Diffusion tensor imaging of white matter after cranial radiation in children for medulloblastoma: Correlation with IQ¹

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Treatment of children with cranial-spinal radiation (CSR) for brain tumors is associated with adverse intellectual outcome and white matter damage. However, the correlation between IQ and measures of white matter integrity has received little attention. We examined apparent diffusion coefficient (ADC), fractional anisotropy (FA), and intelligence in pediatric patients treated with CSR for medulloblastoma relative to control subjects. ADC and FA measures were obtained for eight patients and eight control children and evaluated in multiple regions of interest in the cerebral hemispheres. Mean ADC and mean FA for each region were calculated, group differences were evaluated, and the relationship between these measures and intelligence were examined. In our study group, decreased IQ was associated with increased ADC and decreased FA ($P < 0.01$). Mean IQ for the CSR group was lower than that for the control group, but the difference was not significant when controlling for overall mean FA or ADC ($P > 0.10$). Overall mean FA was lower and ADC was higher in the CSR group relative to controls ($P < 0.01$). Specifically, FA was lower in the genu of the corpus callosum, the anterior and posterior limbs of the internal capsule, inferior frontal white matter, and high frontal white matter, and ADC was higher in all regions in patients relative to controls ($P < 0.01$). Compromised white matter integrity was observed for multiple regions within the cerebral hemispheres following CSR. A novel finding was that microscopic damage in normal-appearing white matter, as indexed by higher ADC and lower FA, was related to poor intellectual outcome relative to age-matched controls.

**Key Words:** cranial radiation • diffusion tensor imaging • intelligence • white matter

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