



## Considerations in the management of concussion with an illustrative case example

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Concussions are extremely common injuries, especially among student athletes. With emerging guidelines that will require physicians to make decisions regarding injured athletes' return to physical activity, the family physician will soon be faced with more frequent questions from injured athletes and with new responsibilities to help ensure patients' safety. Assessment tools such as Sport Concussion Assessment Tool and neurocognitive testing will assist with evaluation and return to play decisions, but ultimately, it is important for the physician to develop a strategy for comfortably and appropriately managing this frequently encountered and challenging problem.

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Concussion is a common injury among high school student athletes participating in high-energy sports. The Centers for Disease Control and Prevention reports that there are 2 million nonfatal sports-related concussions in the United States per year.<sup>1</sup> The family physician has the greatest potential to impact the outcome of this condition both on the sidelines and in the office. As new information becomes increasingly available, it is imperative for the family physician to be comfortable with the diagnosis and management of the concussed athlete. There is no cure for concussion, so the most important consideration clinically is the safe and timely return of the athlete to activity after injury.<sup>2,3</sup> This becomes even more important as emerging practice recommendations make the family physician responsible for return-to-play decisions.

Of the 2 million sports-related concussions occurring each year, more than 136,000 involve high school athletes.<sup>4</sup> In the United States, there are currently 14,226 high schools

with more than 7.6 million athletes. Of those, more than 1.1 million athletes participate in 11-player football.<sup>5</sup> Recent information suggests that most high school concussions happen as a result of football (57%), followed by girls soccer (12%).<sup>2</sup> Most concussion (69%) occurs during competition rather than during practice situations,<sup>2</sup> but an overwhelmingly large number of high schools do not have a physician on staff to assess injured athletes. The American Osteopathic Association of Sports Medicine and the American Medical Society of Sports Medicine have roughly 2200 active members combined, according to their representatives. Compare this with the 7.6 million athletes and it becomes obvious that the majority do not have specialized Sports Medicine physicians readily available. According to the Center for Injury Research and Policy in Columbus, Ohio, less than 50% of the 14,226 US high schools are covered by a certified athletic trainer (ATC). This is in contrast to college and professional football coverage, where multiple physicians and ATCs are present during games and practice. Although professional football receives increased media coverage and attention, there are currently 32 teams with less than 1700 active professional football players on the rosters in the National Football League

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(NFL) at any one time during the regular season.<sup>6</sup> In college divisions I, II, and III, there were 633 college football teams with just under 69,000 players during the 2008-2009 season.<sup>7</sup> Given these statistics it is understood that there is a great need for medical coverage at high school sports events. Emerging guidelines, which require physician assessment for return to play after injury, will result in an overwhelming increase in the number of injured athletes seeking appropriate care.

## Current and emerging guidelines

Since 2001, concussion experts have assembled periodically to discuss return to play guidelines post concussion. Vienna and Prague, and recently Zurich, have been the sites for these experts to discuss and update new information.<sup>3,8,9</sup> Recently, a series of tragic events with significant media involvement have resulted in increasing momentum for legislative action based on recommendations from these assemblies. On September 30, 2010, the Concussion Treatment and Care Tools Act (ConTACT) was passed in the House of Representatives and would have required the Department of Health and Human Services to convene a conference of medical, athletic, and educational professionals to establish a set of concussion management guidelines for student athletes. Salient points of the bill included establishment of concussion management guidelines that addressed the prevention, identification, treatment, management, and funding for the implementation of computerized preseason baseline and postinjury neurocognitive testing for concussions. The bill was introduced in the Senate on November 15, 2010 during the 111th congress but never became law before the termination of the that congress.<sup>10</sup> In addition, the American Academy of Neurology (AAN) released a position statement in October 2010 stating that "any athlete who is suspected to have suffered a concussion should be removed from participation until he or she is evaluated by a physician with training in the evaluation and management of sports concussions."<sup>11</sup> In addition, a physician with proper training should be consulted after a concussion before return to play.<sup>12</sup> This statement is similar to recommendations made at the 3rd International Conference on Concussion in Sport, held in Zurich in 2008, which recommended that the disposition of the player be assessed by a physician and that the decision concerning return to play be based on sound clinical judgment on an individual basis.<sup>3</sup>

These policy changes will give the family physician an excellent opportunity to make a difference in the health of high school athletes and prevent further injury. It is our intention to use an illustrative case to guide the family physician through the evaluation and management of an athlete who has sustained a concussion. We will also provide a strategy for confident decision making concerning releasing the concussed athlete to return to play.

## Case overview

During a football game, JT, a 17-year-old male player, sustained a helmet-to-helmet hit during the second quarter while tackling a player from the opposing team. Stunned and complaining of a frontal headache, he continued to play until the half expired. At halftime JT's teammates reported that he was not acting "normally," at which point the ATC was notified. Using the Pocket Sport Concussion Assessment Tool (Pocket SCAT), the ATC evaluated an uncooperative JT. Memory, balance, and symptoms were assessed. JT stated, "I feel fine," "Leave me alone," and "I just got dinged." Based on this information and assessment, he was allowed to return to play during the second half. After the game, JT's parents stated that their son had not played well and they sensed that he was "not right." They decided to take JT to the emergency department, where he underwent a CT scan, which was unremarkable. He was diagnosed with a concussion and instructed to follow up with his family physician for evaluation and return to play considerations. Three days later, JT presented to his family physician complaining of headaches and light sensitivity. His mother stated that he had been unusually emotional. At this point, JT reported that he may have sustained an additional concussion two weeks before but did not report it for fear he would not be allowed to play.

## Definition of concussion

Concussion, as defined in Zurich at the 3rd International Conference on Concussion in Sport,<sup>3</sup> is a complex pathophysiological process. It is induced by traumatic *biomechanical* forces resulting from either a direct blow to the head, face, or neck, or from a blow elsewhere on the body with an "impulsive" force transmitted to the head. The patient typically experiences a rapid onset of short-lived impairment of neurologic function, with or without a loss of consciousness. The clinical and cognitive symptoms (most commonly headache<sup>2</sup>) typically resolve spontaneously (Table 1). Post-concussive symptoms may be prolonged, however, in a small percentage of cases. These acute clinical symptoms largely reflect a functional disturbance rather than a structural injury, thus no abnormality is usually seen on standard imaging studies.<sup>3</sup>

## Discussion

This case is an extremely common scenario, and the family physician will be called upon to make management decisions. In an ideal situation, the patient and physician would have a previously established relationship with documented results of a preparticipation examination (PPE) available. The PPE is an opportunity for the physician to establish a thorough concussion history (Table 2). More commonly,

**Table 1** Symptoms of concussion

Cognitive	Somatic	Affective
Confusion	Headache (93%) <sup>2</sup>	Emotional lability
Posttraumatic amnesia	Fatigue	Irritability
Retrograde amnesia	Disequilibrium	
Loss of consciousness (4.6%) <sup>2</sup>	Nausea/vomiting	
Disorientation	Visual disturbance	
Vacant stare	Phonophobia	
Difficulty focusing		
Delayed verbal and motor responses		
Slurred or incoherent speech		
Excessive drowsiness		

however, a physician will be asked to evaluate a concussed athlete without prior knowledge of the patient or the concussive event. This can prove to be challenging. A focused history will need to be obtained at the time of the initial office visit with a detailed physical examination with special attention paid to the neurologic exam, including assessment of mental status, cognitive function, gait, and balance. All the previously mentioned points of the history and physical are contained within the Sport Concussion Assessment Tool 2 (SCAT2). The SCAT2 was designed and developed by international experts at The 3rd International Conference on Concussion in Sport for evaluating concussed athletes and can be used for evaluating athletes age 10 years and older.<sup>3</sup> The SCAT2 is available for download online (<http://links.lww.com/JSM/A11>). Ideally, serial SCAT2 assessments should be performed by a physician *immediately after a suspected concussion has occurred*. Because most concussions occur during competitions rather than at practice,<sup>2,13</sup> an ideal model would involve physician coverage at all high school sports events, or minimally at football games. As previously discussed, the majority of high school sports events do not have physician coverage available.

In the more common scenarios, like the one described here, the physician is seeing the patient hours to days after the event and must glean as much information as possible from the patient and event witnesses about the mechanism of injury and progression of symptoms. This reality was addressed at the same conference in Zurich with the development of the PocketSCAT2. This tool was developed for the lay person (e.g., parents, coaches, referees, ATC) to

**Table 2** PPE questions

Have you ever had a head injury or concussion?  
 Have you ever had a hit or blow to the head that caused confusion, prolonged headache, or memory problems?

**Table 3** Neurocognitive assessment option

Name	Source
<b>Axon Sports</b> (Collie, Assessment and Management of traumatic brain injury)	<a href="http://www.axonsports.com">http://www.axonsports.com</a>
<b>ImPACT</b> (Immediate Post-Concussion Assessment and Cognitive Testing)	<a href="http://www.impacttest.com">http://www.impacttest.com</a>
<b>ANAM</b> (Automated Neuropsychological Assessment Metrics)	<a href="http://www.DVBIC.org">http://www.DVBIC.org</a>
<b>HeadMinder</b>	<a href="http://www.headminder.com">http://www.headminder.com</a>

rapidly assess concussion. If the student athlete has symptoms or signs consistent with concussion, it is recommended that they be immediately removed from play and not be allowed to return on the same day. Serial monitoring should be performed in the initial few hours after injury to detect any signs of deterioration. If deterioration does occur, neuro-imaging such as magnetic resonance imaging (MRI) or computed tomography (CT) should be performed. Signs or symptoms that would alert the physician to the need for imaging include prolonged disturbance of consciousness, confusion, seizure activity, persistent or worsening symptoms, or focal neurologic deficits.<sup>3</sup> A CT scan without contrast can be obtained quickly to evaluate for skull fractures and intracranial bleeds, whereas MRI without contrast can detect more discrete intracranial bleeds or axonal injury.<sup>14,15</sup>

In the majority of cases, symptoms resolve within three to 10 days post concussive event and there is no serious concomitant injury.<sup>2,3</sup> However, subclinical cognitive effects may still be present even after the athlete feels completely recovered.<sup>16</sup> At this point, the physician needs to discuss the need for neurocognitive testing to detect these subclinical effects. Neurocognitive testing is available to the family physician in the form of readily available computerized questionnaires that can be taken online in the patient’s home or administered by the physician or trained office staff. They provide objective data in areas such as attention, memory, reaction, concentration, processing speed, and response accuracy, all of which can be affected by concussion. To optimize the usefulness of this data, the physician should have obtained baseline data during the preparticipation examination. Realistically, preseason baseline testing is likely going to be a requirement in the future based on proposed laws such as the ConTACT Act.<sup>10</sup> Thus, it is essential that the family physician become familiar with neurocognitive testing options (Table 3). In our office, we have chosen to use either the Collie Assessment and Management of Traumatic Brain Injury, also known as Axon Sports, or the Immediate Post-Concussion Assessment and Cognitive Testing, also known as ImPACT. Other options

include HeadMinder or Automated Neuropsychological Assessment Metrics (ANAM).<sup>17</sup> It has been shown that athletes managed with neurocognitive testing are generally out of play longer than those not tested, secondary to the ability of computerized neurocognitive testing, to detect subtle changes in brain function.<sup>2</sup> Despite the usefulness of neuropsychologic testing, it is essential that the physician continue to rely on their clinical skills in evaluating the concussed athlete.

In the past year, significant changes have been implemented in college and professional football to protect its athletes. In April 2010, The National Collegiate Athletic Association (NCAA) adopted a new policy regarding concussion in all three divisions. The policy requires that all schools have a concussion management plan in place such that any athlete suspected of sustaining a concussion should be removed from play and evaluated by an experienced athletic health care provider. Once diagnosed with a concussion, the athlete cannot return to activity without clearance from the team physician. In addition, NCAA student athletes are now required to sign a statement accepting responsibility to report any signs or symptoms of concussion to medical staff, and at the time of signing they are presented with educational materials about concussion. As part of the NCAA concussion management plan, institutions will obtain baseline neuropsychologic testing for each student athlete before the first practice. The same baseline testing should be used to evaluate the athlete post concussion.<sup>18</sup> At the professional level, the NFL made an announcement on February 25, 2011 introducing their new sideline concussion assessment protocol,<sup>19</sup> which was developed on the basis of the recommendations made in Zurich and using the SCAT2 as a foundation. The protocol was then modified to meet the specific needs of professional football, enabling them to provide care consistent with expert opinion.<sup>3,19</sup>

## Return to play

One of the most difficult decisions the assessing physician must make is when to allow the athlete to return to play. The physician may feel pressure from the patient, coaches, trainers, and family members to rush return to play decisions, so it is imperative to educate all involved parties about the inherent dangers. This is yet another situation in which good communication and working relationships with the patient, as well as family and coaches, are crucial.

The following protocol can be used by family doctors acting as team physicians to manage the return to play decision. Once the patient's symptoms are fully resolved at rest and neurocognitive testing results have returned to baseline, the next step is a supervised graduated exertion test. This test is composed of 20 to 30 minutes of observed exercise at gradually increasing levels of exertion over a four-day period (Table 4). On the first day, the patient will

**Table 4** Graduated exertion test<sup>3</sup>

<b>Day 1</b>	Light aerobic activity	Walking, swimming, stationary bike
<b>Day 2</b>	Sport-specific exercise	Drills, running; no risk of head impact
<b>Day 3</b>	Noncontact training drills	Passing drills with progressive resistance training
<b>Day 4</b>	Full-contact practice	<i>Supervised</i> full-contact play with team members

be instructed to perform light aerobic activity for 20 to 30 minutes, followed by rest for the remainder of the day. If the patient remains asymptomatic, they will repeat this test the following day at an increased exertion level, as described in Table 4. If the patient has maintained asymptomatic status for the duration of this four-day process of graduating intensity, they may finally be allowed unrestricted return to play. There are several important factors to keep in mind during this graduated testing. The patient is expected to rest during the day when they are not engaged in the supervised activity. As we mentioned previously, more than 50% of high school athletic programs lack an ATC. In this case, it will be necessary to assign someone, possibly a coach, on whom the physician can rely to accurately assess and report the patient's progress. It should also be noted that this is a four-day process, at minimum, which does not begin until the patient's symptoms have completely resolved while at rest. If the athlete has any concussive symptoms during exertion, the process is repeated once they are again symptom-free. Finally, the final return to play decision must be made at the physician's discretion using the information provided by the patient and the ATC or responsible party performing the testing, in addition to the results of the physical examination and neurocognitive testing.

## Conclusion

We have described appropriate concussion management for the family physician; 136,000 high school athletes per year will sustain a concussion.<sup>4</sup> Changing guidelines will place physicians in the position responsible for releasing patients to return to play; therefore, the physician must have a strategy in place for evaluation of concussed athletes. The information provided here can be used to help physicians comfortably and appropriately manage this frequently encountered and challenging problem.

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