

Recovery of function after spinal cord injury: Reactivation of plasticity and enabling effective rehabilitation.

James W. Fawcett, PhD, FRCP.

Cambridge University Centre for Brain Repair, Robinson Way, Cambridge CB2 0PY, UK.

Repair of spinal cord injuries can be through long distance axon regeneration or through plasticity. Plasticity is a combination of short-distance sprouting of damaged and preserved axons and changes in synaptic strength, leading to new circuits. Current experimental treatments are fairly effective at promoting plasticity, less so at inducing axon regeneration. Enhancing plasticity may create new circuits in the injured cord, but it does so randomly, and the CNS needs to learn to use these new connections, strengthen useful connections and prune inappropriate ones. Helping the CNS to learn to use its new connections is a purpose of rehabilitation, so there has been considerable interest in how to use rehabilitation during the window of plasticity opened by treatments. The overall experience has been that plasticity treatments enhance the effectiveness of rehabilitation, but there have also been some indications that the relative timing of the interventions is critical. There are several treatments that promote plasticity, including anti NogoA and chondroitinase, both of which have led to functional recovery in animal models of SCI. Anti NogoA is currently in clinical trials. The treatments reverse some of the events that turn off plasticity at the end of childhood critical periods. Amongst these, there has been particular interest in perineuronal nets; these are cartilage-like coatings around inhibitory interneurons and their connections which play a key part in limiting plasticity in the adult CNS.

Alongside these biological approaches to restoring function, there are also efforts to use electronics and prosthetics. A difficulty has been obtaining reliable and high bandwidth connections between the CNS and the electronics. Some new approaches show promise for improving this situation.