Researchers develop more reliable concussion tests

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(Medical Xpress)—It could happen during a nasty spill on the ski slopes, a hard tackle at football practice, or even a car accident. ASU nursing student Sarah Hollowell sustained her concussion playing intramural softball, when she took a hit from a ball right between the eyes.

"I had a bad headache, short-term memory loss, late reactions, was unbalanced and sometimes I would confuse words," says Hollowell.

After toughing out her symptoms for a week, Hollowell decided it was time to see a sports medicine doctor. There, she completed tests such as remembering a few words and repeating them, and walking back and forth in a straight line. It didn't take long for her doctor to diagnose a severe concussion.

Since there is no treatment for concussions, doctors rely on the "wait-and-see" approach. Hollowell was told not to drive or exercise as long as she had symptoms. She also took weekly online assessments to gauge her memory and reaction time.

After about a month, Hollowell's test scores had improved and she felt better. By current medical standards, this constitutes a full recovery. But the absence of symptoms can be misleading when it comes to concussions, explains David Dodick, a neurologist at the Mayo Clinic.

"We know from highly specialized imaging of the brain that there is a lag or a delay from the time people report their symptoms are gone and the time the brain has actually metabolically recovered from a concussion," Dodick says.

Concussion patients can experience a diverse array of symptoms. Some, like Hollowell, have bad headaches and short-term memory loss. Others say they feel "fuzzy" and irritable, or have trouble sleeping. These vague symptoms don't always point to an obvious culprit, which can result in undiagnosed concussions.

"There is no objective, physiological marker for concussion that's reliable, cost-effective and efficient," like the blood test used to diagnose diabetes, Dodick says. Neither is there a simple, reliable test to

determine when the brain has recovered. This can be particularly dangerous for people at high risk for experiencing multiple concussions, like athletes.

"When concussions occur repeatedly, over time they have a cumulative effect, which can be quite devastating," says Julie Liss, a professor in the Department of Speech and Hearing Science, part of ASU's College of Liberal Arts and Sciences.

Dodick has seen this disturbing effect firsthand.

"I just saw one 23-year-old patient today who had experienced three concussions playing basketball, recovered nicely from all of them, but the fourth concussion she had two years ago has rendered her unable to work the past two years," he says.

Cases like this have spurred recent legislation requiring medical clearance for student athletes to return to play after they've suffered a concussion. That means health care providers could face legal liability if their patients get back in the game too soon.

"I don't want to be responsible for returning your child to play competitive sports prematurely, because the next concussion they get could either kill them or permanently disable them," Dodick says. "School districts are nervous now, athletic trainers are nervous, coaches are nervous, physicians are nervous, and well they should be."

Concussions are a contentious topic on the professional level, as well. Right now in the United States, more than 3,500 retired National Football League players are suffering from the effects of multiple cumulative concussions.

Together, they are filing a class-action lawsuit against the NFL.

Liss and Dodick want to find a solution to ensure the safety of concussion patients. Combining her expertise in the speech and hearing sciences with his medical background, the researchers have teamed up to develop a sensitive neurological test for diagnosing concussions and determining when a patient's brain has truly healed. They are currently testing their method on patients from the concussion clinic at Mayo.

Liss and Dodick fit a patient's scalp with an array of electroencephalography (EEG) electrodes. The electrodes pick up on very low-level electrical activity the brain gives off as neurons are firing. With the electrodes secured, a patient listens to statements spoken by a computer and must determine whether those statements are true or false. For example, the computer might say, "apples are fruits."

In some trials, the computerized speech is clear and easy to understand. But on other trials the speech is distorted, making it more difficult or even impossible to understand. This type of speech-recognition task requires the integration of multiple brain functions that occur in different regions of the brain.

"Listeners have to concentrate really hard and pull together all these pieces of information so they can understand what's being said. It requires a lot of brain activity," Liss explains.

Tools doctors use routinely, like a CAT scan or MRI, can't pick up on subtle disruptions in metabolic or structural brain integrity. That's why Dodick and Liss chose the more sensitive and precise EEG electrodes, which feed into a computer program and provide a kind of map of the brain.

Patients will be tested within the first couple of weeks of their concussions, then again when they report feeling better, which is referred to as clinical recovery. About six weeks after that, Liss and

Dodick will use another form of testing to verify that the patient's brain has actually healed. Then they will run the speech test again to see if the new results correspond with the patient's brain recovery. If there is a meaningful difference, Liss and Dodick will know their test works as it should.

Over the course of a year, the researchers will collect data from 20 to 30 subjects and compare those results to non-concussed individuals. If the speech recognition test proves to be effective, it will provide doctors with a simple, objective and cost-effective tool for diagnosing concussions and declaring patients healed.

"Identifying biomarkers of recovery will give us a better idea of when intervention should happen and possibly even the nature of intervention," Liss says. "Understanding concussions allows us to potentially ward off a whole epidemic of cognitive and emotional problems in, for example, kids who play soccer and those kinds of things."

Provided by Arizona State University

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