Improved Assessment, Diagnosis and Management of Brain Injuries

By David Stern —

Recent events have served as sad yet significant reminders of the seriousness of head injuries or traumatic brain injuries (TBIs).

As the football season ramped up, two tragic incidents took place in October alone. Christion Abercrombie, a linebacker for Tennessee State University, was rushed to the hospital and underwent life-saving emergency brain surgery after suffering a severe head injury. In Georgia, Pike County High School linebacker Dylan Thomas also sustained a severe head injury and was rushed to the hospital for surgery, but he tragically passed away soon afterwards.

The frequency and health risks of traumatic brain injuries, which include sports-related concussions, are increasingly being discussed and studied. As indicated in Table 1, there are close to 4 million sports-related concussions each year, with an additional 50% not being reported. The risks of not properly diagnosing and treating a brain injury are severe.

A concussion temporarily disrupts mental function and if not treated, it can have debilitating long-term consequences. People with an untreated concussion may suffer from headaches and fatigue—sometimes for years. They are not as sharp as they should be mentally, and they have problems focusing.

Additionally, not promptly diagnosing a concussion and allowing an athlete to return to play even further increases their chance of harm. Right after a concussion, people are at much higher risk for further injury since they are not able to react or think quickly. Also, the brain is very sensitive after an injury. Reinjuring the brain while concussed can lead to very serious health problems—far more serious than one injury. Researchers have found that individuals who have suffered multiple concussions during their lifetime increase their chances of depression, post-traumatic stress syndrome (PTSD) and suicide by 1.5x to 3x.

Another very harmful immediate possible outcome of a head injury is a brain hemorrhage or brain bleed, which is a type of stroke. This can be a life-threatening situation. The presence of blood in the brain increases pressure on nearby brain tissue, and that reduces vital blood flow and can damage brain cells. Typically, a trip to the hospital for a CT Scan, a special X-ray test, is necessary to detect brain bleeding. Having the ability to quickly identify a brain injury and provide treatment can save lives. Yet, this can be challenging, as many tests are subjective and are generally focused on how the player feels, their ability to answer simple questions, repeat numbers and words in proper sequence and maintain balance. These types of tests cannot reliably identify brain injuries and the severity if present. Fortunately, there is a new device that is changing the way medical professionals evaluate and treat concussions.

Electrical signals course through the brain and when someone has a brain injury these electrical signals change and are different from those that would be present in an uninjured brain. The brain's electrical signals can be measured and tracked by an electroencephalogram (EEG). A unique, FDA-cleared medical device named BrainScope® One uses the EEG signal to determine whether the patient likely has a brain bleed. The BrainScope One device has been thoroughly tested and has demonstrated that it can identify patients with as little as 1cc of brain blood with 99% success rate. This assessment function is referred to as a Structural Injury Classifier.

Dr. Manu Mehdiratta, a neurologist who specializes in concussion and works at the Trillium Health Centre in Mississauga, Canada explains, "The Structural Injury Classifier helps determine the need for a CT scan or advanced neuroimaging. Basically, this will tell you with a high level of certainty whether or not there is likely a bleed in the brain, which is very useful."

Dr. Leigh Vinocur, Emergency Room Physician, and Chief Medical Director at MedStar PromptCare Clinics says, "I was excited about Brain-

Scope when I first learned about it because it's 99 percent sensitive for picking up a structural injury and a bleed, even down to 1 cc of blood, which is such a small amount that sometimes doesn't even show up on a CT scan."

In addition to being able to identify patients who may have a brain bleed, the BrainScope One uses the same EEG signal to determine the presence and severity of a concussion. The device automatically and quickly compares the patient's EEG to a large database of EEGs from healthy patients of the same age to determine their level of brain function impairment. This assessment function is appropriately named the Brain Function Index.

"Along with determining if there's a structural injury, the BrainScope also uses EEG to determine if there is functional brain impairment," Vinocur continues. "It uses big data from years and years of EEGs of normal brain function, so when you use it with an athlete it compares their EEG waves with those of thousands of people who never had a head injury. Then it can show you if the athlete's Brain Function Index is lower than what it should be."

In the words of Dr. Mehdiratta, "The Brain Function Index determines the degree of brain injury that's occurred and guides clinical management and return to play decisions."

To further assess a patient's level of brain impairment, BrainScope's device also has two rapid neurocognitive (brain processing capability) tests. On the device, the patient takes these tests which measure reaction time, decision making, attention span, and short-term memory, and once again their results are compared to healthy patients of the same age to assess their brain's function. In addition, an extensive digital library of standard concussion assessment tools is available on the device.

The BrainScope One's ability to quickly provide this level of objective assessment in a sideline setting has quickly drawn the attention of Professional and University sports teams. For Stacey Czaplewski, MAEd, LAT, ATC, Head Athletic Trainer at Winona State University,

- As many as 3.8 million Sports-Related Concussions (SRCs) occur each year in the US
- Approximately, 10,560 NCAA athlete concussions are reported each year
- 50% of all SRCs may go unreported
- In sports in which both sexes participate, the distribution of concussions is 49% for men and 51% for women.

Epidemiology of Sports-Related Concussion in NCAA Athletes

Sport	% of Total
Men's football	36%
Men's ice hockey	13%
Women's soccer	8%
Women's basketball	7%
Men's wrestling	5%
Women's ice hockey	5%
Men's basketball	5%
Women's volleyball	3%
Men's soccer	3%
Women's lacrosse	3%
Women's softball	3%
Men's lacrosse	3%
Other	4%
TOTAL	**100%**

Harmon KG, et al. Br J Sports Med 2013;47

Zuckerman SL, et al. The American Journal of Sports Medicine, Vol. 43, No. 11

Table 1

the BrainScope One also helps athletes feel confident that they are receiving the best care possible. "We've been using the BrainScope for close to a year and what has been really positive about it is our student-athletes realize that it's another layer of protection for them, and that it helps us treat their concussion and see when a referral is absolutely necessary," she says. "When we pull it out it reassures them that we're trying to test everything possible."

Czaplewski also enjoys how quick and easy it is to use. "You get instantaneous feedback as soon as you download the data from the electrodes in the brainwaves, and the whole process only takes a few minutes," she explains. "It's also very simple to determine whether a referral is needed or not. The results are very easy to read and can help you decide what the next step should be."

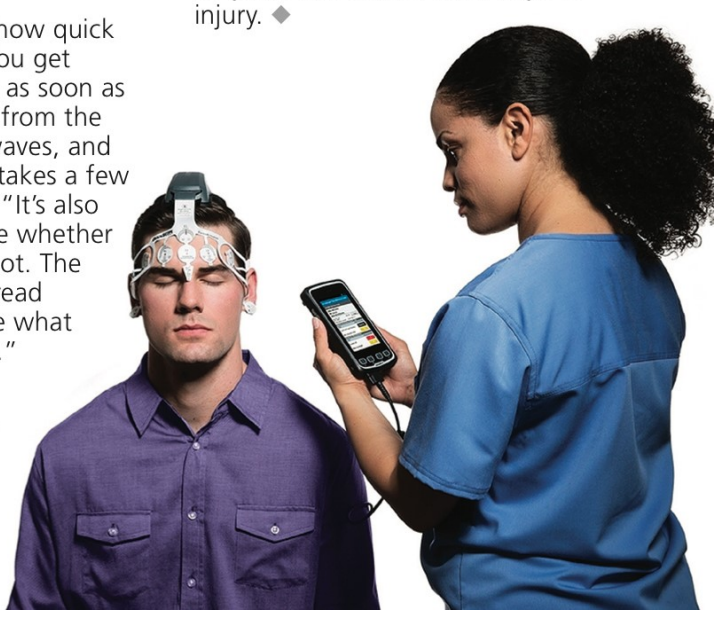
Dr. Mehdiratta shared, "For example, I recently treated a quarterback who had two concussions in a short period of time and his Brain Function Index was very low. As a result, we asked him not to play until we're able see how he does with rehabilitation."

Having this objective data to show athletes can be crucial to making sure they understand the significance of the injury. "It's sometimes hard to get athletes to take their injury seriously," says Vinocur. "They don't want to miss out, they want to play in the big games, so they try to shake it off and minimize things. But now we have some objective data and we can show them how their Brain Function Index compares to thousands of people who have never had a concussion. It certainly makes it easier for the physician, athletic trainer, parent, and coach to get the athlete to understand it's a significant injury and they need to rest and take time away from their sport."

Not only is the BrainScope One making concussion assessment easier and more objective, it is also making it more efficient. CT scans and trips to the emergency room can be costly and unnecessary, yet injured athletes often end up there anyway. That no longer has to be the case.

"Though it doesn't replace CT scans, I think the BrainScope is going to help reduce unnecessary CT scans," says Mehdiratta. "In my practice, I've also seen that the BrainScope can reduce the cost of care and improve patient satisfaction overall."

BrainScope One is currently FDA cleared for assessing people 18-85 years old, within three days of injury. ◆



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