

Imaging shows structural changes in mild traumatic brain injury

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Researchers report that diffusion tensor imaging can identify structural changes in the white matter of the brain that correlates to cognitive deficits even in patients with mild traumatic brain injury. The study is published in the October issue of the journal *Brain*.

"We studied patients with all severities of traumatic brain injury -- mild to severe -- and found that abnormalities in white matter existed on the spectrum," said Dr. Marilyn Kraus, associate professor of psychiatry and neurology at the University of Illinois at Chicago College of Medicine and lead author of the study. "Even in patients with mild TBI -- those identified as having minimal or no loss of consciousness -- there were structural deficits."

Diffusion tensor imaging uses magnetic resonance imaging technology to examine the integrity of white matter that is especially vulnerable to traumatic brain injury. This imaging modality allows researchers to quantify and qualify structural changes in white matter, particularly in chronic TBI patients.

Thirty-seven TBI patients (20 mild and 17 moderate to severe) and 18 healthy volunteers underwent diffusion tensor imaging and neuropsychological testing to evaluate memory, attention, and executive function. All subjects were at least six months post-injury, and the majority were high-functioning people who were employed or in school at the time of evaluation.

The researchers found that structural changes in the white matter correlate to observable cognitive deficits related to thinking, memory and attention. Patients with more severe injuries had greater white matter abnormalities, representing a permanent change in the brain.

"We know that discreet brain areas are important for specific types of functioning, such as thinking, memory, cognition and motor skills," said Kraus. "But what's also very important is that the white matter serves as the connection between these significant areas of the brain."

In some ways, the brain is similar to a computer, said Deborah Little, director of MRI research in the department of neurology and rehabilitation medicine at UIC and co-author of the study. "You have the CPU and the memory, but they are worthless unless they are connected to each other. The white matter of the brain has the same function as the cables of the computer."

When white matter is damaged, areas of the brain may appear healthy but they are actually "unplugged" and cannot function.

"This study validates that getting smacked in the head is not a good thing, despite the fact that some clinicians still believe a patient can recover fully after a concussion," said Little.

A significant percentage of patients in the study had no self-reported cognitive deficits, yet they did have permanent damage that was apparent to researchers.

TBI has been a long-standing public health problem and a significant source of disability, but the recent increase in veterans returning from war and athletes who have experienced multiple concussions has generated greater public attention to TBI.

"Very often in TBI there are forces being applied to the brain that stress the tracts of white matter -- pulling them, yanking them -- and the white matter becomes damaged," Kraus said.

Patients who have a contusion, or bruising of the brain, can also suffer from subtle and diffuse damage to the white matter. The researchers believe that not only the focal lesion but the damage to the white matter is very important.

In the study, the researchers were also able to determine axonal damage (tearing of the axons that allow one neuron to communicate with another) in white matter versus abnormalities in the myelin (the protective sheath that, if damaged, can disrupt signals between the brain and other parts of the body.) If an axon is severed, the damage generally cannot be repaired.

"We found that the milder injuries had less myelin damage, and the more severe injuries had both axonal and myelin damage," said Kraus.

"This research helps us to understand how early on, particularly in milder injuries, there may be some ability for myelin to repair," Little said.

"When athletes, for example, are sustaining head injuries over and over -- without being told to sit out -- it may have a huge impact on their recovery. This could affect decisions clinicians make about when someone with a mild injury should return to the battlefield or playing field."

Source: University of Illinois at Chicago

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