Mild Brain Injury Leaves Lasting Scar

A long-term study reveals how the brain responds to a mild impact, and could guide future intervention

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At Sunday’s World Cup Final, German soccer player Christoph Kramer knocked his head against an Argentine opponent’s shoulder with such force that Kramer spun to the ground and fell face down. The blow was one of many at this year’s competition, which further fueled a rising debate about concussion, the damages of fútbol versus football and the best response to head injuries.

Part of the challenge in understanding these injuries is how varied they can be. Although much attention has gone to severe forms of traumatic brain injury (TBI) such as concussion-induced coma, far more common are the milder impacts that come from falling off a bicycle, a low-speed car accident or taking a weak punch in a fistfight. These injuries may not entail losing consciousness but rather just a brief lack in responsiveness before recovering.

Now a group of researchers in the U.K. at Newcastle University, the University of Aberdeen and the University of Edinburgh have released results of a longer-term investigation of individuals who have suffered such first-time, minor head injuries. Their findings hint that the contusions leave a lasting trace in the brain.

The team, led by Newcastle imaging physicist Andrew Blamire, scanned the brains of 53 individuals with mild or moderate TBI within two weeks of the injury. They mapped the tracts of fibers connecting brain regions in the patients as well as in 33 healthy subjects. Blamire and colleagues discovered distinct differences between the two groups. “Even in patients with mild injury, you can detect a marker of that injury,” Blamire says. That marker may distinguish mild injuries from more forceful impacts. In cases of severe TBI, brain tissue known as white matter that envelops the tracts deteriorates, effectively mashed by the impact. But Blamire identified an
opposite trend in the mild and moderate cases. For these patients, the white matter fibers became even more structured. He and his colleagues hypothesize that this organization may be caused by an inflammatory response in which the brain’s glial cells leap into action, perhaps repairing damage or blocking further injury.

Along with scanning, the team also tested thinking and memory in their subjects. Compared with healthy subjects injured patients had lower scores on multiple tests in the two-week interval after their injuries, including an average 25 percent drop on a verbal fluency test, in which an individual thinks of as many words as possible that start with a given letter. The brain changes identified in imaging correlated strongly to this test, suggesting some overlap between the affected area’s function and the test’s cognitive target.

To take their findings a step further Blamire and colleagues repeated their procedure with 23 of their head injury patients one year later. As they report in Neurology on July 16, the variability between patients was high but on average the test scores had returned to the levels of healthy individuals. The brain changes, meanwhile, remained. This suggests that once the brain has sustained damage, the scars persist.

Blamire observes that lingering signs of damage could help certain patients identify a source of their earlier mental troubles—such as memory problems—in the absence of other symptoms. For people with ongoing cognitive difficulties, it could even be useful in legal scenarios, providing evidence of head trauma even after months have past.

Neuroradiologist Michael Lipton at Albert Einstein College of Medicine, who did not participate in this research, explains that the study’s results echo findings from his and other research groups. He notes, however, that the one-year follow-up is unique and agrees that the imaging findings could reflect an inflammatory response. Lipton’s group has further hypothesized that the brain changes may even predict better recovery—in essence, that the brain has rewired itself to compensate for the damage. Only further research will reveal if this is the case, however.

Over the longer term, the findings could contribute to a growing understanding of how the brain responds to collisions and concussions. “Work like this is really essential to understanding how we can intervene,” Lipton says.

Blamire agrees, explaining that eventually brain imaging could help doctors distinguish between which patients will require counseling and treatment and which will make a full recovery on their own.