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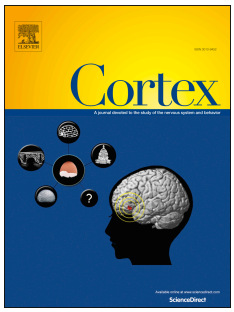


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Sanne Kikkert, Heidi Johansen-Berg, Irene Tracey, Tamar R. Makin

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# Reaffirming the link between chronic phantom limb pain and maintained missing hand representation

Sanne Kikkert[1], Heidi Johansen-Berg[1], Irene Tracey[1,2], Tamar R. Makin[1,3]*

## Affiliations

[1] Wellcome Centre for Integrative Neuroimaging, MRIB Centre, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford OX3 9DU, United Kingdom.
[2] Nuffield Division of Anaesthetics, University of Oxford, Oxford OX3 9DU, United Kingdom.
[3] Institute of Cognitive Neuroscience, University College London, 17 Queen Square, London WC1N 3AZ, United Kingdom.

* Correspondence to: t.makin@ucl.ac.uk
The authors declare no conflict of interest.

## Abstract

Phantom limb pain (PLP) is commonly considered to be a result of maladaptive brain plasticity. This model proposes that PLP is mainly caused by reorganisation in the primary somatosensory cortex, presumably characterised by functional degradation of the missing hand representation and remapping of other body part representations. In the current study, we replicate our previous results by showing that PLP correlates with maintained representation of the missing hand in the primary sensorimotor missing hand cortex. We asked unilateral upper-limb amputees to move their phantom hand, lips or other body parts and measured the associated neural responses using functional magnetic resonance imaging (fMRI). We confirm that amputees suffering from worse chronic PLP have stronger activity in the primary sensorimotor missing hand cortex while performing phantom hand movements. We find no evidence of lip representation remapping into the missing hand territory, as assessed by measuring activity during lip movements in the missing hand cortex. We further show that the correlation between chronic PLP and maintained representation of the missing hand cannot be explained by the experience of chronic non-painful phantom sensations or compensatory usage of the residual arm or an artificial arm (prosthesis). Together, our results reaffirm a likely relationship between persistent peripheral inputs pertaining to the missing hand representation and chronic PLP, and emphasise a need to further study the role of peripheral inputs from the residual nerves to better understand the mechanisms underlying chronic PLP.

**Keywords:**
neuroimaging; plasticity; motor control; amputees; neuropathic pain