Advanced Imaging Reveals Damage To Cerebellar Connections

Conquer Chiari researchers have used an advanced MRI technique called Diffusion Tensor Imaging (DTI) to show structural damage to the white matter connections between the cerebellum and brainstem of Chiari patients. White matter and gray matter are the two main types of brain tissue, and they play different but complementary roles. Gray matter contains the cell bodies of neurons and is where most processing and decision-making happens. White matter, on the other hand, is the brain's communication wiring. It's made up of long nerve fibers (axons) coated in a fatty layer called myelin, which helps electrical signals travel quickly and efficiently. If you think of the brain like a city, gray matter is where the work gets done, while white matter is the network of highways that connects everything together so different regions can share information.

DTI is a special type of MRI scan that lets doctors "see" those white matter pathways. It works by tracking how water moves through the brain—water tends to flow along the length of nerve fibers rather than across them. By measuring that movement, DTI can map out the direction and integrity of these communication pathways, helping identify damage or changes that might not show up on a regular MRI.

For this study, the researchers scanned 18 adult, pre-surgical Chiari patients and the same number of healthy controls (matched by age, sex, and education) using high-resolution DTI. Previous work by the group using DTI had shown general differences in the white matter of certain brain regions of Chiari patients, but the high resolution of the imaging in this study allowed the researchers to zoom in specifically on the white matter bundles between the cerebellum and brainstem. These bundles are called peduncles and there are three of them, the superior, middle, and inferior. In addition to the imaging, the participants answered surveys on Chiari symptoms, pain, and disability and underwent two cognitive performance tasks.

When they compared the images of the Chiari patients to the controls, the researchers found indications of significant abnormalities in the cerebellum, middle peduncle, inferior peduncle, and a specific region of the brainstem. In addition, the magnitude of the white matter abnormality in the peduncles correlated with patient reported pain and disability levels and their performance on the cognitive tasks. Specifically, the worse the 'damage' was to the white matter tracts, the higher the self-reported pain and disability were and the worse the performance on the cognitive tasks was.

Historically, it has been very difficult to link any imaging metrics with specific symptoms, but this study clearly shows how Chiari can affect a specific part of the brain which in turn makes specific symptoms worse. The researchers stress the precise nature of the damage to the white matter can not be determined just from the DTI images and needs to be investigated further.

Source: Houston JR, Rogers TD, Kirkpatrick TM, et al. High-Resolution Diffusion Tensor Imaging of the Cerebellum and Brainstem in Chiari Malformation Type I: Association with Function and Pain. Cerebellum. 2026;25(2):45. Published 2026 Apr 2. doi:10.1007/s12311-026-01991-7

Conquer Chiari's research updates highlight and summarize interesting publications from the medical literature while providing background and context. The summaries do contain some medical terminology and assume a general

understanding of Chiari. Introductory information and many more research articles can be found in the Conquer Chiari Library.

Conquer Chiari is a 501(c)(3) public charity dedicated to improving the experiences and outcomes of Chiari patients through education, awareness and research.