FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDIES OF THE PRIMARY SOMATOSENSORY CORTEX IN RELATION TO COMPLEX REGIONAL PAIN SYNDROME

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By

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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Abstract

Functional MRI was used to detect brain activations in the primary somatosensory cortex (SI) in response to a vibrotactile stimulus applied to the thumb (D1) and little finger (D5) of the right (R) and left (L) hands. Four studies were carried out with healthy subjects in order to determine the scanning and stimulation protocols that resulted in consistent and robust SI activity. It was found that a strong stimulus, compared to a weak stimulus, led to the SI activity being detected more frequently and at a more statistically significant level. Also, extending the scanning duration per digit further increased the T-scores.

The SI activations for each digit showed multiple foci and were distributed throughout the SI area. However, a clustering occurred in separate centres for stimulation to RD1 and RD5 near the Brodmann area 1/Brodmann area 3 boundary. The Euclidean separations of the cortical digit representations for LD1-D5 and RD1-D5 were calculated on the basis of the 'centre of mass' of the multiple activations. Observed separations ranged between 1.2 mm to 22.8 mm.

A further vibrotactile fMRI study was carried out involving patients with complex regional pain syndrome (CRPS). It has been suggested an altered central processing mechanism is involved in the disease, possibly due to cortical reorganisation in the sensory/motor cortices. The most efficient experimental protocols from the healthy subject studies were used to determine if these cortical differences were present in four patients. Data were acquired over two scanning sessions, approximately four months apart. The study revealed multiple SI foci and overlapping between the digits in both the healthy and CRPS hands, similar to those observed in the first studies. Larger SI activations were detected in one patient,

smaller SI activations were detected in another patient and two patients demonstrated cluster sizes in the normal range. The cluster sizes and the changes in size between the two scans suggest a correlation with the amount of pain experienced by the patients.

A general lack of consistency in the results from all the studies may be attributed to the difficulty of reliably detecting SI activity at a field strength of 1.5 T.

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