that the clinical test for tactile direction discrimination had similar sensitivity as vibration detection in detecting patients with diabetic neuropathy. The cortical network for tactile direction discrimination involved the primary somatosensory cortex, the opercular parietal area 1 of the secondary somatosensory cortex, and dorsolateral prefrontal cortex as well as anterior insular cortex.

In conclusion, the clinical test for tactile direction discrimination provides a quantitative clinical test that is sensitive in detecting peripheral nervous lesions. The test seems well-suited for following patients with disturbances in the peripheral and central nervous systems. The neurophysiological mechanisms underlying tactile direction discrimination are well studied from the peripheral afferents in the skin, through the spinal cord and to information processing in the brain.

Keywords: AIC, diabetic neuropathy, DLPFC, fMRI, hairy skin, psychophysics, QST testing, somatosensory cortex, tactile direction discrimination

ISBN 978-91-628-8257-0