

EDITORIALS

Concussion and sport

Players with symptoms and signs of concussion should not continue or return to play until these resolve

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The diagnosis of concussion and some aspects of its management remain contentious, particularly in the context of continuing to play sport and return to play after concussion. The latest Zurich consensus statement on concussion in sport addresses some of these problems and variations in the definition, clinical assessment, and management of concussion.¹

Definitions of concussion vary and include mechanistic, pathophysiological, and clinical features.¹ These complex definitions are necessary for research but have little practical use for most clinicians, including those “pitch or track side.” A more pragmatic definition of a “traumatically induced, usually transient, disturbance of brain function that involves complex pathophysiological processes” is a diagnosis made in retrospect and provides little help with early clinical decision making.²

Some authors use the term concussion synonymously with mild traumatic brain injury (head trauma and Glasgow coma score (GCS) 14 or 15), whereas others consider concussion a distinct pathological phenomenon that lacks any structural abnormality on traditional neuroimaging. In reality, there is likely to be a continuum of brain injury from the mild end of the spectrum, of which concussion is a subset, to more severe injuries. Rotational forces leading to transient distortion of intracerebral tissues seem an important element of the injury mechanism, which partly explains why concussion may be seen with rotational injuries even where there is no impact to the head. Although advanced magnetic resonance imaging can now identify abnormalities in concussed patients,³ correlation with clinical features and outcomes is unclear.

Several tools are available for the sideline assessment of sports concussion, each with its own sensitivity and specificity characteristics.² Equally important, in a sporting context, is that the time taken to administer these tests on the field of play varies from less than one to 10 minutes, rendering many impractical for on-field use. Many of these assessment tools share in common test items for short term memory formation and retention (temporal lobe related), cognitive flexibility (frontal lobe related), and coordination. On field the Maddocks’

questions and the clinical experience of the healthcare professional probably remain the best initial assessments for suspected concussion.⁴

The sport concussion assessment tool version 3 (SCAT3)⁵ and its paediatric version (CHILD-SCAT3) adopted for the Zurich consensus statement incorporates the Maddocks’ questions as part of a more extensive questionnaire.⁶ SCAT3 assesses GCS, orientation, patient reported concussive symptoms (such as headaches, dizziness, visual disturbance, slowed thought processes), cognition, a rudimentary neck examination, balance, and coordination. Neurocognitive pitchside testing, whether by paper or automated test protocols (such as *CogSport* or *Impact*), has been shown to be more valid, effective, and reliable than imaging for diagnosing and managing most concussed athletes.



The game must go on, but should he?

[Image: CAMERON SPENCER/GETTY IMAGES]

Further assessment is needed if severe injury is suspected (for example, GCS <14 immediately or GCS <15 by two hours after injury, deteriorating mental state, potential spinal injury, worsening neurological signs); this is covered in detail, for United Kingdom practice, by National Institute of Health and Care Excellence (NICE) head injury guidelines.⁷ Although duration of loss of consciousness appears in several concussion scales, it does not directly correlate with neurocognitive deficits and cannot determine the severity of concussion.⁸

Having established a diagnosis of concussion, the clinician must decide whether to remove the player from the field, what further monitoring to instigate and whether to refer the player to an emergency department. All guidelines recommend that people with symptoms and signs of concussion should not continue or

return to play until these resolve.¹⁻⁹ Early return to play with ongoing symptoms and slowed protective reactions risks further injury and exacerbation of concussive symptoms. Whether a “second impact” before complete recovery from the first causes a more severe cumulative injury is yet to be proved and warrants further study.

Return to play during the same game is possible in sports with “rolling substitutions”—for example, Australian rules and rugby football. Substitution can give the concussed player time to recover before pitchside cognitive and functional testing shows fitness to return to the game. Although this “rapid rehab” keeps with the “spirit” of rest until symptoms recover and facilitates a graduated return to activity, whether it increases susceptibility to injury is worth studying.

The live broadcast of elite sport shows the cognitive and physical disorientation immediately after a concussive injury.¹⁰ The player or team staff may feel pressured to continue playing, despite symptoms, with the continuing deficits all too obvious. Published advice is not infrequently “flouted” in elite sport, despite ratification by the Fédération Internationale de Football Associations, the International Rugby Board, the International Ice Hockey Federation, the International Olympic Committee, and the Fédération Equestre Internationale. This can make it difficult for medical personnel to convince amateur athletes to comply with their advice.

In essence, the management of concussion requires early recognition of the condition, rest until cerebral recovery, and then a graduated return to cognitive and physical activity. Formalised protocols exist,^{1, 2} but a personalised approach is needed, based on the player, the level of performance, and the rules and practicalities of the sport. The International Rugby Board’s head injury guidelines, for example, are practical clinical pathways developed for clinicians working in Rugby Union.¹¹

If symptoms such as excessive tiredness or headache return on increasing exertion, then extension of the period of rest and reduction in level of activity are recommended. Players, coaches, and family members need to know that important symptoms can be present even when the patient seems “normal.”

We recommend specialist services are available to refer patients with symptoms lasting more than three weeks for clinical assessment and, if needed, formal neuropsychological input. Consider assessment for post-concussive migraine, vestibular disturbance, cervicogenic symptoms, and retinal injuries. Chronic traumatic encephalopathy is likely to be a distinct degenerative tauopathy in susceptible patients, rather than an inevitable consequence of repeated minor head injuries.¹²

The long term prognosis for concussion is generally good with most patients recovering completely given time. The post-concussion syndrome of persistent symptoms can last weeks or months but even this is self limiting in most patients. Headway (www.headway.org.uk), the brain injury association, provides excellent practical advice for recovery after brain injury.

The problems in accurately defining concussion and the lack of specific treatments make it difficult to treat these patients: high quality evidence is limited and most recommendations are based on consensus or extrapolation from animal studies. Given the frequency of these presentations both in sport and to clinical services, further robust studies are needed. The key points are to exclude severe intracranial injury, monitor recovery with appropriate return to play, and ensure that patients (or parents and coaches) are counselled about the need for gradual resumption of activity, with specialist assessment of persisting symptoms.

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1. McCrory P, Meeuwisse WH, Aubry M, Cantu B, Dvorak J, Echemendia RJ, et al. Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012. *Br J Sports Med* 2013;47:250-8.
2. Harmon KG, Drezner JA, Gammons M, Guskiewicz KM, Halstead M, Herring SA, et al. American Medical Society for Sports Medicine position statement: concussion in sport. *Br J Sports Med* 2013;47:15-26.
3. Pitto A, Chen JK, Johnston KM. Contributions of functional magnetic resonance imaging (fMRI) to sport concussion evaluation. *NeuroRehabilitation* 2007;22:217-27.
4. Maddocks DL, Dicker GD, Saling MM. The assessment of orientation following concussion in athletes. *Clin J Sport Med* 1995;5:32-5.
5. SCAT3. *Br J Sports Med* 2013;47:259.
6. Child SCAT3. *Br J Sports Med* 2013;47:263.
7. National Institute of Health and Clinical Excellence. Head injury. CG56. 2007. www.nice.org.uk/nicemedia/live/11836/36259/36259.pdf.
8. Lovell MR, Iverson GL, Collins MW, McKeag D, Maroon JC. Does loss of consciousness predict neuropsychological decrements after concussion? *Clin J Sport Med* 1999;9:193-8.
9. West TA, Marion DW. Current recommendations for the diagnosis and treatment of concussion in sport: a comparison of three new guidelines. *J Neurotrauma* 2013.
10. George Smith head clanger. You Tube 2013. www.youtube.com/watch?v=AjM738x4rSQ.
11. International Rugby Board. IRB concussion guidelines. 2011. www.irbplayerwelfare.com/?documentid=3.
12. McKee AC, Cantu RC, Nowinski CJ, Hedley-Whyte ET, Gavett BE, Budson AE, et al. Chronic traumatic encephalopathy in athletes: progressive tauopathy after repetitive head injury. *J Neuropathol Exp Neurol* 2009;68:709-35.

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