Imaging sensorimotor reorganization after stroke and implications for rehabilitation

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Neurological damage and in particular stroke, accounts for nearly half of severely disabled adults. Treatment of these patients relies on rehabilitation. Strategies aimed at helping patients adapt to impairment are the cornerstone of this approach, but treatments aimed at reducing impairment are less well developed. This is likely to reflect a lack of understanding of the underlying mechanisms of impairment and of the treatments designed to minimise impairment. The clinical neurosciences are in a unique position to help improve this understanding.

Treatments designed to minimise motor impairment can be considered as inputs to a damaged system, in this case the post-stroke brain. The aim of this input is to promote activity driven changes in surviving neuronal networks in order to optimise their functional organisation. It is important to realise that an input will succeed in driving functionally useful change only to the extent that the brain regions and networks with which it interacts are intact and are able to influence motor output. Another approach is to condition the brain to make it more likely that activity driven change will occur in response to an associated treatment (or input). For example, repetitive transcranial magnetic stimulation (rTMS) or drugs such as amphetamine are thought to enhance the effect of physiotherapy in some patients if delivered just prior to the treatment session. Once again, the likelihood of success will depend on a number of factors relating to whether the networks with which the treatment interacts are intact. For example, rTMS to the affected hemisphere primary motor cortex is unlikely to have any success in patients with large middle cerebral artery territory infarcts. As yet, the mechanisms of action of these interventions are not well understood. However, the concept of treatments interacting with residual functional architecture provides a framework with which to explore whether and how interventions of various types work in different types of patients.

It is in this context that modern neuroimaging techniques may be able to shed light on post stroke functional organisation in individual subjects. Techniques such as diffusion tensor imaging tractography will allow some objective assessment of residual anatomy, and functional magnetic resonance imaging can provide insights into the functional organisation of the residual brain networks. Ultimately this should facilitate an understanding of the mechanisms of interventions designed to reduce impairments, and also allow the stratification of patients based on the likely response to an intervention.

Further reading


