Window Into The Brain

New advances in sports concussion management: Functional Brain Imaging

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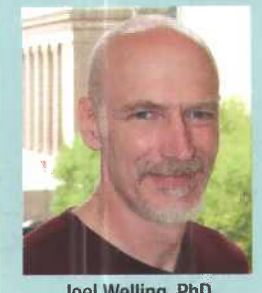
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The past decade has witnessed an explosion in research aimed at understanding recovery from sports-related mild traumatic brain injury (concussion). The dramatic rise in research appears to be the outgrowth of an increased awareness of the dangers of concussion in conjunction with the considerable advances in the neurosciences. Research in this area has resulted in radical changes in the clinical management of sports concussion. Only 10 years ago, there were more than 20 separate return-to-play guidelines, and none of these guidelines had undergone validation through research. This led to considerable confusion among sports medicine practitioners. More recently, return-to-play directives have been increasingly based on new advances in research.

The orthopedic surgeon plays a key role in the clinical management of concussion in athletes. The orthopedist is often the first health professional to evaluate the athlete after concussion, and they frequently have the responsibility of making complex and difficult return-to-play decisions. Therefore, it is crucial that they have a current grasp of new and evolving research.

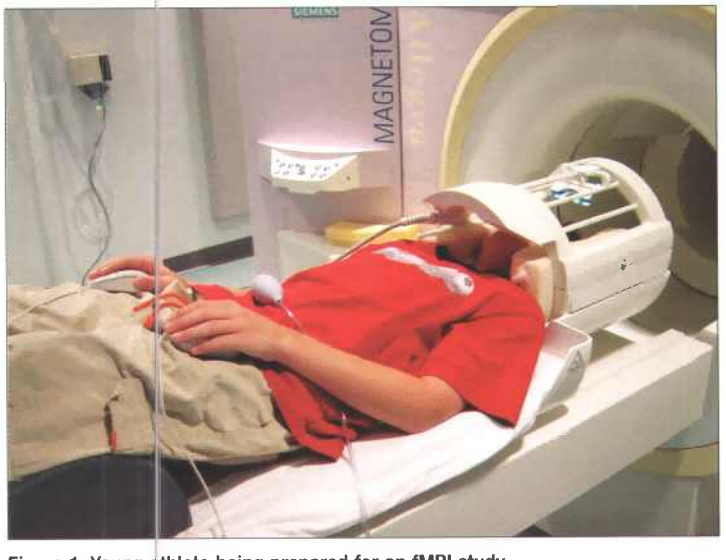

Figure 1. Young athlete being prepared for an fMRI study.

New Frontiers in Concussion Management

Until quite recently, little was known about changes in brain function following concussion, and our understanding was based solely on animal research. For example, in the late 1990s, David Hovda, PhD, director of the University of California, Los Angeles, Brain Injury Research Center, and his associates demonstrated a "metabolic mismatch" characterized by increased energy demand within the brain, accompanied by a decrease in cerebral blood flow, presumably secondary to the accumulation of endothelial Ca++, leading to widespread cerebral neurovascular constriction. In this animal model, concussion was found to last up to 2 weeks post injury. This mismatch between energy demand and supply within the brain has since been postulated to leave the brain more vulnerable to a second injury, possibly helping to explain the rare but often fatal "second impact syndrome" seen in children and young adults. This metabolic dysfunction was also thought to provide the basis for the less severe, though occasionally incapacitating, postconcussion syndrome (eg, postconcussion symptoms that persist months and even years after injury).

Although extremely important in advancing our base of knowledge, this initial animal research in the 1990s did not provide information that was directly applicable to humans.

Understanding the metabolic process of concussion in humans is important for several reasons:

First, an understanding of how the brain recovers following concussion could eventually lead to the development of clinical return-to-play guidelines based on neurological recovery, rather than on purely clinical sympto-