

Return to Play After Concussion

Principles and Practice

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Objective: The sport medicine team is increasingly being asked to manage concussed athletes and to provide written clearance for return to play postconcussion, making it critical to have a good understanding of concussion recognition, assessment, and management.

Data Sources/Synthesis: A handy way to think of concussion management is the four Rs: recognition, response, rehabilitation, and return.

Results: Athletes, coaches, parents, therapists, and physicians need a thorough understanding of concussion signs and symptoms. An athlete suspected of having sustained a concussion should be removed from the game or practice and assessed by a member of the sideline medical team. All athletes who sustain a concussion should be evaluated by a medical doctor. Rehabilitation has similarities to but also differs from the traditional orthopedic model in that the first step is rest, both physical and cognitive. Once asymptomatic at rest, a step-wise return to activity is undertaken.

Conclusions: This protocol has been adapted for various sports. It may be used for children, although it is prudent to be more conservative and to progress more slowly than in an older age group.

Key Words: concussion, return to play, rehabilitation

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One of the biggest challenges facing a physician who treats athletes is the assessment and management of sport-related concussion. Physicians are increasingly being asked by sport leagues and federations to provide written clearance for return to play postconcussion, and it can be anticipated that this will increase in the future. Therefore, it is critical that physicians have a good understanding of concussion recognition, assessment, and management, and to be able to advise safe steps to return the athlete to his or her activity. Complicating the matter is the fact that, in many cases, this assessment and decision making is attempted at the side of the field, or at an ice rink, during the heat of battle. There is often significant

pressure from coaches, parents, and often the player himself to return to play.¹ To assist in this task, a number of concussion grading scales have been developed through the years, with at least 25 published by 2001.² These divided concussions into different grades based on a number of symptoms and signs, and provided recommended return to play times. However, none of these guidelines were based on valid scientific evidence, but were rather anecdotal, observational systems based on the experience of their authors, albeit very extensive. In November 2001, the first International Symposium on Concussion on Sport was held in Vienna, Austria. Organized by the International Ice Hockey Federation, the Federation Internationale de Football Association, the Federation International de Football Association, the Federation Medical Assessment and Research Center, and the International Olympic Committee Medical Commission, this symposium brought together concussion experts from around the world.³ It was the consensus of the experts, including authors of the most commonly used concussion grading systems, that “the CIS (Concussion In Sport Group) recognizes strength and weaknesses of several existing concussion grading scales that attempt to characterize injury severity, but no single system was endorsed. It was the recommendation of the group that combined measures of recovery should be used to assess injury severity (and/or prognosis) and hence individually guide return to play decision,” reiterating that management, rehabilitation, and return to play decisions must be individualized in every case.³ Although this may seem to leave the clinician with no return to play guidance, in fact, a very clear protocol was endorsed, based on the Canadian Academy Sport Medicine Management Guidelines published in 2000.⁴ The protocol emphasizes concussion recognition and removal from play, rest until asymptomatic, then a step-wise return to play; this approach was supported in the Second International meeting, Prague 2004.⁵ This is discussed here in detail, including some sport-specific examples. A handy way to think of concussion management is the four Rs: recognition, response, rehabilitation, and return.

RECOGNITION

Guskiewicz et al⁶ note that “perhaps the most challenging aspect of managing sport-related concussion is recognizing the injury, especially in athletes with no obvious signs that a concussion has actually occurred.” Through the years, numerous myths and half-truths have been propagated about concussion, and even the definition was controversial. A significant part of this problem is the fact that although concussion as a clinical entity has been known since the 10th century AD,² the exact pathophysiological changes to the brain

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following concussion are not yet fully understood.⁷ The Concussion in Sport group defines concussion as follows: Concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. Several common features that incorporate clinical, pathological, and biomechanical injury constructs that may be used in defining the nature of a concussive head injury include:

1. Concussion may be caused either by a direct blow to the head, face, neck, or elsewhere in the body with an 'impulsive' force transmitted to the head.
2. Concussion typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously.
3. Concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than structural injury.
4. Concussion results in a graded set of clinical syndromes that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course.
5. Concussion is typically associated with grossly normal structural neuroimaging studies.³

Special attention must be paid to point 4; one of the biggest mistakes made diagnosis is that loss of consciousness (LOC) is a requirement for concussion diagnosis. It is well recognized that most concussions do not involve LOC, and a number of studies have shown that brief LOC has not been found to reflect injury severity or performance on neuropsychologic testing post injury.^{2,8-10} In a recent study, Asplund et al¹¹ found that any LOC was associated with a greater likelihood of a longer return to play time (greater than 7 days), although, as the authors note, "whether this was secondary to provider conservatism or actual neurovegetative symptoms is unknown." Nevertheless, LOC is best thought of as one of a number of potential symptoms and signs arising from concussion, rather than a requirement for diagnosis. Paradoxically, LOC is also the presentation that is most obvious, and therefore, the athlete is most likely to receive appropriate management in that scenario.

Signs and symptoms following a concussion can be physical, cognitive, or emotional (Table 1). Although many are quite obvious, some are more subtle, such as the sensation of feeling dazed or having your bell rung, or simply not feeling right. Cognitive symptoms may involve some subtle disorientation or concentration deficits. Thus, it is very important for the physician who is working with athletes at the sidelines, or assessing them in a clinical setting, to have a heightened awareness in this regard, because all of these symptoms are consistent with concussion. The Vienna Guidelines clearly states that "if any one of the following symptoms or problems is present (Table 1) a head injury should be suspected and appropriate management instituted."³

RESPONSE

Any athlete who is suspected of having a concussion should be removed immediately from the game or practice.^{3,4} Even when initial symptoms clear quickly, the athlete may experience delayed symptoms or depressed neurocognitive

TABLE 1. Signs and Symptoms of Acute Concussion^{3,4,5,14}

If any one of the following symptoms or problems is present, a head injury should be suspected and appropriate management instituted.

(1) Cognitive Features

- Unaware of period, opposition, score of game
- Confusion
- Amnesia
- Loss of consciousness
- Unaware of time, date, place

(2) Typical Symptoms

- Headache
- Dizziness
- Nausea
- Unsteadiness/loss of balance
- Feeling "dinged," stunned or dazed, "foggy"
- "Having my bell rung"
- Seeing stars or flashing lights
- Double vision

Other symptoms such as sleepiness, sleep disturbance, and a subjective feeling of slowness and fatigue in the setting of an impact may indicate that a concussion has occurred or not completely resolved.

(3) Physical Signs

- Loss of consciousness/impaired conscious state
- Poor coordination or balance
- Concussive convulsion/impact seizure
- Gait unsteadiness/loss of balance
- Slow to answer questions or follow directions
- Easily distracted, poor concentration
- Displaying inappropriate emotions (eg, laughing or crying)
- Nausea/vomiting
- Vacant stare/glassy eyed
- Slurred speech
- Personality changes
- Inappropriate playing behavior (eg, running in the wrong direction)
- Significantly decreased playing ability

levels.^{6,12,13} It is the experience of the authors that a return to play while still symptomatic greatly increases the risk of more severe postconcussive symptoms and a more prolonged postconcussive course. In addition, the athlete puts himself at greater risk for injury elsewhere if reaction time or coordination is impaired.¹⁴ Second impact syndrome¹⁵ is a widely feared sequelae of return to play while symptomatic, but this is an extremely rare entity. Assessment of the injured athlete^{2,3} can then take place, including a thorough history, a variety of physical tests, and cognitive assessment, such as the Maddocks questions,¹⁶ Standardized Assessment of Concussion,¹⁷ McGill ACE (unpublished), or recent combined tools developed from the strengths of each.⁵ Given that concussion is currently thought of as a functional brain injury, traditional imaging studies will usually be negative and need only be done if one does suspect a structural injury.^{3,5,18} Neuropsychological assessment has also been demonstrated to be extremely valuable.^{3,19-24} In a recent paper, Pellman et al²⁵ reported that concussed American football players (NFL) who were returned to the game after evaluation using specific criteria had no apparent untoward effects. These players had transient

symptoms that were fully resolved. However, this approach cannot be advocated in a recreational situation where there is often little or no medical support for evaluation. Whether it can ever be used in this setting remains to be seen.

REHABILITATION

The concept of rehabilitation postinjury is a very familiar one to both the injured athlete and to the physician who treats the athlete. Their experience is primarily from an orthopedic model, which can be thought of to consist of 3 phases with some overlap (Fig. 1). The initial healing phase certainly must include rest from aggravating activities, but the concept of relative rest or alternate activities is a cornerstone of most sport injury rehabilitation. For example, if a runner has a stress fracture of the tibia, running would be contraindicated so as to allow the fracture the appropriate environment in which to heal, but an alternate activity to maintain cardiac conditioning, such as cycling, swimming, or deep water running, would be encouraged. As healing progresses, the return to function phase can begin, which involves progressively increasing activities to improve range of motion, strength, proprioception, and flexibility. As the athlete progresses, the third phase can be introduced, which is a return to sport phase. This would involve a gradual increase in sport-specific skills, ultimately leading to full sport participation.

Rest

It has been well recognized that postconcussive symptoms are aggravated by exertion, both physical²⁶ and cognitive.⁵ Whether this may be related to autonomic or cardiovascular factors remains an interesting question to be addressed in ongoing and future studies.^{27,28} In any case, this necessitates that concussion rehabilitation differ from the aforementioned orthopedic model in that the first phase must be rest of an absolute nature. The alternate physical activities or relative rest of the orthopedic model will not work with concussion, and will, in fact, tend to aggravate symptoms. The concept of rest refers not only to discontinuing sport specific activities, but also to fitness activity, aerobic activity, and exertional activities of daily living such as walking to school or work, shoveling snow, or even sexual intercourse.²⁶ At the second Consensus Conference on Concussion held in Prague, Czech Republic, in November 2004, an updated Summary and Agreement Statement was developed,⁵ and the concept of cognitive exertion was introduced. The document

supports what clinicians dealing with concussion have long noted, namely, that concentration, memorization and learning (such as occurs in school particularly) can also aggravate postconcussive symptoms (both physical and cognitive). Thus, rest must also involve cognitive rest, which may mean an appropriate period of time away from school or work. Only when the athlete is completely asymptomatic at rest should further rehabilitation progression take place (Fig. 2).

Rest is the most difficult phase of rehabilitation, especially for the athlete who is used to a high level of activity. They are often used to working through pain, and must be given extensive education and support. It is the authors' clinical experience that failure to rest until asymptomatic is one of the chief causes for athletes having prolonged postconcussive courses. Unfortunately, it is not possible to predict how long the athlete will need to rest before symptoms resolve, due to the multifactorial nature of concussion, individual characteristics, and our lack of firm knowledge of the pathophysiology of concussion. This uncertainty is extremely difficult for athletes, who are more used to the orthopedic model, in which injuries usually have more specific time lines for recovery. This also creates problems for coaches hoping to get their athletes back to play as soon as safely possible, but in some predictable time line. The uncertainty can certainly also wreak havoc when the athlete must miss work, as it is not possible to give the employer a definite return date, creating difficulties in finding replacements, ensuring the athlete's job is done, and so forth. In most cases, concussion is an invisible injury (i.e., no outward physical signs), which may cause some to doubt the veracity of the athlete's condition. Unfortunately, this can lead to greater stress for the injured athlete at a time when stress reduction and cognitive rest are so important. It is important for the treating physician to recognize this, and to educate coaches, schools, employers, and insurers on appropriate concussion management, of which rest remains the cornerstone.

Step-Wise Return to Play

Once athletes are completely asymptomatic (which includes physical, cognitive, and emotional manifestations of concussion), they may progress to a step-wise return to play protocol,^{3,4,14} as described in Table 2. It must be emphasized that each step must take a minimum of 1 day, as it is widely recognized that symptoms may not worsen at the time of the exertion, but rather later in the day or even the next day.

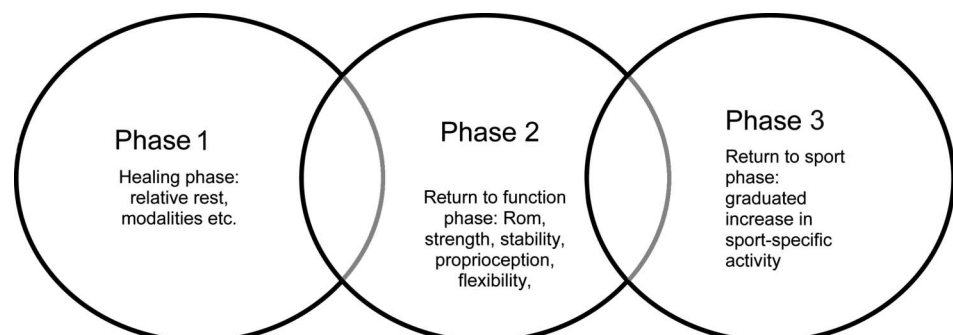


FIGURE 1. "Orthopedic" rehabilitation model. Note overlap between phases.

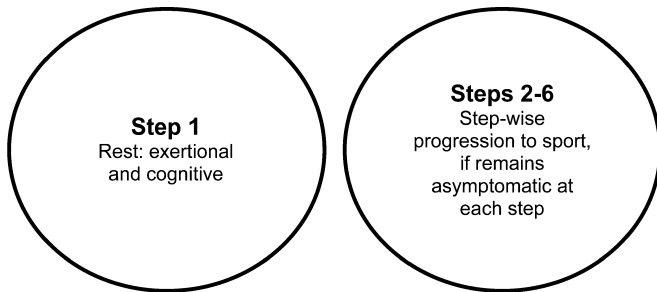


FIGURE 2. Concussion rehabilitation model. Note that step 1 does not overlap with steps 2–6.

Progression through the protocol is dependent upon being asymptomatic at each level. If any symptoms occur, then the athlete should cease activity, drop back to the previous asymptomatic level, and try to progress again the next day. However, if symptoms recur and are persistent, the athlete should return to resting until asymptomatic.

This protocol can be adapted for various sports. Johnston et al²⁶ published hockey and soccer programs incorporating progressive activities that were more sport-specific (Fig. 3). Soccer presents an additional facet of rehabilitation, as heading (purposeful head contact with the ball) must be reintroduced before return to game play. Activities focusing on breathing, stretching, and toning are being looked at as potentially being useful at earlier levels of the rehabilitation process.^{15,26}

One of the significant developments of the Prague conference was the conceptual understanding that concussion may be categorized for management purposes as either simple or complex. A *simple concussion* is described as “an injury that progressively resolves (both at rest and with exertional provocation) without complication over seven to ten days.” It is noted that this form of concussion is the most common form of the injury, and it is recommended that this can be “easily managed by primary physicians or certified athletic trainers working under medical supervision.” It is, however noted, that “all concussions mandate evaluation by a medical doctor.” These injuries will generally progress through the step-wise return to play without symptom aggravation and return to play

TABLE 2. Step-Wise Return to Play Protocol

Step 1: No activity, complete rest (exertional and cognitive)
Step 2: Light aerobic exercise such as walking or stationary cycling, no resistance training
Step 3: Sport-specific training (eg, skating in hockey, running in soccer)
Step 4: Noncontact training drills
May add resistance training progressing from light to heavier weights at steps 3 or 4
Step 5: Full contact training after medical clearance
Step 6: Game play
The athlete should progress to the next step only if completely asymptomatic at the current step. Each step should take a minimum of 1 day; symptoms may recur later in the day. If any symptoms are experienced, the athlete should drop back to the previous asymptomatic level and try to progress again after 24 hours.

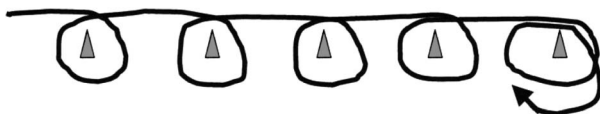
Adapted with permission.³⁻⁵

Ball work: (10 minutes)

- 1) Juggling ball, footwork (2 minutes)
- 2) Dribbling ball, straight line (2 minutes)
- 3) Dribbling (2 minutes):



- 4) Dribbling (2 minutes): Clockwise and counterclockwise



- 5) Dribbling with change of direction (2 minutes): run forward, backward, sideways

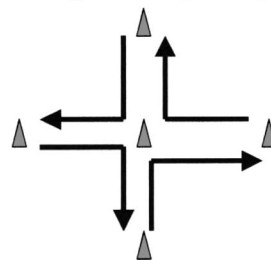


FIGURE 3. Sport specific training activities for soccer (for additional soccer drills and hockey drills see reference 26).

without difficulty. A *complex concussion* is defined as “encompassing cases where athletes suffer persistent symptoms (including symptom recurrence with exertion) specific sequela or prolonged cognitive impairment following the injury. This group may also include athletes who suffer multiple concussions over time or where repeated concussions occur with progressively less impacted force.” These athletes may not be able to progress through a step-wise return to play in so simple a fashion and may require a more prolonged period of asymptomatic rest before starting into the program, and more time at each step. No definite time lines are available for this but are rather left up to the experience of the treating physician. For this reason, it is recommended that complex concussions be “managed in a multi-disciplinary manner by physicians with specific expertise in the management of concussive injuries such as a dedicated sport medicine doctor with experience in concussion, sports neurologist or neurosurgeon.”⁵

Special Considerations

Children

The recommendations of the Vienna Consensus statement³ were originally intended for management of adult concussions (i.e., greater than age 18). Experts at the Prague conference agreed that these recommendations were applicable to concussion in the pediatric age group as well, and this has been reflected in the that consensus document.⁵ There, children are defined as age 5 to 18. Some difficulties with regard to neuropsychologic testing are identified,²⁹ but the return to play approach is considered to be similar to that in

adults. However, it is noted that “because of the different physiological response during childhood to head trauma, a conservative return to play approach is recommended and future research is needed in this area.”

It was found by Field et al⁶ that when compared with collegiate athletes who sustained a concussion, high school athletes who sustained concussion had more prolonged memory dysfunction. Thus, it may be more prudent to progress return to play somewhat more slowly with the child than with an adult, to be particularly conservative in return to play decisions and timing, and always to “err on the side of caution.”⁴

Weight Training

Many athletes incorporate weight training as part of their ongoing sport training. When advised to rest from activity, many may interpret this to mean rest from sporting activity but not from training activity such as weights. Resistance training has been shown to increase intracranial pressure and to exacerbate postconcussive symptoms, particularly headaches, dizziness, and so forth.³⁰ Again, it is critical to emphasize the importance of total rest to the athlete. Resistance training can be generally added in the later stages of the step-wise approach (around step 4), beginning with low weight/high repetition exercises and then progressing to higher weights if asymptomatic and tolerated.

Pharmacological Therapy

Currently, there is no evidence-based pharmacological therapy available for treating concussion. With limited understanding of the pathophysiology, it is extremely difficult to treat concussions pharmacologically.³¹ Treatment of symptoms, such as using analgesics for headaches, may be helpful for the concussed athlete; however, in general, concussion headaches are unique in quality and, in the authors' experience, often quite refractory to pharmacological management. Ongoing studies in this area may provide new insights.

Sport Psychology

Many concussed athletes report symptoms of depression, and these symptoms may persist even when physical symptoms are decreasing.²⁶ This must be recognized, and support must be provided to the athlete, who is worried about recovery and long-term sequelae, and who may feel isolated, angry, and sad.³² Horton et al³³ found that concussed elite level athletes who participated in a support group had lower scores of mood disturbance than those in a control group. Bloom et al³⁴ suggest that the use of sport psychology techniques such as support groups and peer modeling may be very beneficial for concussed athletes. Podlog and Eklund³⁵ include many of these criteria for a successful transition to return to sport in general.

Neck Injuries

It is not uncommon for the neck to be injured concurrently with a concussion. A blow to the head or face may cause a whiplash motion of the neck, and concussion can occur as a result of a whiplash motion itself. Neck injuries often have associated headaches, which may be difficult to separate from a postconcussive headache. As a general rule, cervicogenic headaches are worse with neck motion or prolonged postures,

with postconcussive headaches being aggravated by any physical or cognitive exertion, but this is not always clear. Active rehabilitation of neck injuries may aggravate postconcussive headaches.²⁶ Thus, rehabilitation of the neck, although possibly helpful, must be done in a cautious manner and response to treatment carefully monitored.

RETURN

The athlete who has progressed through the step-wise return to play protocol and is asymptomatic is ready to return to sport participation. Before return, though, the physician should discuss the importance of reducing future concussion risk with the athlete. Protective equipment, technique, adherence to rules, and the need to remove himself or herself from play if repeat injury occurs or if symptoms recur must be stressed to the athlete, as well as to parents, coaches, trainers, officials, and other individuals associated with the athlete/sport. Individual athletes' attitudes toward protection vary,³⁶ and proactively addressing the issues may be helpful. Often the athlete becomes a resource person for teammates with similar injuries, so time spent by the health care provider educating the recovered athlete is time well invested for all. As well, this is the time for baseline testing in view of potential future reinjury.

Caution must be exercised in complex concussions, where simple progression through the aforementioned protocol may not be sufficient. These athletes should be managed by physicians with specific concussion management experience, in a multidisciplinary fashion.⁵ In most cases, return to play is ideally a combined decision of the athlete and all those involved in their medical care.

In some cases, it may not be in the best interest of the athlete to return to a collision or contact sport. It is widely believed that once you have had a concussion, you are more prone to experiencing another.^{37,38} Debate also exists over the question of how many concussions are too many, and the cumulative effect of multiple concussions. Each case must be individually considered; however, most experts would agree that an athlete in the following scenarios is one who should potentially consider discontinuing activities with a high risk of concussion:

- (1) The athlete who has had numerous concussions, with each concussion seemingly more easily obtained, and with symptoms that are more severe and/or longer lasting, i.e., disproportionate to the impact
- (2) Any athlete with residual neurocognitive problems persisting well after other symptoms have resolved
- (3) An athlete with protracted, prolonged symptoms

CONCLUSIONS

McCrary³¹ stated that, “until recently, the medical treatment of concussion in sport has been one of close observation and ‘masterly inactivity.’” Based on our current understanding and recent expert consensus,^{3,5} this continues to hold true, but in a different way than initially intended. Close observation is critical in terms of concussion recognition, followed by an appropriate response (removal from play and assessment by a physician). However, we can now refer to

clear management protocols to help rehabilitate the athlete; “masterly inactivity” now refers to rest until asymptomatic, which is the most difficult, but most critical, phase of post-concussion rehabilitation. Progression through a step-wise return to play protocol follows, with more sport-specific programs being developed. Many will have difficulty with this seemingly slow progression and will want to rush back to play. As Johnston et al²⁶ state, “within the context of concussion, we (and the athlete) are left to wonder why an investment of 4 months to rehabilitate a high ankle sprain is considered acceptable, whereas 4 months for brain rehabilitation is considered untoward!” It is critical to provide the athlete (and significant others) with extensive education, support, and encouragement to help them return to their sport safely.

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