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## Update on concussion: Here's what the experts say

The latest consensus statement—and handy assessment tool—from the sports medicine community will help you manage this all-too-common injury.

### PRACTICE RECOMMENDATIONS

› Don't allow an athlete who has symptoms at rest or with exertion to return to play. **C**

› Consider neuropsychological testing in conjunction with continued clinical assessment for objective measurements to assist in managing concussion. **B**

› Recommend up-to-date protective equipment for athletes. Recent improvements, especially in football, have been shown to help decrease the incidence of concussion. **A**

#### Strength of recommendation (SOR)

- A** Good-quality patient-oriented evidence
- B** Inconsistent or limited-quality patient-oriented evidence
- C** Consensus, usual practice, opinion, disease-oriented evidence, case series

**CASE** ▶ Jeff, a 15-year-old high school ice hockey player, asks you to write a note for his coach, stating that he has recovered from his concussion and can return to play. He says that 2 days ago he collided with another player and was knocked unconscious for roughly 10 seconds. He had a headache for the rest of that evening, and complained that the light was hurting his eyes. Now he has no symptoms at rest, but activity gives him a slight headache.

How would you evaluate this patient to determine whether he can return to play?

Concussions like Jeff's are common in sports-related activities, and family physicians are frequently asked to manage the condition and decide when the injured athlete can safely return to play.

Concussions occur in both helmeted and nonhelmeted sports, and are most common in collision sports.<sup>1</sup> A 2007 estimate from the Centers for Disease Control and Prevention (CDC) suggests that 1.1 million people are seen in emergency departments in the United States each year for concussion-related injuries, while nearly another 235,000 people are hospitalized.<sup>2</sup> As astounding as these numbers are, many experts believe they underestimate the true incidence of concussion, given the propensity for athletes not to report symptoms for fear of being held out of sporting events.<sup>3,4</sup>

Further complicating matters: There has historically been a lack of agreement over what, exactly, constitutes a concussion and how to manage these injuries.

### Refining concussion terminology

Concussion has often been referred to as mild traumatic brain injury (MTBI), although more recent expert opinion suggests the terms refer to different injury constructs and should not be used interchangeably.<sup>5</sup> Over the years there has been little agreement on the definition, grading, and treatment of these

injuries.<sup>6-8</sup> On 3 occasions in the last decade, the sports medicine community has held symposia designed to refine an expert consensus on these issues: in 2001 in Vienna, in 2004 in Prague, and in 2008 in Zurich.<sup>5,9,10</sup> These recommendations provide a useful framework for caring for patients like Jeff.

■ **A definition.** According to the consensus statement that emerged from the most recent Zurich conference, sports concussion can be defined as a “complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.” Common features may include:<sup>5</sup>

- A direct blow to the head or elsewhere in the body with an impulsive force transmitted to the head.
- Rapid onset of neurological impairments that resolve spontaneously over time.
- Possible neuropathological changes, although the clinical symptoms reflect a functional disturbance rather than structural injury.
- A graded set of clinical symptoms that may or may not involve loss of consciousness.
- No abnormality on standard structural neuroimaging studies.

### **Athletes with concussion show a range of signs and symptoms**

Athletes who suffer from a concussion may show signs of being dazed or disoriented, or experience retrograde amnesia (where they can't remember things that happened before the traumatic event) or anterograde amnesia (where they can't remember things that happened after the event). They may also suffer from poor coordination, decreased attention span, emotional lability, or loss of consciousness. After the traumatic event, they may complain of headache, dizziness, nausea or vomiting, photophobia, phonophobia, inability to concentrate, sleep disturbances, fatigue, and memory disturbances. Academic performance can also be severely impaired during the postconcussive period.

Symptoms of concussion may be short-lived or persist for many weeks. Postconcussive syndrome is a term used to describe the condition of prolonged and persistent con-

cussive symptoms. Recent studies in military personnel have also shown a strong association between post-traumatic stress disorder (PTSD) and clinical depression in soldiers who have suffered from a traumatic brain injury.<sup>11</sup>

### **Start with the ABCs, then check the spine**

If you are a team physician on the spot when the injury occurs, you can do the initial assessment on the field of play. A certified athletic trainer can also do this first assessment. Start by checking the basics: airway, breathing, and circulation. Once the ABCs have been completed, palpate the head and neck to rule out a head or cervical spine injury. If the player complains of neck pain or you can palpate bony tenderness or step-off over the spinous processes, suspect a possible cervical spine injury. Make sure the player is put onto a spine board with cervical spine precautions and transported to the nearest medical facility.

### **Look for neurologic deficits**

If the cervical spine is cleared, you can do the rest of the assessment in a quiet location either on the sideline or in your office. Your history should include a narrative of how the injury occurred, an estimate of the force involved, the duration of any symptoms, and any previous concussions. The physical examination comes next, and should include a neurologic assessment and a full cognitive evaluation. Reassess frequently after the traumatic event to monitor for any signs of neurologic decline. If any neurologic deficits are found, the patient should be transported to the nearest medical facility for neuroimaging studies to rule out a structural brain injury.

### **The SCAT2:**

#### **A convenient assessment tool**

Standardized tools now exist to help you evaluate patients with concussion. The Pocket Sport Concussion Assessment Tool (SCAT2) on page 430 has been endorsed by the Zurich conference.<sup>5</sup> It is a condensed version of the conference recommendations, suitable for use on the field of play. The SCAT2 includes a symptom scale, mental status tests, instruc-



**There is a propensity for athletes not to report symptoms for fear of being held out of sporting events.**

**>**  
 Many different classification systems for grading the severity of concussion have been proposed, but none is endorsed by the Zurich conference.

**FIGURE**

**Pocket Sports Concussion Assessment Tool (SCAT2)**

Concussion should be suspected in the presence of any of the following: symptoms (such as headache) or physical signs (such as unsteadiness), or impaired brain function (eg, confusion) or abnormal behavior.

**1. Symptoms**

Presence of any of the following signs and symptoms may suggest a concussion:

- Loss of consciousness
- Seizure or convulsion
- Amnesia
- Headache
- "Pressure in head"
- Neck pain
- Nausea or vomiting
- Dizziness
- Blurred vision
- Balance problems
- Sensitivity to light
- Sensitivity to noise
- Feeling slowed down
- Feeling like "in a fog"
- "Don't feel right"
- Difficulty concentrating
- Difficulty remembering
- Fatigue or low energy
- Confusion
- Drowsiness
- More emotional
- Irritability
- Sadness
- Nervous or anxious

**2. Memory function**

Failure to answer all questions correctly may suggest a concussion:

- "Where are we right now?"
- "Which half is it now?"
- "Who scored last in this game?"
- "What team did you play last week/game?"
- "Did your team win the last game?"

**3. Balance testing**

**Instructions for tandem stance**

"Now stand heel-to-toe with your nondominant foot in back. Your weight should be evenly distributed across both feet. You should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Observe the athlete for 20 seconds. If he or she makes more than 5 errors (such as lifts hands off the hips, opens eyes, lifts the forefoot or heel; steps, stumbles, or falls; or remains out of the start position for more than 5 seconds), then this may suggest a concussion.

Any athlete with a suspected concussion should be IMMEDIATELY REMOVED FROM PLAY, should undergo urgent medical assessment, should not be left alone, and should not drive a motor vehicle.

Adapted from: Pocket SCAT2. Available at: [http://bjsm.bmj.com/content/43/Suppl\\_1/i89.full.pdf](http://bjsm.bmj.com/content/43/Suppl_1/i89.full.pdf). Accessed July 7, 2010.

tions on neurologic screening, and guidelines for return to play.

**No system for grading severity is recommended**

Many different classification systems for grading the severity of concussion have been

proposed, but none of them is endorsed by the Zurich conference.<sup>5,7,12-15</sup> The classification schemes that have been proposed are complex, not evidence-based, and unable to encompass the full range of concussion symptoms. Thus, the 3rd International Conference on Concussion in Sport abandoned

TABLE

### “Modifying factors” that may influence concussion management

Symptoms	How many?
	How long did symptoms last? (>10 days?)
	How severe?
Signs	Loss of consciousness lasting >1 minute, amnesia
Sequelae	Concussive convulsions
Timing	Repeated concussions, concussions occurring close together in time, or recent concussion
Threshold	Repeated concussions with progressively less impact force or slower recovery after each
Age	Child or adolescent <18 years
Comorbidities	Migraine, depression, other mental health disorders, attention deficit hyperactivity disorder, learning disabilities, sleep disorders
Medications	Psychoactive drugs, anticoagulants
Behavior	Dangerous style of play
Sport in which injury occurred	High-risk, contact, and collision sports, “high sporting level”

Source: McCrory P, et al. *Br J Sports Med*. 2009.<sup>5</sup>

all attempts to use or create classification systems, but recommended that each case be treated clinically on the basis of the symptoms displayed and the duration of the impairment.<sup>5</sup> Athletes with severe impairment or prolonged symptoms may require referral to a sport medicine specialist with expertise in the management of concussion.

The third conference did agree on a range of “modifying factors” that may influence management and possibly predict the potential for prolonged or persistent symptoms (TABLE). The conference participants endorsed that any athlete displaying these features should be managed in a multidisciplinary manner coordinated by a physician with specific expertise in the management of concussive injuries.

#### Return to play is the crucial decision

Just as multiple systems for classifying severity have been proposed, so have guidelines for

return to play.<sup>13-15</sup> Again, each of the proposed guidelines has been based on expert opinion and no single set of guidelines has ever been proven to be accurate.<sup>10</sup> There is, therefore, no universally accepted guide for making the decision of when an athlete can safely return to play. It is universally accepted, however, that no athlete should return to play if he or she is still symptomatic at rest or with any exertional maneuvers.<sup>3,7,16</sup> Additionally, the athlete should not be taking any medication that could minimize any of the signs or symptoms of concussion when the physician is determining whether he or she can return to activity.

Once you are assured that the player has no symptoms at rest, you can start him or her on a graded, step-by-step regimen for returning to play. Athletes should spend 24 to 48 hours at each level before progressing to the next. If symptoms return at any point, instruct the athlete to drop back down a step for 24 hours and then proceed with the progression as tolerated.<sup>9,10</sup> The stages of

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activity are:<sup>3,10</sup>

- Light aerobic exercise
- Moderate to intense aerobic exercise
- Sport-specific activities/noncontact training drills
- Full contact activities
- Game play.

### Neuropsychological testing can help you decide

In 1989, Barth and colleagues evaluated 2300 college football players, 200 of whom had suspected concussion.<sup>17</sup> Neuropsychological testing at 24 hours, 5 days, and 10 days showed a decline from baseline following a concussion, with the majority of the athletes returning to baseline by 10 days postconcussion. This finding led researchers to believe that testing could help identify concussions, and several computer-based testing products were developed.<sup>11,18</sup>

Neuropsychological testing should include measures of concentration, motor dexterity, information processing, visual and verbal memory, executive function, and brain stem function.<sup>19</sup> Testing can be performed in the athletic setting with a Web-based computer program, by a sports medicine specialist with an interest in concussion, or by a neuropsychologist with expertise in concussion.

Improvement in cognitive function as a concussion resolves may come prior to, or follow, the resolution of clinical symptoms. Therefore, it is important to properly assess cognition and symptoms before you make a recommendation about returning to play.<sup>3,10</sup> Baseline performance parameters must be established before the season starts.

Neuropsychological testing can provide both an objective measure of the neurocognitive effects of concussion and the ability to track recovery. It may also assist in making return-to-play recommendations in complicated cases, but bear in mind that no data are available to suggest that return to play is safe once neuropsychological testing has returned to normal.<sup>3,9</sup> Test results can aid clinical decision making, but cannot substitute for it. Testing may be most helpful in athletes with repeated concussions or those with persistent symptoms.<sup>10</sup>

### Educating athletes, parents, and coaches in prevention

No foolproof method exists for preventing concussion in sports. Sports medicine research has focused on designing and testing safer equipment and on devising new rules to make play safer.<sup>20-22</sup> At present, there is no evidence that protective equipment will prevent concussions, but recent studies by Collins and Viano suggest that newer football helmets may assist in decreasing the incidence of concussions.<sup>20,22,23</sup>

The Zurich consensus statement warns that protective equipment can have a paradoxical effect, influencing athletes to take risks that they might otherwise avoid, thus increasing injury rates.<sup>5</sup> Trials of rule changes in different sports have been and continue to be conducted, such as barring spearing in football and restricting helmet-to-helmet hits. Given the frequency of concussion, further research is clearly needed. In the meantime, family physicians can play a major role in educating players, parents, and coaches about the seriousness of concussive injury and the need for identifying concussion promptly and allowing adequate time for recovery.

### What do you tell Jeff?

Your answer for Jeff is, "You're not ready to go back to practice or play. You feel OK when you're resting, but when you get up, your headache returns. Come back to the office in a day or 2, and I'll re-evaluate you. If you don't have any symptoms then, you can start a program of graduated activity, beginning with some light aerobic exercise. If you feel all right with that, you can go on to a moderate and then an intense aerobic workout. If you still feel good, you can go on to sports-specific activities with no contact training, and then full contact training.

"At each stage, you will need to be re-evaluated by me or by your team trainer. Once you've finished the program without any reactivation of symptoms, I'll clear you for play."

**JFP**

### CORRESPONDENCE

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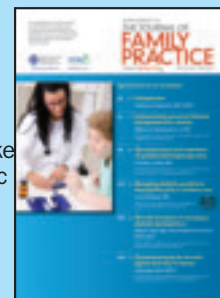
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## SUPPLEMENT

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