Corticospinal tract abnormalities are associated with weakness in multiple sclerosis.

BACKGROUND AND PURPOSE: The association of MR imaging abnormalities with clinical disability in multiple sclerosis (MS) has been disappointing. This association might be improved by imaging specific functional systems in the central nervous system-for example, the motor system in a patient with weakness. Our aim was to assess the relationship between muscle strength in MS and corticospinal tract (CST) abnormalities detected with multimodality MR imaging of the brain.

MATERIALS AND METHODS: In 47 individuals with MS, diffusion tensor imaging (DTI) at 3T was used to reconstruct the intracranial CSTs. Tract profiles depicted the variation in T2 relaxation time, magnetization transfer ratio (MTR), and DTI-derived indices (fractional anisotropy and diffusivity) as a function of normalized position along the tract. Brain parenchymal fraction was calculated as a normalized measure of brain volume. Stepwise linear regression modeling was used to determine the MR imaging indices most closely related to ankle dorsiflexion and hip flexion strength assessed with quantitative dynamometry.

RESULTS: Individuals with MS were significantly weak: Average ankle strength fell 1.7 SDs below the age-, handedness-, and sex-corrected healthy mean. Brain parenchymal fraction was not associated with weakness. A parsimonious model that includes MTR in the brain stem and MS clinical subtype explained 30%-45% of the
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Variance in ankle and hip strength. The model was successfully applied to scans and strength data from the same individuals at an earlier time point.

**CONCLUSION:** MR imaging abnormalities specific to the motor tract are associated with clinical dysfunction related to that tract. The relevant abnormalities are found in the brainstem, distant from the periventricular inflammatory lesions that are common in MS. This suggests that neurodegeneration, rather than primary inflammation, at least partially explains the findings.

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