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Phantoms in the brain

Question the assumption that the adult brain is "hard wired"

After amputation many people experience vivid sensations of the body part they have lost.[1] These "sensory ghosts" can arise within hours of the loss of the limb and are often painful. Such phenomena have been a mysterious part of medical lore for over a century, but recent research suggests that phantoms can teach us substantial lessons about the organisation and plasticity of the brain.

We stand to learn most from phantoms if we attend closely to patients' subjective reports. One innovative study, for example, has made use of digital photography to depict how amputees perceive their phantoms (fig 1) (A Wright et al, Wellcome Trust Sci Art Project, 1997). By remaining true to patients' own experiences, the researchers found it possible to document several neglected features. Patients reported a wide range of phantom sensations and many described striking changes in the phantom over time. Similar phantom sensations have been reported to occur after mastectomy[2] and after stroke.[3]

Similar work by Aglioti with women undergoing mastectomy found that 25% of patients experienced a phantom breast when the pinna region of the ear lobe (on the same side as the mastectomy) was stimulated.[2] This surprising finding suggests that these two regions might share neighbouring neural representations on the sensory homunculus in the brain.

Several recent brain imaging experiments also lend support to the functional remapping hypothesis. Studies of arm amputation using magnetoencephalography—a technique which allows high fidelity recordings of the electrical activity of small regions of the cortex—have shown that brain areas which ordinarily represent the hand were activated when either the lower face or upper arm was touched.[6 7] Functional imaging techniques, such as positron emission tomography, provide another means of establishing which brain areas are activated by specific stimuli and tasks. One recent study demonstrated that stimulation of the trunk with touch reliably activated the representation of the hand on the sensory cortex, showing that sensory input to the trunk had gained access to the "homuncular hand."[8]

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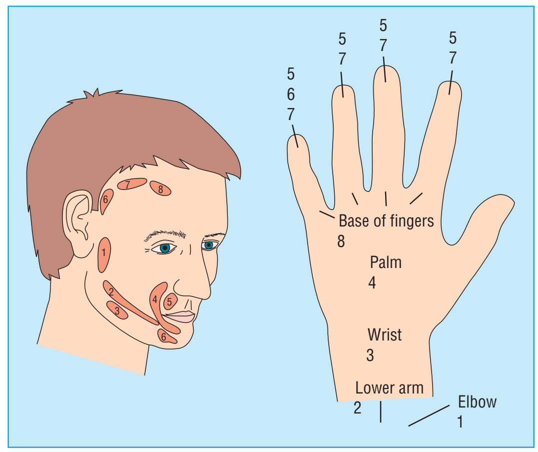

Fig 2 The areas depicted on the right side of the face in this patient elicited the precisely localised referred sensations in the phantom hand, shown with supine position

Given the relatively short delay between amputation and phantom experience—usually less than 24 hours—this "invasion" of neuronal connections is unlikely to result from the sprouting of new connections. A more plausible explanation is that existing dormant synapses between neighbouring cortical areas are unmasked after large scale sensory loss. However, both processes could be at work, and indeed this remapping may involve neuronal changes at both cortical and thalamic levels.[9]

All of these findings question the widely held assumption within neuroscience that the primary sensory areas of the adult brain are hard wired. There is now growing evidence that complex brain adaptation can occur after stroke, and functional remapping may explain the striking degree of recovery seen in some patients. It has also been shown that extensive training can produce physical changes in specific parts of the brain: Braille readers and trained musicians show highly developed brain areas responsible for touch and musical appreciation.[10]

ALEXA WRIGHT

Fig 1 How amputees perceive their phantoms

Understanding how the brain reorganises itself may eventually facilitate the treatment of patients with intractable phantom pain. Ramachandran, for example, has proposed a novel technique for the relief of the cramp-like pain caused by a clenched phantom fist. By observing the reflection of their free moving normal hand in a mirror, so that it appears in the position of the phantom, some patients report an immediate and compelling illusion whereby they are able to generate voluntary movements in the phantom hand. In some cases, the sensation of unclenching the phantom hand relieves the pain.[5] The efficacy of this method will require a prospective controlled trial, but it offers the prospect of a real clinical benefit from an exciting insight into how the brain organises itself.

Peter W Halligan *MRC senior research fellow*

Department of Experimental Psychology, University of Oxford, Oxford OX1 3UD

Adam Zeman *consultant neurologist*

Department of Clinical Neurosciences, University of Edinburgh, Western General Hospital, Edinburgh EH4 2XU

Abi Berger *science editor, BMJ*

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Pituitary surgery for acromegaly

Should be done by specialists

The objective of treatment in acromegaly is not only to alleviate symptoms, improve quality of life, and prevent complications but also to reverse the increased (two to threefold) mortality from vascular and respiratory disease and colon cancer. That this can be achieved if "target" basal growth hormone concentrations of <5 mU/l (2.5 ng/ml) are reached has been shown,[1 2] with the proviso that serum insulin-like growth factor 1 (IGF-1) values may need to be reduced to the normal age-related reference range.[3] Transsphenoidal adenomectomy is the most rapid means of reducing serum growth hormone and IGF-1 in acromegaly. The question then arises of how effective surgery is at achieving the target growth hormone and IGF-1 values. Subsidiary issues are: (*a*) what determines the outcome of surgery? (*b*) what is the relapse rate? (*c*) what is the complication rate? and (*d*) what is the most cost effective service provision?

Surgical outcomes in terms of safe target growth hormone concentrations have recently been reported in over 1000 patients.[3–11] All these series show that large tumour size, together with the degree of extrasellar extension (particularly lateral), and high preoperative serum growth hormone concentrations are major determinants of initial surgical failure. Thus, in 1999 a patient with a microadenoma (<1 cm in diameter) or mesoadenoma (>1 cm but confined to the sella turcica) should have upwards of 80% chance of successful adenomectomy. However, the surgical outcome for those with a macroadenoma (>1 cm with extension outside the sella) is by no means so successful, with at best 60% achieving the safe target growth hormone concentration. However, even for macroadenomas it is important to reduce the serum growth hormone level as much as possible, since the outcome of adjuvant treatment with somatostatin analogues, dopamine agonists, or radiotherapy is directly related to the pretreatment growth hormone concentration.[8]

What is new in the recent reports is the demonstration that the outcome of surgical treatment for acromegaly is related to the experience of the operator. In the study from Manchester,[8] where 73 patients were operated on by any of nine surgeons, fewer than 20% of patients achieved a growth hormone <5 mU/l, an outcome the authors attribute to the few cases operated on by any one surgeon. Likewise, the success rate in Birmingham was also low at 33%,[5] where eight surgeons were involved. However, in Oxford, Newcastle, or St Bartholomew's Hospital, London (each of which had only one surgeon performing pituitary surgery), a patient had a chance of a successful adenomectomy of 42-56%.[4 6 10] Interestingly, Yamada et al in Japan report a doubling of the success rate when a single surgeon started operating on their patients with acromegaly (from 37% to 81%).[7] Similarly, the proportion of patients achieving the target basal growth hormone concentration of <5 mU/l in Birmingham doubled (from 33% to 64%) when a single surgeon took over all operations.[11] The Oxford authors also report improvement in results of a single surgeon as his experience grew over 20 years.[10]

The relapse rate 5-10 years after successful initial surgery is low, at 0-7%, and major complication rates (leaks of cerebrospinal fluid, meningitis, permanent diabetes insipidus, new pituitary hypofunction) are also low, at less than 10%. Thus, in experienced centres

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