Corticospinal regeneration into lumbar grey matter correlates with locomotor recovery after complete spinal cord transection and repair with peripheral nerve grafts, fibroblast growth factor 1, fibrin glue, and spinal fusion.

Authors: Tsai EC, Krassioukov AV, Tator CH

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Abstract:

Knowledge of which tracts are essential for the recovery of locomotor function in rats after repair is unknown. To assess the mechanism of recovery, we examined the correlation between functional recovery and axonal regeneration. All rats underwent complete cord transection and repair with peripheral nerves, fibroblast growth factor 1, fibrin glue, and spinal fixation. Repaired rats recovered both motor-evoked potentials recorded at the lumbar level and locomotor function. Cord retransection rostral to the repair abolished the recovery, indicating improvement was due to long tract regeneration. To determine which long tracts correlated with recovery, a novel technique of simultaneous bidirectional axonal tracing and immunohistochemical examination of axonal type was used to quantitate the regeneration of corticospinal, rubrospinal, reticulospinal, vestibulospinal, raphespinal, propriospinal, serotonergic, and calcitonin gene-related peptide containing axons. Multiple linear regression analysis revealed recovery of function correlated only with regeneration of corticospinal axons into the gray matter of the lumbar spinal cord ($R = 0.977$, $p < 0.02$). For the first time, we show that regeneration of the corticospinal tract into the lumbar gray matter is a mechanism of functional locomotor recovery after complete cord transection and repair.