Central nervous system (CNS) trauma is intractable and, in the peripheral nervous system (PNS), outcomes are less than optimal. Despite significant advances in cellular and drug-based therapies, there is no cure for either type of neurotrauma. Two animal models, one involving the CNS (lizard visual system) and the other the PNS (rat facial nerves) show striking parallels with robust regeneration. However, regeneration is highly inaccurate with axons neither finding appropriately located target cells nor restoring fast, secure synaptic transmission. Consequently, regeneration is dysfunctional with lizards remaining blind and rats unable to ‘whisk’ or blink. Task-specific training in both models restores correctly located connections as well as normal behaviour. Together with other mounting evidence, these clear mechanistic examples of the effects of training on nerve cells have implications for translation into rehabilitation for neurotrauma. A program funded by the Victorian Neurotrauma Initiative, and others, has recently been launched and is undertaking three randomised controlled clinical trials for patients with spinal cord injury. The program involves all spinal units in Australia and New Zealand and examines novel exercise programs from the time of injury in intensive care, to in-patients and out-patients and also encompasses a community-based program.