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Recovery of locomotor function following spinal cord hemi-transections in larval lamprey

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In vertebrates, reticulospinal (RS) neurons in the brain activate spinal motor networks to initiate locomotor behavior. Following spinal cord injury (SCI), RS neurons no longer communicate with the spinal cord, and animals are paralyzed below the lesion. In higher vertebrates, such as birds and mammals, the axons of RS neurons do not regenerate, and paralysis usually is permanent. In contrast, spinal cord transected lower vertebrates such as the lamprey display robust axonal regeneration and recovery of function within a few weeks. In our previous studies we showed that following spinal cord hemi-transections (HTs) in larval lamprey, injured RS neurons undergo a number of substantial changes in electrical properties and expression of ion channels which recover within several weeks. The purpose of the present study is to determine the rate of behavioral recovery following HTs and ultimately to correlate axonal regeneration of injured RS neurons with recovery of normal properties of these neurons. In the present study, animals received HTs on the right side of the rostral spinal cord and recovered for 1d - 6 wks. At early recovery times (1 day), animals swam with a spiraling movement and turned toward the intact side of the spinal cord, but the pattern of muscle activity was relatively normal. Swimming movements began to recover within the first week, and by the fourth week animals swam normally with little or no spiraling. In the future, anatomical experiments will be conducted to determine if recovery of swimming following HTs is due to regeneration of injured axons through the HT or to functional compensation of intact pathways on the opposite side of the spinal cord. This information will be important in determining what factors alter the properties of RS neurons following SCI and if these altered properties are important for successful axonal regeneration.