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A Review of Return to Play Issues and Sports-Related Concussion

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Abstract

Mild traumatic brain injury in sports has become a significant public health concern which has not only received the general public's attention through multiple news media stories involving athletic concussions but has also resulted in local, state, and national legislative efforts to improve recognition and management. The purpose of this article is to review the current literature for return to play (RTP) guidelines. State, regional, national, and professional legislation on sport-related concussion RTP management issues will be reviewed. This article will be helpful in developing a generalized systematic approach to concussion management and highlight specific RTP guidelines. The article will also touch upon specific contraindications to RTP, the role of neuropsychological testing in RTP, and other considerations and complications that affect an athlete's ability to return to competition. Finally, considerations for terminating an athlete's competitive season or ending a career after sustaining a concussion resulting in prolonged and protracted symptomatology or repeated concussions will be reviewed. PubMed and Google were searched using the key terms mentioned below. In addition, the author's library of concussion-related articles was reviewed for the relevant literature.

Keywords: concussion, return to play, neuropsychological testing, post-concussion syndrome, chronic traumatic encephalopathy

Introduction

The number of athletes participating in contact and collision sports worldwide is on the rise. Therefore, the incidence of sports-related concussions is on the rise with an estimated 1.6 million to 3.8 million cases per year in the United States.²¹ For the purpose of this review article, concussion is defined as a neurologic injury resulting from a blow to the head or body which causes an alteration in mental status and one or more of the following symptoms: headache, nausea, vomiting, dizziness/balance problems, fatigue, trouble sleeping, drowsiness, sensitivity to light or noise, blurred vision, difficulty remembering, and difficulty toward concentrating.

Caring for athletes, from the initial date of injury through rehabilitation to the decision making involved in returning of the athlete to play remains challenging despite current treatment protocols and management strategies. Physicians and athletic medical care providers are increasingly being asked to provide written clearance for return to play (RTP) post-concussion. There is often significant pressure on the athletic medical care provider (sports physicians, athletic trainers, appropriate medical specialists, and neuropsychologists) from coaches, athletes, and their parents with regard to RTP. Therefore, it is critical that athletic medical care providers have a good understanding of concussion recognition, assessment, and management to implement safe steps to return the athlete to his or her sports activity.

We are now starting to understand the consequences of returning an athlete to play too soon following initial concussion diagnosis as well as the effects of repeated concussions over time. It is important to remember that every concussion is unique. For that reason, RTP issues need to be individualized, and many physiologic factors and diagnostic modalities need to be taken into consideration. Modalities that can be used include neuropsychological testing, balance testing, diagnostic imaging, screening tests and/or baseline tests, a thorough history, and physical exam with an emphasis on neurologic testing. Given that the evaluation and management of each concussion is individualized and the vast number of tools that can be used in concussion diagnosis and treatment, it has been difficult to establish a single "gold standard" set of concussion management and RTP guidelines. It is important to use a team approach including the athlete, their parents, coaches, and athletic medical care providers, as mentioned.

Generalized Approach to Management

The existing literature shows that in the majority of concussions, symptoms will resolve within 10 days to 2 weeks.⁹ Having a good clinical understanding of concussion and using a generalized systematic approach to management will help clinicians allow athletes to safely return to play while minimizing complications and optimizing the RTP time line. The health and safety of the athlete should always be the clinician's primary concern. Us-

ing this approach will also help us recognize those athletes who have persistent neurocognitive deficits and post-concussion symptomatology, thereby allowing for proper neurocognitive rest and rehabilitation.

Currently, we do not have a “gold standard” approach to concussion management because of the availability of so many guidelines, practice parameters, and diagnostic modalities. There have been more than 25 different specific approaches to grading concussions and making RTP decisions since 2001. Most of these have focused on signs and symptoms. In addition technological advances have afforded us many different diagnostic testing options for concussed athletes. While this provides a wide variety of objective measures, it can further complicate management. Regardless of what methods the clinician chooses to use, it is essential to have a good understanding of clinical course of sport-related concussion. In 2005, Kissick and Johnston provided a generalized systematic approach using the four R’s: Recognition, Response, Rehabilitation, and Return to play.¹⁸

They stated that recognition was the most challenging part of concussion management because signs and symptoms can be vague and there are other considerations that may motivate the athlete to disguise or ignore their concussion symptoms. The authors further elaborate on the importance of understanding the definition of concussion as well as the signs and symptoms following concussion. This will help athletic medical providers better recognize concussion and in turn be better prepared to manage concussion. The appropriate response once a concussion is suspected is to immediately remove the athlete from competition and promptly initiate assessment. This approach will help protect the athlete from further injury and provide the basis for appropriate management. Once the athlete has been removed from play and appropriately diagnosed, the rehabilitation phase can be implemented to help the individual efficiently and safely return to play. Rehabilitation is broken up into three phases—relative rest, step-wise return to functional activities, and followed finally by return to sport-specific activities. Following this step-wise approach and as long as the athlete remains asymptomatic, will allow the athlete to be ready for the last R, which is return to sport. During this phase, it is also important to discuss possible mitigation strategies to reduce the risk of future concussion.¹⁸

Concerns for Return to Play (RTP) Decisions

As discussed earlier, decision making for RTP is often confusing and can lead to uncertainty in decision making. This is because of the protean nature of sports-related concussion and the subtleness of signs and symptoms. There are three major categories of concern when deciding to return an athlete to competition: second impact syndrome (SIS), a prolonged recovery from sequential concussions (post-concussion syndrome), and chronic traumatic encephalopathy (CTE).⁹

The SIS is a devastating injury with a mortality rate of at least 50% and nearly a 100% morbidity rate.⁴ SIS is believed to be caused by a rapid loss of cerebral auto-regulation with massive intracerebral swelling.¹⁷ Except in the case of boxing, it has not been reported in athletes older than 20 years of age and occurs in those who sustain a second concussive

event while still symptomatic from a prior event.¹³ Although some controversy exists regarding SIS, most authorities concur that an initial incident precedes the catastrophic second event and is marked by incomplete recovery from the initial concussion.

The second category of concern relates to the possibility of prolonged recovery from the initial concussion or subsequent concussions. Collins and colleagues showed that athletes with a history of concussions were more likely to experience significant on-field symptoms of amnesia and confusion during repeat concussions.⁷ These symptoms may be related to a more protracted rate of recovery. Some athletes may be removed from the competitive season, and those athletes with prolonged and persistent symptomatology may need to be removed from their sport entirely.

The last area of concern is CTE or Chronic Traumatic Encephalopathy that may result from the cumulative effects of repeated traumatic brain injury. This syndrome was initially recognized in boxers many years ago and was termed “dementia pugilistica.” Similar symptoms are now being recognized in National Football League (NFL) players and several other collision sport participants.⁸ It involves trauma to areas of the brain that results in loss of intellect, memory, balance, and behavioral changes and can result in symptoms similar to those of Parkinson’s disease.⁹ Symptoms usually present in the fourth and the fifth decades several years after concussive injuries. Studies have shown correlation with multiple concussions and deficits on neuropsychological testing.⁷ Pathophysiology includes neurofibrillary tangles and the accumulation of the neurotoxic tau protein. One of the main differences between Alzheimer’s and CTE is the location of the involvement in the brain. It is often associated with diffuse axonal loss which can cause Parkinsonian-type symptomatology.⁹

Current Recommendations for Return to Play

With a solid foundation of concussion knowledge and a generalized systematic approach to management, specific recommendations can be made for RTP. Many articles reviewed cited the 2008 Zurich Consensus Statement.²³ This statement recommends a graded and progressive step-wise approach to concussion rehabilitation before RTP. In most situations, the athlete’s signs and symptoms will resolve spontaneously over several days, and they will be able to asymptotically proceed through the progressive RTP protocol.

Graduated Return to Play as Stated in the Zurich Consensus Statement:

1. No activity—complete and cognitive rest until asymptomatic. Objective is rest and recovery.
2. Light aerobic exercise—walking, stationary bike at >70% intensity. Objective is to increase heart rate.
3. Sport-specific exercise—skating drills, running soccer drills, etc. Objective is to add movement.
4. Non-contact training drills—more advanced drills like passing drills, etc. May add resistance training. Objective is to add coordination and cognitive load with exercise.

5. Full contact practice—participate in normal training activities. Objective is to restore confidence and allow assessment of functional skills by coaching staff.
6. Return to play.

Each step will take approximately 24 h. If an athlete advances through without any symptoms, then the RTP approach will take approximately 1 week. If any symptoms develop during one of these phases, then they revert back to step one. Another thought in this progressive model is to compare an athlete to their baseline tests. Many athletes at a variety of levels of participation will have a series of baseline physiologic parameters that can aid clinicians as they begin the step wise rehabilitative protocol. A variety of speed, power and agility data are usually collected. Our experience is that athletes can usually begin the progression at about 75% of their typical maximum effort and gradually progress as outlined above. This will provide objective data to initiate the protocol as well as gauge the athlete's progress. These baseline parameters might include such measurements as 40 or 100 yard dash times, mile run times, maximum bench press or a variety of other measures. These tasks can be incorporated into the step wise RTP protocol along with other sport-specific skills.

Considerations Affecting RTP

The above recommendations are further elaborated on by the Zurich consensus statement as well as the American College of Sports Medicine consensus statement.^{2,23} The current opinion is that any athlete with signs and symptoms of concussion and/or clinical neuropsychological testing abnormalities should not return to play on the same day of injury.²

Before beginning the step-wise approach to RTP, it is imperative that the athlete is completely asymptomatic at rest (relative to their typical state) before resuming any exertional activity. It must not be overlooked that any cognitive effort may also exacerbate symptoms. It is important that the athlete, coaches, parents, and school administrators understand the importance of cognitive rest and that the athlete's activities are monitored. A recent poll of concussed high school athletes by our lab (AM) found athletes engaging in activities (while recovering), such as snowboarding, running a 5-km race, and a Sunday afternoon touch football game. Some athletes are hesitant to ask for extended time on papers or for exams. Accommodations should be made to keep an athlete out of school or to provide a reduced schedule if activity is increasing symptoms or signs of injury. Cognitive rest includes minimal-to-no TV, cell phones, text messaging, computers, video games, and any prolonged use of electronic visual interfaces. Just as with a step-wise approach in return to activity, an athlete can utilize a progressive program for return to school. For example, once the student-athlete is asymptomatic, they may be able to return to half days and avoid testing scenarios and then can progress back to full-time status.^{2,9}

Pharmacotherapy in the setting of sport-related concussion can be used for management of prolonged symptoms and reduction of symptom severity. Examples include, but are not limited to, sleep disturbance, depression, anxiety, and headaches. Medications have not been shown to speed recovery but can reduce the morbidity associated with

sport-related concussion. Ideally, before return to cognitive as well as physical activities, an athlete should be free of all medications because of the potential to mask symptoms. There are specific situations, however, where the clinician will need to exhibit caution, especially when dealing with underlying emotional instability and post-concussion pharmacotherapy.⁹

There are several additional factors that clinicians should be aware of when managing concussions and returning athletes to sporting activity. The age of the athlete should be taken into consideration. Younger athletes may require more time to recover because their brain is still developing. Precautions should be taken to give the younger athlete more time to progress through the RTP protocol than the older athlete.^{5,9}

Consideration must be given to athletes who sustain multiple concussions. To date, no specific number has been established to mandate season-ending injury or retirement. However, experts understand that repetitive concussions can be associated with more significant neurocognitive deficits.³ This group would include those with increased number of concussions, decreased time between concussions, increased recovery time, and concussion resulting from decreased biomechanical forces.⁹ With this group, more conservative management and a more gradual progression through the RTP protocol should be undertaken. The clinician may wish to consider a full neuropsychological evaluation and the use of advanced imaging techniques in these athletes.

The sports clinician must also be aware of signs and symptoms that may suggest underlying cognitive deficits as well as post-concussion syndrome which may ultimately delay RTP. Some researchers have concentrated on amnesia as a marker for increased recovery time.²² Loss of consciousness for less than 1 min has not been found to be a useful predictor of prolonged recovery.⁶ On occasion, differentiating between postconcussive headaches and migraines can complicate RTP considerations. Clinicians must determine whether the patient has post-concussive headaches, which indicate incomplete recovery, or whether a primary migraine was triggered by the injury. Some factors differentiating the two that can be beneficial when deciding the RTP status as documented by d'Hemecourt are a headache that is not exacerbated by activity/exercise, a positive family history of migraines, all other concussion symptoms have resolved, and neuropsychological testing has returned to baseline. At this point, the clinician might consider a primary diagnosis of migraine, and therefore consider allowing the athlete to return to play.⁹ Neck injuries should also be considered when athletes sustain a concussion and report consistent headaches. It is not uncommon to have associated neck injury and pain, likely secondary to soft tissue strain resulting from traumatic biomechanical forces applied to the head and neck during injury. Cervical soft tissue injuries can be associated with headaches and should be differentiated from migraines and post-concussive headaches.¹⁵ Athletes with learning disabilities may have baseline cognitive deficits, and therefore should not be overlooked. More precautions should be used in these athletes and the progression through the RTP protocol should be increased.⁹

Finally, sport psychology plays an important role. There is a correlation with concussion and depression which may persist longer than physical symptoms.¹⁵ Horton found that athletes who participated in support group after concussive injury had less mood adjust-

ment problems.¹⁴ As previously mentioned, appropriate pharmacotherapy of mood disorder associated with concussion is an important component of management. Social pressure must also not be overlooked when deciding RTP status. The clinician may feel pressure from the athlete, coaches, and family. Again, for all of these reasons, it is extremely important to take an individualized approach when managing athletes who have been concussed, and utilize appropriate consultants in deciding their RTP status.

Neuropsychological Testing in RTP

Neuropsychological testing can be an invaluable tool in assisting the RTP decision-making process. There are several commercially available testing systems for sport-related concussion. However, it must be noted that resolution of clinical symptoms does not always correlate with the results of the neuropsychological testing, with test results typically taking longer to return to baseline than reported symptoms. The current commercial testing systems recommend baseline testing to allow for post-concussion comparative testing. If a baseline test is not available, there is the option of using normative data as the comparator. The test is typically administered once the athlete is symptom free because current recommendations do not allow symptomatic athletes to RTP. Many clinicians obtain a follow-up neuropsychological test at 48–72 h post-concussion to gauge the baseline as well as assess the recovery profile. Statistical adjustment for repeat testing is included so that a more accurate assessment of score recovery is obtained. Studies suggest that the combination of having both test scores and symptoms returned to baseline is a more specific and effective criteria than either alone.¹⁶ Special consideration can be made to test athletes with prolonged symptoms. This may help in guiding the clinical recovery process and assist in determining whether or not academic accommodations and specific cognitive rehabilitation techniques may be indicated.⁹ A trained neuropsychologist should be utilized, if available, to interpret test results and to help in managing such athletes.²³

Considerations for Retirement

We are starting to understand the long-term effects that athletes may suffer from repeated sport-related concussions. This raises the question of when to remove an athlete from the competitive season or recommend permanent retirement from competition. As with other concussion management decisions, this needs to be individualized, and many factors need to be taken into consideration. These include pathophysiology, neurology, neuropsychology, clinical sports medicine, prior concussion management, social factors, financial factors, and legal implications. Social pressure from family, coaches, agents, and teammates may drive the athlete to RTP despite persistent symptoms, thereby increasing the athlete's risk of concussion and potential for persistent disability.

While making a decision on retiring an athlete, it is a sports clinician's responsibility to include the athletes in the decision-making process and provide them with all information about their medical condition. A team approach should be used, and all parties should be in agreement. An additional consideration can be given to consulting with an independent

physician with knowledge and expertise in sport-related concussion to review the case and assist with the decision. The NFL currently uses this method.²⁹

Even though all cases should be individualized, there have been some suggestions to help guide the sports physician's decision:

- Season ending—Prolonged post concussive symptoms, three or more concussions in a single season, two or more severe concussions in a single season, decreased academic, and athletic performance, or clinically relevant imaging abnormality.
- Career Ending (Retirement)—Pathologic abnormality, such as Chiari malformation, an intracranial hemorrhage, clinically relevant imaging abnormality, diminished academic performance or cognitive abilities, persistent prolonged post-concussion syndrome, decreased threshold for concussion, three or more major concussions, or symptoms consistent with the clinical syndrome of Chronic Traumatic Encephalopathy.²⁹

State and Federal Government Legislation

Within the past few years, Texas (2007), Washington, and Oregon (2009) passed the first concussion-specific laws addressing scholastic sports. Each mandated education for coaches, immediate removal from play of any athlete suspected of a concussion in a game or practice and proper medical clearance before that athlete could return. Washington's law was named after Zackery Lystedt, a teenager who in 2006 sustained a serious brain injury while playing football. The "Lystedt law" is considered to be a template for other states considering similar legislation. This legislation covers youth sports beyond football including contact sports, such as girls' soccer and basketball, which have been recognized as resulting in concussions that often get neglected or are mistreated. The biggest problem with this legislation are the costs of implementing such a program which would include athletic trainers present at all practices and games as well as physician coverage for games. In many areas of the country, this is not financially or logistically possible.²⁸

The Federal Government has also gotten involved in the concussion debate, and the Government Accountability Office (GAO) published its report on the testimony given before the committee on education and labor of the House of Representatives on May 20, 2010. This report highlighted some of the differences in the wording and implementation of the state legislative efforts regarding the diagnosis of concussion and key aspects of clearance for RTP. The RTP requirements of the key state laws vary with respect to the conditions under which the requirements apply. The RTP requirements of the Texas law apply only to athletes with injuries that result in a loss of consciousness and therefore exclude many concussions. In contrast, the RTP requirements of the Oregon and Washington laws apply to athletes with symptoms or suspicion of concussion. While each state law requires that an athlete removed from play should receive written permission from a health care professional before returning to play; the laws vary in the types of health professionals who can provide such permission. The Texas law requires clearance from a physician, and the Oregon law requires clearance from a health care professional. The

Washington law requires that an athlete suspected of having a concussion be evaluated and cleared to return to play by a health professional specifically trained in the evaluation and management of concussion. Washington Interscholastic Athletic Association's (WIAA) website indicates that such professionals include medical doctors, doctors of osteopathy, advanced registered nurse practitioners, physicians' assistants, and licensed certified athletic trainers. According to the WIAA website, the organization is considering whether other licensed health care providers have sufficient training to qualify them to authorize RTP. The Oregon law is the only one of the three that specifically prohibits an athlete removed from play or practice from returning to play or practice on the same day.¹⁹

Collegiate and Profession Legislation

The National Collegiate Athletic Association (NCAA) and many professional sports organizations have adopted concussion management policies that have been more cautious and conservative. This becomes increasingly important because it not only protects their athletes but also provides education and sets an important example for athletes and organizations at all levels. The NCAA requires each school to have a concussion management plan. This includes education for student-athletes (SAs) on the signs and symptoms of concussion, a process to ensure that SAs with signs and symptoms be removed from play, no same-day RTP, and that the SAs receive medical clearance before returning to play. The development and implementation were placed on each institution and conference.²⁷ The National Football League (NFL) has developed sideline tools to determine whether an athlete is a "No-Go."²⁴ Their policy also states that, once removed from the duration of the game or practice, the athlete should not return until fully asymptomatic, has a normal neurological exam, normal neuropsychological testing, and has been cleared both by the team physician and the independent neurological consultant.¹ Major League Baseball (MLB) uses neuropsychological testing for all athletes, has established a 7-day disabled list for concussion, has instituted specific RTP guidelines, and gives the team physician the ability to consult with other physicians before clearance.²⁰ The National Hockey League (NHL) will remove any player with signs and symptoms of concussion and send them into the locker room for a 15 min uninterrupted exam. If he passes the tests the medical staff can clear him to return to the ice. The league is currently investigating a more rigorous protocol for concussion management which would include better equipment safety, evaluation of all 30 rinks, removal from games for athletes who show signs of "listlessness," holding clubs and coaches accountable when hits involve repeat offenders and naming a "blue-ribbon" committee to review all topics related to concussions.²⁶ The National Basketball Association (NBA) currently allows each individual team to follow its own concussion management protocol. They are currently working with a consulting neurologist regarding possible adoption of a league-wide policy.¹² Finally, Major League Soccer (MLS) has instituted a new policy to increase concussion awareness, formed a concussion committee, established baseline testing, player and coach education, removal from play secondary to signs and symptoms, MRI evaluation and each player must be asymptomatic for 3 days before beginning a progressive RTP approach.²⁵ Each organizations has their own specific

policies for clinicians to follow but all have the same underlying objective of increased safety, education, and a standardized protocol for concussion management.

Conclusions

Despite intense clinical and basic research into the pathophysiology and management of concussion, the RTP decision remains one of the most difficult and controversial in clinical sports medicine. The literature is often unclear and contradictory regarding specific diagnostic and therapeutic approaches. We believe that it is important for sports clinicians to develop a generalized systematic approach that is based on the currently available best practices. Johnston et al. have suggested a clinical strategy for concussion rehabilitation and RTP that is summarized below.^{10,15}

1. Prevent or correct additional disability—The authors enforce, through discussion about resistance training, the importance of following the step-wise RTP protocol as previously discussed.
2. Enhance systems unaffected by the pathologic condition—Unlike most sport injuries, concussion has a global, diffuse effect on the athlete's function and well-being. Therefore, concussion must be considered more of a systemic rather than a local problem and the value of rest, withdrawal from demanding environments, and general health advocacy measures must be emphasized. Rather than enhancing or maintaining other systems, measures to minimize activity are called for. This can be difficult for the athlete, given that physical fitness has generally been a lifelong commitment. Therefore, new strategies at early levels of rehabilitation are now being explored (e.g., low level aerobic exercise, yoga, Pilates, etc.) in an effort to provide both ongoing fitness maintenance and a structured physical program that does not exacerbate the problem. Such programs need to be carefully monitored by sports clinicians and adjusted to the athlete's tolerance on an individual basis.
3. Enhance functional capacity of symptoms affected by the disease—balance deficits are commonly seen in concussion, and balance retraining may have a role to play in recovery.¹¹ Although pharmacologic management of associated headache is commonly unsuccessful, treatment of associated sleep disruption has met with some success. In general, however, the common recurring theme of improvement with rest is documented and remains the mainstay of early management.
4. Use of adaptive equipment to promote function—In isolated situations systems retraining (vestibular, visual systems, etc.) may offer some advantage if that function is notably affected. Adaptive equipment may also be incorporated into the rehabilitation protocol with the use of sport-specific equipment, such as skating treadmills in hockey.

5. Modify social and vocational environment—While team interaction is very important for an athlete, it has the potential to impose its own supports and stressors. A balance of the “pros and cons” of that environment must be weighed for each individual case. In certain circumstances, it may be best for an athlete to stay with the team, whereas for another, temporary return to a home environment may be the best option. Regardless of the environment, regular follow up is also important. This allows for continuity of care and provides a venue for questions and concerns. Other contributing factors in the environment are related to lifestyle issues and substance use. Frank discussion is mandated to minimize the impact of such factors on concussion recovery.
6. Psychological techniques to enhance patient performance and education; the authors note that this strategy may be the single greatest tool currently available to help recovery. They note that interest in this area has stemmed and developed from the observation that there is significant overlap between some symptoms of concussion and affective disorders such as depression, anxiety, irritability, insomnia, and personality change. Further elaboration on these affective disorders is made through their publication.

Finally, the sports clinician must always remember that the long-term health and safety of the athlete is the primary concern. In addition, one must be aware of local, state, and national legislative efforts that may govern or significantly influence RTP clinical decision making. Using this team approach for clinical management, the RTP decision-making process will result in improved outcomes and reduced disability associated with the clinical syndrome of concussion.

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