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Concussion 101: Knowing the Basics to Protect Your Athletes

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ABSTRACT

Sport-related concussions have recently been at the forefront of mainstream media, where the attention is now turning to the safety of our young athletes. With the recent rise of concussion lawsuits, coaches need to know concussion basics to protect their athletes and themselves. What we know about concussions has evolved, and it is critical that coaches understand these changes and how they impact the management of their teams' injuries. In the absence of medical personnel, coaches are responsible for removing athletes from play if they have potentially sustained a concussion. Coaches must therefore understand the different mechanisms of injury, signs and symptoms, and the protocol to follow if they believe their athlete has sustained a concussion.

Key Words: head injury, education, mild traumatic brain injury, pathology



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The days of simply having your “bell rung” and returning to the field of play are over. Approximately 173,285 sport-related traumatic brain injuries (including concussions) occur each year in youth athletes (Gilchrist, Thomas, Xu, McGuire, & Coronado, 2011), and it is becoming a major concern for coaches, athletes, and parents. For the age group of 15–24-year-olds, athletic competitions are the second leading cause of traumatic brain injury, making up approximately 9–15% of all high school athletic injuries (Gessel, Fields, Collins, Dick, & Comstock, 2007; Meehan, d’Hemecourt, Collins, & Comstock, 2011). Topping the list of concussion incident rates is football, followed by women’s and men’s soccer respectively (Meehan et al., 2011).

So, how can coaches better protect their athletes and themselves from improperly managing concussions in the absence of a healthcare provider? The simple answer is knowledge and understanding of the current literature. Valovich, Mcleod, Schwartz, and Curtis (2007) found that only 61% of youth coaches could correctly identify the signs and symptoms of a concussion. A 2011 study found that 66% of sampled coaches reported limited knowledge of concussive injuries, even though 90% of them felt that having a strong base of knowledge regarding concussions was critical in their role as a coach (Mrazik, Bawani, & Krol, 2011). All coaches need to know what a concussion is, the mechanisms of injury, signs and symptoms, and proper management techniques. The goal of this article is to inform coaches of these concussion basics and, it is hoped, to create a safer environment for our athletes.

What Is a Concussion?

Over the years the definition of a concussion has evolved to encompass current research findings. For example, the Committee on Head Injury Nomenclature (1964) originally defined a concussion as “a clinical syndrome characterized by immediate and *transient* impairment of neural function due to brainstem involvement” (p. 386). Research is now showing that concussions may not result in a temporary impairment of neural function, and individuals may experience complications throughout their entire life. New research is also linking multiple concussions to numerous pathologies (see the Mechanism of Injury section, below).

Currently a concussion is defined as a “complex pathophysiological process affecting the brain, induced by biomechanical forces” (McCrorry et al., 2013, p. 89). It is truly a complex process, made all the more frustrating because it does not show up on standard imaging techniques (e.g., X-ray, CT, MRI). There is no quick, completely accurate, objective diagnostic tool to identify a concussion. Information provided by the athlete is heavily relied upon, but is not always accurate. Studies have shown that athletes will lie in order to return to play faster (Sye, Sullivan, & McCrorry, 2006), and the reasons for not reporting their concussion did include fear of losing playing time (McCrea, Olsen, Leo, & Guskiewicz, 2004). In the absence of medical personnel, coaches must make the decision to remove an athlete from play based on what they are seeing in their athlete, which means that they must be able to identify a potential concussion. A recent study evaluated the impact of the “Heads Up: Concussion in Youth Sports”



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initiative by the Centers for Disease Control and Prevention (CDC). It found that 77% of coaches reported an improved ability to identify concussions in their athletes after reviewing the CDC's information (Covassin, Elbin, & Sarmiento, 2012). In other words, reviewing information from reliable sources will help a coach to identify a potential head injury.

The definition of a concussion is not the only piece of information that has changed over the years. How we determine the severity of a concussion has also changed tremendously. Previously, concussions were graded on a 1–3 scale with a grade 3 being the most severe. Next there was a transition into “simple” and “complex” concussions. In the most recent consensus statements, a concussion is simply identified as a concussion (McCrary et al., 2013; McCrary et al., 2009). There are no grades, no “mild” concussion, and if an athlete has the mechanism of injury (MOI) for a concussion and is experiencing symptoms, then the athlete is diagnosed as having a concussion. There is no gray area, no “concussion-like” symptoms.

Mechanism of Injury

The MOIs for sustaining a concussion are a direct blow to the head *or* a blow to the body where the force is transmitted up into the brain (McCrary et al., 2013). A blow to the body can create a “whiplash” effect, causing an athlete to sustain a concussion when a direct blow to the head never occurred.

Studies have revealed a significant increase in the likelihood of athletes sustaining an additional concussion after an initial concussion injury. Athletes with a concussion history are four to six times more likely to sustain an additional concussion in their athletic career, and they are three times more likely to sustain an additional concussion within the same season (Valovich, Tamara, Bay, Heil, & McVeigh, 2008). Additionally, athletes with a concussion history will display worsened symptoms and are more likely to experience a slower recovery (Iverson, Brooks, Lovell, & Collins, 2006). If coaches have knowledge of an athlete's concussion history, they may be more able to identify when an athlete sustains a subsequent concussion, as well as understand and encourage the necessity of a longer recovery timeframe.

One of the larger concerns of multiple concussions is second impact syndrome (SIS). This syndrome occurs when an athlete who sustained a concussion returns to play too soon and receives another head injury. The brain, which did not have time to fully heal after the first injury, will swell quickly. The second head injury is usually minor and may not have been the result of a direct blow to the head, but rather to the trunk. The signs and symptoms of SIS include dilated pupils, loss of consciousness leading to a coma, and respiratory failure. These symptoms occur quickly, usually within minutes of the injury (Arnheim & Prentice, 2009, p. 923). Although rare, SIS is a potentially fatal syndrome that occurs mainly in athletes under 20 years of age (Marineau, Kingma, Bank, & Valovich, 2007). In some athletic settings, especially those involving youth athletes, medical personnel are not readily available, so the coach is left to perform the duties of a first responder. In the instance of SIS, immediate activation of emergency



medical services (EMS) is paramount. Do not attempt to move the athlete and, if necessary, begin rescue breathing and/or CPR/AED.

Signs and Symptoms

Signs and symptoms of concussions can range in variety as well as severity. The most commonly reported concussion symptoms are headaches (Valovich et al., 2008) or dizziness (Miyashita, Timpson, Frye, & Gloeckner, 2013). Additional concussion symptoms include confusion, amnesia, balance problems, nausea, visual difficulties, hearing problems, irritability or other emotional changes, fatigue, poor coordination, seizures, unsteady gait, being slow to answer questions, easy distractability, vomiting, vacant stare, slurred speech, and/or decrease in playing ability (Table 1; McCrory et al., 2009). It is critically important for athletes and coaches to understand that a concussion can occur even without a loss of consciousness, which actually does not occur in a majority of cases. Valovich et al. (2007) found that 42% of coaches believed loss of consciousness was necessary in order for a concussion to occur. Additionally, loss of consciousness is not associated with worsening neurological damage when compared to other concussion symptoms (Makdissi et al., 2010).

Symptoms may arise at the same time, be delayed, or occur at mixed intervals. The intensity may also vary between symptoms and between athletes. Studies are also finding a difference between genders, with females reporting an increase in the number and severity of symptoms experienced (Comstock et al., 2011; Covassin, Elbin, Harris, Parker, & Kontos, 2012). It is crucial that athletes report all their concussion symptoms to ensure proper monitoring. Having a symptom checklist at hand will assist in the monitoring of an athlete with a concussion, and it can be given to parents to take home and continue the monitoring of their child (Table 1). An increase in the number and severity of symptoms has been linked to three or more concussions. Athletes with this concussion history were more likely to experience loss of consciousness, amnesia, confusion, and prolonged mental status changes (Collins et al., 2002). Such athletes also have an increased risk of suffering from a variety of medical conditions (Iverson et al., 2006; Iverson, Echemendia, LaMarre, Brooks, & Gaetz, 2012), including post-concussive syndrome (Sterr, Herron, Hayward, & Montaldi, 2006), Lou Gehrig's disease (Chen, Richard, Sandler, Umbach, & Kamel, 2007), clinical depression (Guskiewicz et al., 2007), and attention deficit disorder (Van Donkelaar et al., 2005).



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Table 1.
Concussion Symptom and Severity Checklist

Symptom	Severity: 0-10 Scale, 10 = worst, 0 = Not Present										
Headache	0	1	2	3	4	5	6	7	8	9	10
Dizzy	0	1	2	3	4	5	6	7	8	9	10
Confusion	0	1	2	3	4	5	6	7	8	9	10
Amnesia	0	1	2	3	4	5	6	7	8	9	10
Balance problems	0	1	2	3	4	5	6	7	8	9	10
Nausea	0	1	2	3	4	5	6	7	8	9	10
Difficulty seeing	0	1	2	3	4	5	6	7	8	9	10
Difficulty hearing	0	1	2	3	4	5	6	7	8	9	10
Irritable	0	1	2	3	4	5	6	7	8	9	10
Emotional changes	0	1	2	3	4	5	6	7	8	9	10
Fatigue	0	1	2	3	4	5	6	7	8	9	10
Poor coordination	0	1	2	3	4	5	6	7	8	9	10
Seizures	0	1	2	3	4	5	6	7	8	9	10
Unsteady gait	0	1	2	3	4	5	6	7	8	9	10
Slow to answer questions	0	1	2	3	4	5	6	7	8	9	10
Easily distracted	0	1	2	3	4	5	6	7	8	9	10
Vomiting	0	1	2	3	4	5	6	7	8	9	10
Vacant stare	0	1	2	3	4	5	6	7	8	9	10
Slurred speech	0	1	2	3	4	5	6	7	8	9	10
Decrease in playing ability	0	1	2	3	4	5	6	7	8	9	10

Concussion Management

Properly managing concussions may reduce the number of cumulative concussions an athlete sustains throughout life. Concussion management addresses the proper protocol that should be followed immediately after an athlete sustains a concussion. Ideally an athletic program will have an athletic trainer or other trained healthcare professional on staff who will be first on the injury scene to evaluate the athlete. If this does not or cannot occur, the coach is responsible for the well-being of the athlete. The coach should understand his or her scope of knowledge and duties in regard to caring for the athlete and refer the athlete to the appropriate medical personnel. If an allied healthcare provider is not immediately available to evaluate a suspected concussion, the coach should remove the athlete from play and immediately refer the athlete to a physician (McCrorry et al., 2013). All programs should have a list of the medical personnel, contact information, and physical addresses with them at all times.

With an acute concussion, management is very conservative. An athlete exhibiting *any* symptom must be immediately removed from play and not allowed to return that day. A majority of states have regulations in place requiring an athlete to have a signed note from a physician that clears the athlete to return to play. Certain factors should be evaluated by medical personnel at



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the time of injury to rule out a more serious injury, including cervical spine fractures and cranial hematomas. If there are any indications of these potentially life-threatening injuries, EMS should be activated immediately.

If medical personnel are unavailable, the coach must make the decision. Currently there are numerous apps available to coaches to download onto their smart phones, including but not limited to “Concussion recognition and response” and “Concussion assessment and response” by PAR, Inc.; “Concussion awareness” by Polar Mobile; and “Concussion quick check” by MentorMate, LLC. These are only meant as a tool and are not designed to replace medical personnel. Coaches are always urged to err on the side of caution and hold an athlete out of play until further evaluation and diagnosis is possible. Coaches also need to recognize that athletes may not report their injury. A recent study found that only 36 out of 64 players with concussions told their coach (Baker, Devitt, Green, & McCarthy, 2012), and another study found that 43% of coaches felt their athletes would not report a concussion to them (Mrazik et al., 2011). Coaches must be aware of the mechanisms of injury and observe athletes who experience these mechanisms for the potential onset of symptoms.

Following a concussion, athletes should not be alone for the remainder of the day and evening, in case their condition deteriorates and the EMS has to be activated. A take-home guide should be given to the individual staying with the athlete. The affected athlete should report to the medical staff on a daily basis for re-evaluation, at which time the medical staff will assess symptom severity, development of new symptoms, and neurocognitive function (McCrorry et al., 2013).

Return to Play

Return-to-play (RTP) criteria have changed greatly over the years, based on research findings. Currently, it is recommended that the medical staff implement a graduated RTP protocol after receiving a clearance from a physician (Figure 1). Within this stepwise graduated protocol, initiated when the athlete is symptom free, athletes can proceed to the next stage if they remain asymptomatic for 24 hours. The entire protocol should take approximately 1 week to complete. However, for a youth athlete, some physicians increase the 24-hour block to 48 hours. If athletes experience any symptoms while progressing through the protocol, they drop to the previous symptom-free stage and remain there for 24 hours. Once free of symptoms, athletes can begin to immediately perform light aerobic exercises. If they are able to progress to the next stage, the athletes can begin to perform sport-specific exercises. The next stage includes noncontact drills, with a progression to full-contact practice. At the completion of a full-contact practice, and after remaining asymptomatic for 24 hours, the athlete is allowed to return to play (McCrorry et al., 2013). Coaches’ knowledge of the proper protocol will assist in ensuring that an athlete does not progress too quickly or perform actions not allowed.



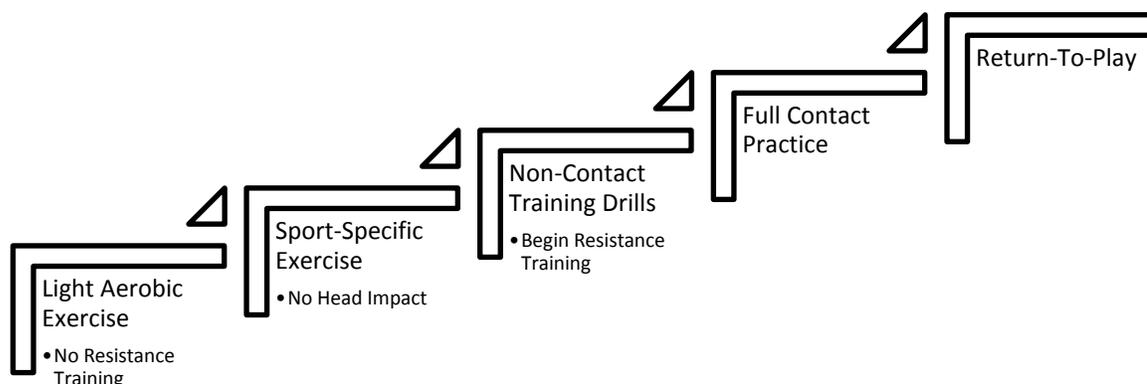


Figure 1.
Return-to-play protocol following a concussion.

A tool that coaches should consider implementing is the completion of medical questionnaires. All athletes should complete a medical history questionnaire before beginning any activity. An accurate medical history identifies 75% of the issues plaguing athletes. Medical histories should be updated before the start of every season. All preseason questionnaires should address whether and when the athlete has sustained a concussion, how many have been sustained, and the length of time held from play (Valovich et al., 2008). These questionnaires rely on the athletes to accurately and honestly report their injury history. The preseason questionnaires allow medical personnel to determine whether athletes are at an increased risk for sustaining further head trauma and whether or not they should be allowed to participate in certain sports. It should be noted however, that self-documentation of concussion history has been shown to be unreliable. Medical histories are obtained to provide proper and accurate treatment to athletes, as well as to reduce potential legal repercussions (McCrary et al., 2009).

All athletic seasons should begin with education for the athletes. Athletes must be educated on the basics of concussions if they are to recognize whether they have sustained one. Coaches can play an instrumental role in the education of athletes, setting examples, and ensuring a more safety-conscious playing environment (Gianotti & Hume, 2007; Guilmette, Malia, & McQuiggan, 2007). Athletes should be encouraged to report any and all symptoms to the appropriate person. Studies have suggested that athletes have a skewed perception of concussions. An anonymous survey evaluating high school football players revealed that 66% of these athletes did not report their concussions because they did not believe it was serious enough



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to warrant medical attention. Other reasons that athletes fail to report include an aversion to being held out of play and/or lack of awareness of the injury (McCrea et al., 2004).

Implications and Recommendations for Coaches

Management of concussions has greatly evolved, and all individuals working with athletes must realize this fact. No longer can we push athletes back to play while telling them to “suck it up” and they just got their “bell rung.” Instead we must treat all potential concussive injuries conservatively. If there are coaches who disagree with this new mentality, they are strongly encouraged to look at the long-term complications associated with multiple concussions. It does not matter how one sustains a concussion—whether in sports or an accident—the brain cannot tell the difference. We must protect our athletes’ brains as best we can from unnecessary secondary injury, even if it requires removing athletes from play. A majority of states have youth concussion laws in place, including components such as formalized concussion education for athletes, parents, and/or coaches; immediately removing an athlete with a suspected concussion from play and referring to a physician; and requiring a concussed athlete to receive a note from a physician that clears the athlete to return to play (Covassin, Elbin, Sarmiento, 2012). In the absence of an on-field/on-site healthcare provider, the coach needs to collect information from the athlete and maintain accurate records. It is recommended that all coaches keep a yearly injury file and document who sustained the injury, when (date/time, practice/game), MOI, signs/symptoms, witnesses, and action taken (Table 2). Athletes competing at higher levels (colleges/universities/professional) typically have an allied healthcare professional readily available. If this is the case, the coach should immediately refer an athlete with a suspected concussion to this individual. If a healthcare provider is unavailable, coaches should follow the recommended guidelines provided in this article. Coaches at any level should educate themselves on concussion basics, which they can find in an abundance of reliable sources such as the *Journal of Coaching Education*, the CDC’s Heads-Up program, and the *British Journal of Sports Medicine*’s 2013 publication of the most recent consensus statement on concussions. Coaches can also contact the CDC to receive free information, including posters, magnets, and pocket “cheat sheets” for concussion identification.



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Table 2.
Injury Documentation.

Name: _____	Date: _____
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Time of Injury:
Game or Practice:
Mechanism of Injury:
Signs/Symptoms:
Witnesses:
Action Taken:
Follow-Up:



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