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◂ Previous Article | Next Article ▸

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Anatomical Changes in Human Motor Cortex and Motor Pathways following Complete Thoracic Spinal Cord Injury

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A debilitating consequence of complete spinal cord injury (SCI) is the loss of motor control. Although the goal of most SCI treatments is to re-establish neural connections, a potential complication in restoring motor function is that SCI may result in anatomical and functional changes in brain areas controlling motor output. Some animal investigations show cell death in the primary motor cortex following SCI, but similar anatomical changes in humans are not yet established. The aim of this investigation was to use voxel-based morphometry (VBM) and diffusion tensor imaging (DTI) to determine if SCI in humans results in anatomical changes within motor cortices and descending motor pathways. Using VBM, we found significantly lower gray matter volume in complete SCI subjects compared with controls in the primary motor cortex, the medial prefrontal, and adjacent anterior cingulate cortices. DTI analysis revealed structural

abnormalities in the same areas with reduced gray matter volume and in the superior cerebellar cortex. In addition, tractography revealed structural abnormalities in the corticospinal and corticopontine tracts of the SCI subjects. In conclusion, human subjects with complete SCI show structural changes in cortical motor regions and descending motor tracts, and these brain anatomical changes may limit motor recovery following SCI.

Key Words: corticopontine tract • corticospinal tract • diffusion tensor imaging • motor control • voxel-based morphometry

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