

**Sports Medicine Bulletin Commentary – Active Voice:  
The Need for Clinical Assessment of Perception-Action Coupling Capabilities**

Despite major advances in sport injury management over the past several decades, repetitive injury occurrence and chronic dysfunction are still extremely common among competitive athletes of all ages. Multiple recent reports have documented a substantial increase in musculoskeletal injury rate after concussion, which has raised questions about the possible existence of a subtle and persistent neurological impairment that is not identified by standard clinical tests. A rapidly growing body of evidence strongly supports the importance of brain network connectivity for integration of sensory inputs (i.e. perception) and generation of effective neuromuscular responses (i.e. action) to rapidly changing circumstances in a competitive sport environment. Neuroplasticity appears to play a central role in both positive and negative alterations in connectivity patterns among spatially distant areas of the brain that contribute to maintenance of dynamic joint stability. For example, advanced neuroimaging and electrophysiological methods have yielded evidence supporting an increase in reliance on visual input for motor programming after loss of proprioceptive input from disruption of mechanoreceptors within the anterior cruciate ligament, which may be an important factor contributing to the high incidence of subsequent knee injury and osteoarthritis after the ligament has been surgically reconstructed.

Historically, musculoskeletal injury management has focused on reduction of pain and swelling to facilitate progression to exercises for restoration of normal joint range of motion and muscle strength. Currently, clinical management of concussion almost exclusively relies on resolution of subjective symptoms for progression in physical

activity intensity and return to full sport participation. A persisting alteration of brain network connectivity may result from either musculoskeletal injury or concussion, despite the appearance of normal functional capabilities. Compensatory mechanisms may permit an athlete to exhibit acceptable performance on clinical tests that do not impose a sufficiently complex demand to reveal a deficiency in neural processes related to perception-action coupling. Although abnormalities in both structural and functional connectivity among brain regions may be identified through advanced diagnostic methods, such testing is cost-prohibitive for routine utilization in sport injury management. Because concussion, repetitive subconcussive head blows, or musculoskeletal injury can initiate a cycle of progressive worsening in functional status that may ultimately result in mental or physical disability, there is a critical need for inexpensive and time-efficient clinical tests that will identify suboptimal integration of neural and mechanical processes (i.e. neuromechanical function) prior to an athlete's exposure to the intense demands of a competitive sport environment.

Our recent work has been focused on development of clinical testing procedures for assessment of perception in the peripheral visual field, resolution of cognitive conflict, visuomotor reaction time, and visuospatial orientation, which we believe to be critical elements of integrated neural processes that mediate sport injury risk. More evidence will be needed to confirm that perception-action coupling deficiencies contribute to injury occurrence, and to guide development of targeted training activities for improvement in neuromechanical performance capabilities. An expanding volume of relevant research evidence that is consistent with our findings suggests that an important advance in sport injury prevention could be on the horizon.

## Links to publicly accessible full-text publications relevant to the topic:

### [Neuroimaging of sport concussion: persistent alterations in brain structure and function at medical clearance](#)

Nathan W. Churchill, Michael G. Hutchison, Doug Richards, General Leung, Simon J. Graham, Tom A. Schweizer

Sci Rep. 2017; 7: 8297. Published online 2017 Aug 24. doi: 10.1038/s41598-017-07742-3

PMCID: PMC5571165

### [Neuroscience Application to Noncontact Anterior Cruciate Ligament Injury Prevention](#)

Dustin R. Grooms, James A. Onate

Sports Health. 2016 Mar; 8(2): 149–152. Published online 2015 Nov 25. doi: 10.1177/1941738115619164

PMCID: PMC4789930

### [Concussion May Increase the Risk of Subsequent Lower Extremity Musculoskeletal Injury in Collegiate Athletes](#)

Daniel Herman, Debi Jones, Ashley Harrison, Michael Moser, Susan Tillman, Kevin Farmer, Anthony Pass, Jay Clugston, Jorge Hernandez, Terese Chmielewski

Sports Med. Author manuscript; available in PMC 2018 May 1.

Published in final edited form as: Sports Med. 2017 May; 47(5): 1003–1010. doi: 10.1007/s40279-016-0607-9

PMCID: PMC5318296

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