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Reorganization of corticospinal tract fibers after spinal cord injury in macaques

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【Purpose】
Manual dexterity in primates is controlled through the direct corticospinal tract (CST) and become severely impaired after spinal cord injury (SCI). Although plasticity and/or regeneration of the CST after SCI are considered to be critical for the functional recovery from motor impairments, the possible mechanisms underlying these events in the adult are poorly understood. We have shown that at least part of injured CST fibers extends beyond the lesion site to recover the manual dexterity in macaques. However, the manner of spinal reinnervation by extending CST fibers remains unclear. Here we investigated the pattern of reorganization of the CST fibers after SCI in adult macaques.
【Methods】
Three rhesus monkeys (*Macaca mulatta*) were used for this study (4, 4, and 11 years old). All experimental procedures were approved by the Animal Care and Use Committees of our institute and National Institutes of Natural Science. In our SCI model, unilateral lesions were made at the level between the C7 and the C8 segment, and then the extent of spontaneous recovery of manual dexterity was assessed through multiple behavioral tests with the Brinkman board test, a reaching/grasping task, and the use of precision grip in the reaching/grasping task. The CST fibers were traced with biotinylated dextran amine.
【Results】
The impaired manual dexterity was recovered gradually over 3 months after SCI. Extending CST fibers below the lesion site displayed a specific laminar distribution, compared with intact CST fibers. Our data revealed that the CST fibers extended preferentially into lamina IX where the spinal motor neuron pool was located to innervate the motor neurons directly.
【Discussion】
The present results indicate that the reorganization of CST fibers is critical to recover manual dexterity after SCI efficiently and effectively through a limited number of extending CST fibers.