

Laterality of the Corticospinal Tract and the Influence of Handedness: Findings of a DTI Study [President Award Proceedings]

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Background and purpose : Laterality in the absolute values of diffusion tensor imaging (DTI) indices of the corticospinal tract (CST) and the influence of handedness are disputed for the brain, and variation in these values for the spinal cord is unknown. We evaluated laterality in the absolute values of the major DTI indices of the CST of the brain and the cervical spinal cord and their variation with handedness.

Methods : Sixteen healthy subjects, including 8 left-handed (4 men, 4 women ; aged 21 to 42 years ; mean age, 34 ± 6.7 years) and 8 age- and gender-matched right-handed (4 men, 4 women ; aged 23 to 42 years ; mean age, 35 ± 6.0 years) individuals, underwent DTI of the brain and cervical spinal cord. We measured the absolute values of the major DTI indices — longitudinal ($\lambda_{//}$), transverse (λ_{\perp}), and mean (MD) diffusivities, and fractional anisotropy (FA) — in circular regions of interest at the bilateral precentral gyri (PrCG), posterior limbs of the internal capsule (PLIC), either side of the basis pontis, and bilateral lateral columns (LC) of the cervical spinal cord from the level of the second cervical vertebral body through the level of the intervertebral disc between the sixth and seventh cervical vertebrae. For each handedness group, we compared the absolute values of the major DTI indices between the 2 sides. We also compared the indices between groups. We used paired and 2-sample t-tests to determine significance at $P < 0.05$. We tested repeatability of the measurements in one subject and excluded scanner-related factors that might influence laterality of the results in a phantom.

Results : For both handedness groups, the left LC had significantly lower λ_{\perp} and MD and higher FA values than the right. The left PrCG and PLIC of the left handers had significantly lower λ_{\perp} and MD and higher FA values than the right. The left side of the basis pontis tended to have lower λ_{\perp} than the right. In the right handers, the left PrCG had significantly lower MD values than the right. There were tendencies toward lower λ_{\perp} and higher FA of the left PrCG, higher FA of the left PLIC, and lower λ_{\perp} and MD and higher FA of the left side of the basis pontis than the right. The left han-

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ders had lower λ_{\perp} and higher FA values of the left PrCG, higher λ_{\perp} and MD values of the right PLIC, higher $\lambda_{//}$ of the right side of the basis pontis, and lower MD and higher FA of the left LC than the right handers. Repeatability assessment revealed Cronbach's α values exceeding 0.80 for all areas, which suggested the repeatability of measurements in all areas.

Conclusions : The results of this preliminary study suggest a similar pattern of laterality in the absolute values of the major DTI indices of the CST between the brain and the cervical spinal cord, which contradicts the expectation of the reversed pattern of laterality between the brain and the spinal cord from decussation of the CST fibers at the medulla oblongata. The absolute values of the major DTI indices may vary with handedness. Knowledge of laterality of the major DTI indices and their variation with handedness is important in interpreting the indices in disease states. This is the first report that evaluates laterality of the major DTI indices of the CST from the PrCG to the cervical spinal cord and compares the indices between left and right handers.