

GUIDELINE 21

SPORT-RELATED CONCUSSION

June 1994 • Revised July 2004, 2009, July 2010, July 2011, July 2013, July 2014

In July 2014, the NCAA, in partnership with numerous medical and sport organizations, announced “Inter-Association Guidelines” (www.NCAA.org/ssi) that addressed diagnosis and management of sport-related concussion. The section in teal that follows is taken directly from these guidelines.

BACKGROUND

There are more than 42 consensus-based definitions of concussion. A recently published, evidence-based definition of concussion follows.¹

Concussion is:

- a change in brain function,
- following a force to the head, which
- may be accompanied by temporary loss of consciousness, but is
- identified in awake individuals, with
- measures of neurologic and cognitive dysfunction.

Diagnosis and management of sport-related concussion is a clinical diagnosis based on the judgment of the student-athlete’s health care providers.² The diagnosis and management of sport-related concussion is challenging for many reasons:

- The physical and cognitive examinations are often normal, and additional tests such as brain computerized tomography (CT), brain MRI, electroencephalogram and blood tests are also commonly normal. Although comprehensive neuropsychological tests may be a useful adjunctive tool supporting the diagnosis of sport-related concussion, there remains controversy regarding interpretation and utility as a clinical tool.
- The clinical effects of sport-related concussion are often subtle and difficult to detect with existing sport-related concussion assessment tools.
- The symptoms of sport-related concussion are not specific to concussion and it is challenging to evaluate a student-athlete who presents non-specific symptoms that may be related to other conditions.
- Sport-related concussion may manifest with immediate or delayed-onset symptoms. Symptom manifestation can vary between individuals and in the same individual who has suffered a repeat concussion.

- Modifying factors and co-morbidities -- such as attention deficit hyperactivity disorder, migraine and other headache disorders, learning disabilities and mood disorders -- should be considered in making the diagnosis, in providing a management plan, and in making both return-to-play and return-to-learn recommendations.³⁻⁷
- “Signal detection” on clinical measures (e.g., cognitive and balance testing) often quickly diminishes in the acute setting of early recovery. Although cognitive function and balance assessed within 24 hours with various sideline tests (Standardized Assessment of Concussion [SAC] and Balance Error Scoring System, respectively) have been shown to be useful in diagnosing concussion, these tests often normalize within a few days and cannot be used to make a definitive diagnosis.
- Student-athletes may underreport symptoms and inflate their level of recovery in hopes of being rapidly cleared for return to competition.^{8,9}
- Clinical assessment of sport-related concussion is a surrogate index of recovery and not a direct measure of brain structure and functional integrity after concussion.

In summary, the natural history of concussion remains poorly defined, diagnosis can be difficult, there are often few objective findings for diagnosis or physiological recovery that exist for clinical use, and there often remains a significant reliance on self-report of symptoms from the student-athlete.

The NCAA Concussion Policy and Legislation mandates that institutions implement the following:¹⁰

1. An annual process that ensures student-athletes are educated about the signs and symptoms of concussion;
2. A process that ensures a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from athletics activities and evaluated by a medical staff member with experience in the evaluation and management of concussion;
3. A policy that precludes a student-athlete diagnosed with a concussion from returning to athletic activity for at least the remainder of that calendar day; and
4. A policy that requires medical clearance for a stu-

dent-athlete diagnosed with a concussion to return to athletics activity as determined by a physician or the physician's designee.

GUIDELINES

The goals of developing guidelines for the diagnosis and management of sport-related concussion are: (1) helping athletic health care providers to diagnose and manage sport-related concussion; (2) developing prevention strategies for sport-related concussions and repeat sport-related concussion; (3) promoting sport-related concussion injury resolution; (4) minimizing factors that contribute to prolonged or recurrent symptoms of sport-related concussion; and (5) preventing or minimizing complications of other co-morbidities that may accompany sport-related concussion (e.g., ADHD, migraine and other headache disorders, learning disabilities and mood disorders).

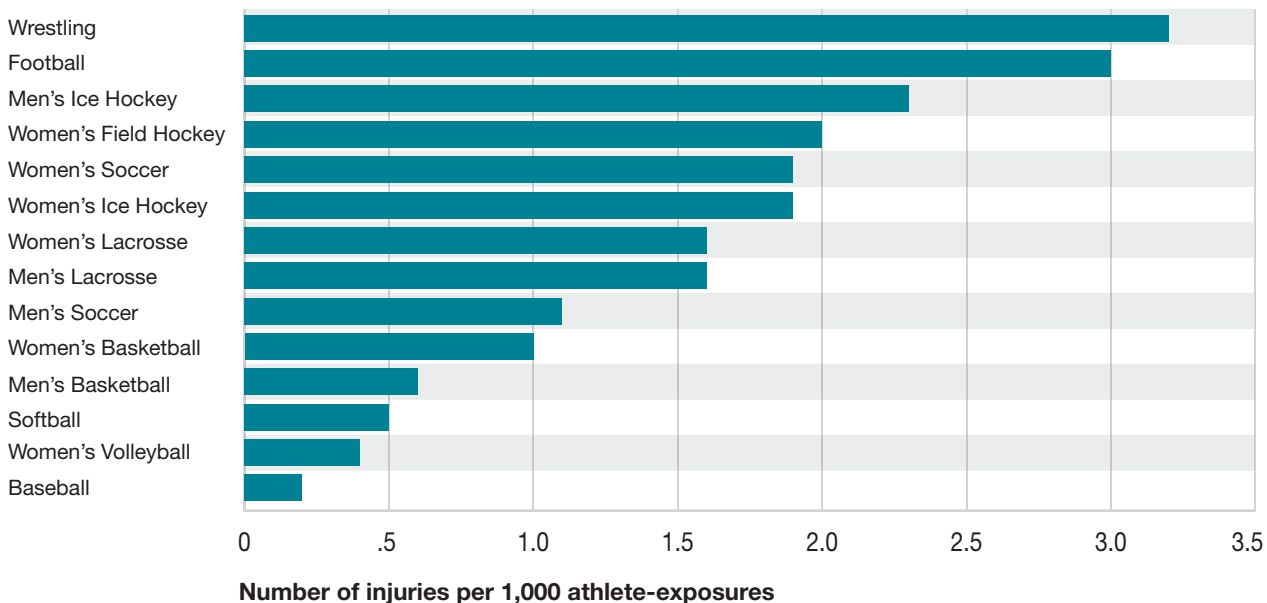
CONCUSSION MANAGEMENT PLAN

Institutions should make their concussion management plan publically available, either through printed material, their website, or both. Guideline components of a concussion management plan are:

1. Education: Institutions should provide applicable NCAA concussion fact sheets or other applicable educational material annually to student-athletes,



Figure 1: Rate of competition concussion injury in 14 NCAA sports



Data from 2004-05 to 2013-14. Overall practice and game injury rates for each sport can be found in

coaches, team physicians, athletic trainers, and athletics directors. There should be a signed acknowledgment that all parties have read and understand these concussion facts and their institution's concussion management plan.

2. Pre-participation assessment: A one-time, pre-participation baseline concussion assessment for all varsity student-athletes should include, but not necessarily be limited to:

- A brain injury/concussion history;
- Symptom evaluation;
- Cognitive assessment; and
- Balance evaluation.

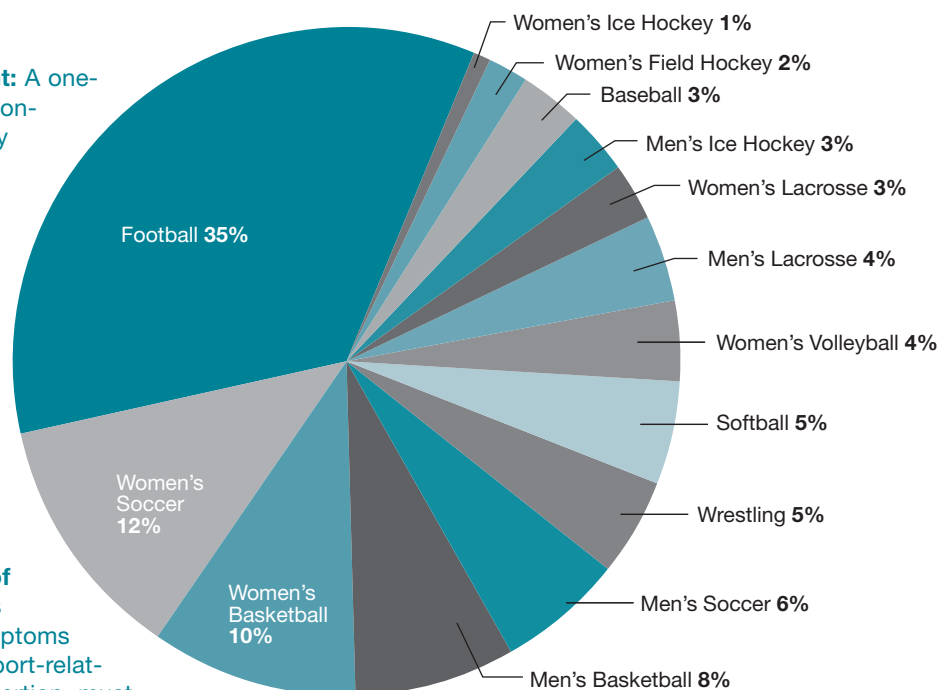
The team physician should determine pre-participation clearance and/or the need for additional consultation or testing.¹¹

3. Recognition and diagnosis of concussion:

All student-athletes who are experiencing signs, symptoms or behaviors consistent with a sport-related concussion, at rest or with exertion, must be removed from practice or competition and referred to an athletic trainer or team physician with experience in concussion management. A student-athlete's health care provider experienced in the diagnosis and management of concussion should conduct and document serial clinical evaluation inclusive of symptom inventory and evaluation of cognition and balance. A student-athlete diagnosed with sport-related concussion should not be allowed to return to play in the current game or practice and should be withheld from athletic activity for the remainder of the day. Disposition decisions for more serious injuries such as cervical spine trauma, skull fracture or intracranial bleed, should be made at the time of presentation.

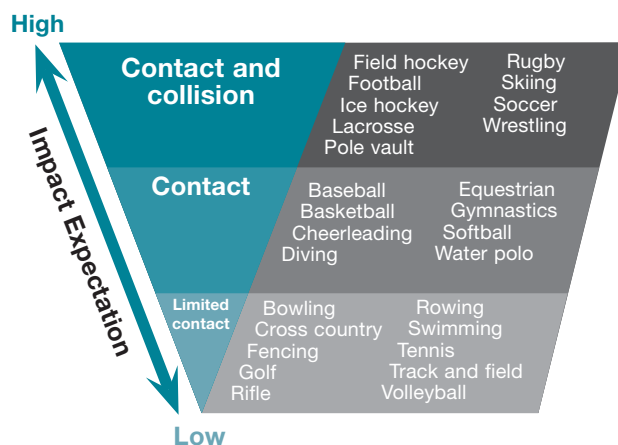
4. Post-concussion management: The foundation of sport-related concussion management is initial physical and relative cognitive rest as part of an individualized treatment plan.² Initial management of sport-related concussion is based on individual serial clinical assessments, taking a concussion history, modifying factors, and taking specific needs of the student-athlete into consideration. Such management includes, but is not limited to:

Figure 2: National annual estimate of concussions for practice and competition in 14 NCAA sports



Data from 2009-14.

Figure 3: Impact expectation by sport



- Clinical evaluation at the time of injury. When the rapid assessment of concussion is necessary (e.g., during competition), symptom assessment, physical and neurological exam, and balance

SIGNS AND SYMPTOMS OF CONCUSSION

Physical

- Headache
- Nausea
- Vomiting
- Balance problems
- Fatigue
- Sensitivity to light
- Numbness/tingling
- Dazed
- Stunned

Cognitive

- Feeling mentally “foggy”
- Feeling slowed down
- Difficulty concentrating
- Difficulty remembering
- Forgetful of recent information and conversations
- Confused about recent events
- Answers questions slowly

Emotional

- Irritable
- Sad
- More emotional
- Nervous

Sleep

- Drowsiness
- Sleeping more than usual
- Sleeping less than usual
- Difficulty falling asleep

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exam should be performed. Brief concussion-evaluation tools such as the Standardized Concussion Assessment Tool 3 (SCAT3), which includes the Standardized Assessment of Concussion (SAC), provide standardized methods and can be compared to a baseline evaluation.¹²

- Assessment for head and cervical spine injury at time of injury and implementation of the emergency action plan, as warranted.
- Transportation to the nearest hospital if any of following signs and symptoms are present: Glasgow Coma score less than 13; prolonged period of loss of consciousness (longer than one minute); focal neurological deficit; repetitive vomiting; persistently diminished or worsening mental status or other neurological signs or symptoms; and potential spine injury.
- Serial evaluation and monitoring for deterioration following injury. Upon discharge from medical care, both oral and written instructions for home care should be given to the student-athlete and to a responsible adult (e.g., parent or roommate) who should continue to monitor and supervise the student-athlete during the acute phase of sport-related concussion.¹²

RETURN TO ACTIVITY

Sport-related concussion is a challenging injury for student-athletes and, unlike other injuries, the timeline for return to full activity (including return-to-play and return-to-learn) is often difficult to project. The psychological response to injury is also unpredictable. Sometimes, student-athletes who are kept out of their sport for a prolonged period of time experience emotional distress related to being unable to participate in sport.¹³ It is important that health care providers remain alert to the

signs and symptoms of depression and other emotional responses to injury that can be particularly challenging following concussive injury.¹³ A student-athlete's health care providers should verify the diagnosis instead of assuming that the student-athlete has prolonged concussion symptoms. These symptoms may represent post-concussion syndrome, sleep dysfunction, migraine or other headache disorders, or co-morbid mood disorders such as anxiety and depression.⁷ Passive management, such as prolonged physical and cognitive rest, may be counter-productive in these scenarios.

RETURN-TO-PLAY

Once a student-athlete has returned to his/her baseline, the return-to-play decision is based on a protocol of a stepwise increase in physical activity that includes both an incremental increase in physical demands and contact risk supervised by a physician or physician-designee.¹² Most return-to-play protocols are similar to those in the Consensus Statement on Concussion in Sport guidelines,² which outline a progressive increase in physical activity if the individual is at baseline before starting the protocol and remains at baseline throughout each step of the protocol. It is noteworthy that all return-to-play guidelines are consensus-based and have not been validated by evidence-based studies.¹⁴⁻¹⁵ McCrea and colleagues¹⁶ have reported that a symptom-free waiting period is not predictive of either clinical recovery or risk of a repeat concussion. Further, student-athletes have variable understanding of the importance of reporting possible concussion symptoms.⁸⁻⁹ In summary, it should be recognized that current return-to-play guidelines are based on expert consensus.

There is emerging evidence that focused exercise or recovery techniques may be utilized before full recovery

has occurred, but more study is needed. Given the paucity of scientific evidence regarding return-to-play and expert consensus documents that have been published, adherence to consensus guidelines is recommended. However, it is important to stress an individualized approach for return-to-play. Some student-athletes may have minimal concussive symptomatology with minimal symptom duration and no modifiers (conditions that may prolong recovery such as prior concussion, migraine, ADHD, depression/anxiety). In scenarios of this nature, and with experienced clinicians in a highly select setting, the return-to-play protocol may be modified.¹⁷ In contrast, if a student-athlete has a concussion history, increased symptom burden or duration, or has symptoms for three to four weeks with other concussion modifiers, then the return-to-play progression should proceed more cautiously and each stage may take more than a day.¹²

Distinctive neurological deficits, such as vestibular or oculo-motor dysfunction, should be specifically addressed to avoid prolonged return-to-play. For example, if a student-athlete suffers from vestibular dysfunction as a manifestation of sport-related concussion, and is unable to progress in the return-to-play protocol, it is important to address the specific vestibular dysfunction rather than to simply return the student-athlete to the previous level of return-to-play progression.⁷ In other words, 'rest' can sometimes lead to adverse outcomes if an accurate diagnosis based on neurological dysfunction is not made. The guidelines presented herein serve as a general guide and are not meant to be prescriptive.

STEPWISE PROGRESSION

The initial management of sport-related concussion is relative physical and cognitive rest. Athletes diagnosed with sport-related concussion must be removed from play and must not return to sport-related activity for at least one calendar day and are to be evaluated by a health care provider with expertise in sport-related concussion. Once a concussed student-athlete has returned to baseline level of symptoms, cognitive function and balance, then the return-to-play progression can be initiated, as follows in this general outline:

1. Light aerobic exercise such as walking, swimming or riding a stationary bike. No resistance training. If asymptomatic with light aerobic exercise, then;
2. Mode, duration and intensity-dependent exercise based upon sport. If asymptomatic with such exertion, then;
3. Sport-specific activity with no head impact. If asymptomatic with sport-specific activity, then;

4. Non-contact sport drills and resumption of progressive resistance training. If asymptomatic with non-contact drills and resistance training, then;
5. Full-contact practice. If asymptomatic with full-contact practice, then;
6. Return-to-play. Medical clearance will be determined by the team physician/physician designee, or athletic trainer in consultation with a team physician.

At any point, if the student-athlete becomes symptomatic (i.e., more symptomatic than baseline), or scores on clinical/cognitive measures decline, the team physician should be notified and the student-athlete should be returned to the previous level of activity. Final determination of return-to-play ultimately resides with the team physician/physician designee.

RETURN TO ACADEMICS

Return to academics (return-to-learn) is a parallel concept to return-to-play,^{6,18-20} but has received less scientific evaluation. Return-to-learn guidelines assume that both physical and cognitive activities require brain energy utilization, and that after a sport-related concussion, brain energy may not be available for physical and cognitive exertion because of a brain energy crisis.³ Return-to-learn should be managed in a stepwise program that fits the needs of the individual, within the context of a multi-disciplinary team that includes physicians, athletic trainers, coaches, psychologists/counselors, neuropsychologists, administrators as well as academic (e.g. professors, deans, academic advisors) and office of disability services representatives. The return-to-learn recommendations outlined below are based on expert consensus. Like return-to-play, it is difficult to provide prescriptive recommendations for return-to-learn. The student-athlete may appear physically normal but may be unable to perform as expected due to concussive symptomatology.

STEPWISE PROGRESSION

As with return-to-play, the first step of return-to-learn is relative physical and cognitive rest. Relative cognitive rest involves minimizing potential cognitive stressors, such as school work, video games, reading, texting and watching television. Data from small studies suggest a beneficial effect of cognitive rest on concussion recovery.²⁰ For the college student-athlete, consideration should be given to avoiding the classroom for at least the same day as the sport-related concussion. The period of time needed to avoid class or homework should be individualized. The gradual return to academics should be based on the absence

STEPWISE RETURN-TO-PLAY PROTOCOL

1. Light aerobic exercise (Walking, swimming or stationary cycling; no resistance training.)

2. Mode, duration and intensity-dependent exercise based upon sport

3. Sport-specific activity with no head impact

4. Non-contact sport drills and resumption of progressive resistance training

5. Full-contact practice

6. Return to play

of concussion symptoms following cognitive exposure. The consensus to date includes:^{3,19}

1. If the student-athlete cannot tolerate light cognitive activity, he or she should remain at home or in the residence hall.
2. Once the student-athlete can tolerate cognitive activity without return of symptoms, he/she should return to the classroom, often in graduated increments.

At any point, if the student-athlete becomes symptomatic (i.e., more symptomatic than baseline), or scores on clinical/cognitive measures decline, the team physician should be notified and the student-athlete's cognitive activity reassessed.

The extent of academic adjustments needed should be decided by a multi-disciplinary team that may include the team physician, athletic trainer, faculty athletics representative or other faculty representative, coach, individual teachers, neuropsychologist and psychologist/counselor. The level of multi-disciplinary involvement will vary on a case-by-case basis. The majority of student-athletes who are concussed will not need a detailed return-to-learn program because full recovery typically occurs within two weeks. For the student-athlete whose academic schedule requires some minor modification in the first one to two weeks following a sport-related concussion, adjustments can often be made without requiring meaningful curriculum or testing alterations.

For those student-athletes whose symptoms persist for longer than two weeks, there are differing ways to access academic adjustment or accommodations. The student-athlete may need a change in his or her class schedule; special arrangements may be required for extended absences, tests, term papers and projects.

Many institutions offer “provisional or temporary” accommodations for individuals who have impairments that are short-term in nature – six months or less (such as a broken arm or concussion). Such accommodations are often accessed through the disability services office.

A more difficult scenario occurs when the student-athlete experiences prolonged cognitive difficulties. In this case, considerations should include neuropsychological evaluation to: (a) determine the nature and severity of cognitive impairment, and (b) identify the extent to which psychological issues may be present and may be interacting with the cognitive processes. Institutions can develop a detailed academic plan that specifies the support services available for that student-athlete. The student-athlete can also choose to disclose the documentation to the disability office in order to seek long-term accommodations or academic adjustments. The disability office will verify if the impairment is limiting a major life activity per the Americans with Disabilities Act. Accommodations or academic adjustments are often provided in order to “level the playing field” for the student-athlete with prolonged cognitive difficulties resulting from a concussion. A detailed academic plan coupled with accommodations can provide the needed support for a student-athlete as he or she returns to learning after a concussion.

The successful implementation of return-to-learn depends on several variables:

- Recognition that concussion symptoms vary widely among student-athletes, and even within the same individual who may be suffering a repeat concussion.
- Identification of a point person or case manager for the student-athlete who can navigate the dual obligations of academics and athletics.

- Identification of co-morbid conditions that may impair recovery, such as migraine or other headache conditions, attention-deficit hyperactivity disorder, anxiety and depression, or other mood disorders.
- Identification of campus resources that can help assure that student-athletes are provided their full rights during this transition period.

Campus resources vary, and may include the following:

- Learning specialists. Many college campuses have certified learning specialists who have specialized knowledge of medical conditions such as concussion and post-concussion syndrome. They usually work directly with the disability office.
- Office of disability services. Most campuses have a disability office that is responsible for verifying each student's impairment under the Americans with Disabilities Act Amendments Act (ADAAA). Sometimes there is a separate disability office and ADAAA office. In this case the first resource is the campus disability office. Concussion and mild traumatic brain injury are covered under ADAAA.

It is advisable for the concussed student-athlete's medical team to identify an academic point person and to be certain this academician is interwoven into the medical management plan. Because return-to-learn is often under-managed and under-recognized, there should also be broad discussions of this important paradigm with athletics departments across the country, engaging organizations such as the National Association of Academic Advisors for Athletics, the American College Personnel Association, NASPA, Student Affairs Administrators in Higher Education, the Coalition on Intercollegiate Athletics, National Athletic Trainers Association, College Athletic Trainers Society, American Medical Society for Sports Medicine and other allied organizations. Student-athletes are more likely to return successfully to full classroom activity in the setting of a proactive and well-integrated management plan.

SPORTS PARTICIPATION DEFINITIONS AND CONCUSSION EPIDEMIOLOGY

Concussion incidence varies among sports. The American Academy of Pediatrics published a classification of sports by contact in 2001. Then in 2013, the American Academy of Neurology's statement described contact and collision sports as those in which athletes purposely hit other athletes or inanimate objects. The purposeful collisions put athletes participating in this class of sports at greater risk for concussions. Limited contact sports were described

as those in which the force and the frequency of collisions, whether with other athletes or inanimate objects, are decreased. Noncontact sports were described as those in which players do not come in contact with athletes or inanimate objects by force.

The rate of concussion in NCAA sports can be assessed in various ways. Figure 1 demonstrates the rate of competition concussion per 1,000 student-athlete exposures. It is noteworthy that the higher rates occur in contact/collision sports. All meaningfully measurable rates occur in either contact/collision or limited contact/impact sports. It is also noteworthy that women have a higher rate of concussion than men for soccer and basketball. Another way to look at concussion is through annual estimates of the actual number of concussions within the sport, combining both practice and competition sessions. Figure 2 depicts the percentage of concussions from each sport given the total number of concussion in 14 NCAA sports.

Because of the large size of football teams and the higher rate of concussion relative to other sports, concussion incidence is highest in football. In assessing the available data, anticipating concussion risk can be made based on the sport; anticipating concussion risk can also be guided by impact expectation. For each sport, it is important to follow the institution's concussion management plan.

The NCAA reviewed various concussion guidelines in addition to the injury data across sports to classify sports by an expectation for impacts and collisions. Unlike the previous two classifications, this classification (Figure 3) lists lower-tier sports as limited contact because athletes are still at risk of a concussion both in sports and daily life.

POST-CONCUSSION RAMIFICATIONS

There is considerable controversy with regard to long-term implications of concussion. On one end of the spectrum, some claim that repeated concussions cause a neurodegenerative brain disease called chronic traumatic encephalopathy or CTE. On the other end of the spectrum, some claim that there are no significant long-term sequelae of concussion. The murky evidence lies somewhere in between.

Post-Concussion Syndrome. Post-concussion syndrome refers to prolonged concussion symptoms following concussion. It is not truly a "syndrome" because there is no core of consistent symptoms and there is no clear correlation with type or severity of concussion, biomarkers, or genetic/personality predisposition.

NCAA CONCUSSION POLICY AND LEGISLATION

The NCAA Executive Committee adopted (April 2010) the following policy for institutions in all three divisions:

“Institutions shall have a concussion management plan on file such that a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from practice or competition and evaluated by an athletics health care provider with experience in the evaluation and management of concussions. Student-athletes diagnosed with a concussion shall not return to activity for the remainder of that day. Medical clearance shall be determined by the team physician or his or her designee according to the concussion management plan.

“In addition, student-athletes must sign a statement in which they accept the responsibility for reporting their injuries and illnesses to the institutional medical staff, including signs and symptoms of concussions. During the review and signing process, student-athletes should be presented with educational material on concussions.”

NCAA adopted concussion management plan legislation

An active member institution shall have a concussion management plan for its student-athletes. The plan shall include, but is not limited to, the following:

- (a) An annual process that ensures student-athletes are educated about the signs and symp-

toms of concussions. Student-athletes must acknowledge that they have received information about the signs and symptoms of concussions and that they have a responsibility to report concussion-related injuries and illnesses to a medical staff member;

- (b) A process that ensures a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from athletics activities (e.g., competition, practice, conditioning sessions) and evaluated by a medical staff member (e.g., sports medicine staff, team physician) with experience in the evaluation and management of concussions;
- (c) A policy that precludes a student-athlete diagnosed with a concussion from returning to athletic activity (e.g., competition, practice, conditioning sessions) for at least the remainder of that calendar day; and
- (d) A policy that requires medical clearance for a student-athlete diagnosed with a concussion to return to athletics activity (for example, competition, practice, conditioning sessions) as determined by a physician (e.g., team physician) or the physician's designee.

Effect of violation. A violation of Constitution 3.2.4.17 shall be considered an institutional violation per Constitution 2.8.1; however, the violation shall not affect the student-athlete's eligibility.

Symptoms may be neurologic (e.g., dizziness, light sensitivity), cognitive (memory, attention deficits) and emotional (depression, anxiety). Post-concussion syndrome is best considered a neuropsychiatric disorder, and it is important to recognize that it has no bearing on the extent of, or expected recovery from, concussion. Post-concussion syndrome is best managed in a multidisciplinary manner that includes gradual increase in physical and cognitive activity. Management is distinctly different from acute concussion management, and individuals should not simply be relegated to prolonged rest, which may perpetuate the symptomatology.

Chronic Neurobehavioral Impairment. Cognitive and executive dysfunction has been described following multiple concussions. However, only two Class I studies exist, and these are for jockeys and rugby players. There

are seven Class II studies that include boxers, NFL players and soccer players, which demonstrate long-term cognitive impairment. Two studies show an association with apoE4 genotype, suggesting a genetic predisposition, and one study shows an association with a prior history of learning disability. There is one Class III study of NFL players. There is some correlation with magnitude of exposure and chronic neurobehavioral impairment in professional athletes, but the relationship between exposure and chronic neurobehavioral impairment in amateur athletes is uncertain. This may be from a combination of underpowered studies and possible brain adaptations that are different in younger individuals.

Depression. Depression also has been reported as a possible long-term manifestation of repeated concussion. Two Class II studies of retired NFL players note

an increased rate of depression in a dose-response manner, and one Class III study of retired NFL players notes a higher depression rate than the general population. There are also studies that show no clear relationship between depression and prior concussion. Of note: about 21 percent of college student-athletes report depression at baseline.

Chronic Traumatic Encephalopathy (CTE). CTE is a progressive neurodegenerative disease whose pathologic hallmark is abnormal tau deposition, with clinical manifestations of mood disorder, neuromuscular incoordination, dementia and death. There are not agreed-upon pathological and clinical criteria for CTE, although it seems clear that CTE is a distinct clinical entity from Alzheimer's disease. In a 2012 publication of CTE case series (Brain), CTE is described as a "progressive tauopathy that occurs as a consequence of repetitive mild traumatic brain injury." In the Zurich 2012 consensus paper, it is noted that "it is not possible to determine the causality or risk factors [of CTE] with any certainty. As such, the speculation that repeated concussion or subconcussive impacts cause CTE remains unproven." The universal consensus in the NCAA Concussion Task Force was that we need to better understand CTE with regard to genetic predispositions and biomarkers. No task force member noted a clear cause-and-effect relationship between concussion and CTE.

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ENDORSEMENTS

The 'Consensus Best Practice, Diagnosis and Management of Sport-Related Concussion' has been endorsed by:

- American Academy of Neurology
- American College of Sports Medicine
- American Association of Neurological Surgeons
- American Medical Society for Sports Medicine
- American Osteopathic Academy for Sports Medicine
- College Athletic Trainers' Society
- Congress of Neurological Surgeons
- National Athletic Trainers' Association
- NCAA Concussion Task Force
- Sports Neuropsychological Society

RESOURCES

- **NCAA Concussion Fact Sheets and Video for Coaches and Student-Athletes**
Available at NCAA.org/SSI.
- **Heads Up: Concussion Tool Kit**
CDC. Available at www.cdc.gov/ncipc/tbi/coaches_tool_kit.htm.
- **Heads Up Video**
NATA. Streaming online at www.nata.org/Heads-Up.

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National Athletic Trainers' Association Position Statement: Management of Sport Concussion



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Objective: To provide athletic trainers, physicians, and other health care professionals with best-practice guidelines for the management of sport-related concussions.

Background: An estimated 3.8 million concussions occur each year in the United States as a result of sport and physical activity. Athletic trainers are commonly the first medical providers available onsite to identify and evaluate these injuries.

Recommendations: The recommendations for concussion management provided here are based on the most current research and divided into sections on education and prevention, documentation and legal aspects, evaluation and return to play, and other considerations.

Key Words: mild traumatic brain injuries, pediatric concussions, education, assessment, evaluation, documentation

Despite a significant increase in research dedicated to identifying and managing sport-related concussion, it remains one of the most complex injuries sports medicine professionals face. Concussions occur from forces applied directly or indirectly to the skull that result in the rapid acceleration and deceleration of the brain. The sudden change in cerebral velocity elicits neuronal shearing, which produces changes in ionic balance¹ and metabolism.² When accompanied by clinical signs and symptoms, changes at the cellular level are commonly referred to as *mild traumatic brain injury*, or concussion. Concussions occur in males and females of all ages and in all sports, but are most common in contact and collision activities. Data collected from emergency department visits show a 62% increase (153 375 to 248 418) in nonfatal traumatic brain injuries between 2001 and 2009,³ with as many as 3.8 million reported and unreported sport- and recreation-related concussions occurring each year in the United States.⁴

As licensed medical professionals, athletic trainers (ATs) receive comprehensive didactic and clinical training in

concussion management. They are typically the first providers to identify and evaluate injured persons and are integral in the postinjury management and return-to-play (RTP) decision-making process. Without exception, ATs should be present at all organized sporting events at all levels of play and should work closely with a physician or designate who has specific training and experience in concussion management to develop and implement a concussion-management plan based on the recommendations outlined here.

An update to the initial 2004 National Athletic Trainers' Association position statement on the management of sport-related concussion,⁵ this document contains recommendations on concussion management for practicing ATs based on the most recent scientific evidence. A review of the literature supporting these recommendations has also been included. The document covers the topics of "Education and Prevention," "Documentation and Legal Aspects," "Evaluation and RTP," and "Other Considerations."

Table 1. Strength of Recommendation Taxonomy (SORT)^a

Strength of Recommendations	Definition
A	Recommendation based on consistent and good quality experimental evidence (morbidity, mortality, exercise and cognitive performance, physiologic responses)
B	Recommendation based on inconsistent or limited quality experimental evidence
C	Recommendation based on consensus; usual practice; opinion; disease-oriented evidence ^b ; case series or studies of diagnosis, treatment, prevention, or screening; or extrapolations from quasi-experimental research

^a Reprinted with permission from "Strength of Recommendation Taxonomy (SORT): A Patient-Centered Approach to Grading Evidence in the Medical Literature," February 1, 2004, American Family Physician. Copyright © 2004 American Academy of Family Physicians. All Rights Reserved.

^b Patient-oriented evidence measures outcomes that matter to patients: morbidity, mortality, symptoms improvement, cost reduction, and quality of life. Disease-oriented evidence measures are intermediate, physiologic, or surrogate end points that may or may not reflect improvements in patient outcomes (eg, blood pressure, blood chemistry, physiologic function, pathologic findings).

INJURY DEFINITION

To best assemble the available concussion research and remain consistent with other medical groups, we sought to evaluate literature that defined *concussion* as a "trauma-induced alteration in mental status that may or may not involve loss of consciousness."⁶ This definition was selected based on its broad application by medical organizations and widespread use within the literature from the time of the first National Athletic Trainers' Association position statement. We recognize the strength of the definition provided by the International Concussion in Sport Group and its subpoints as valid features that further define concussion.⁷ In evaluating and writing this document, we also included research defining concussive injuries in these terms. Notably absent from the literature and consistent with previous recommendations were the terms "ding," "getting one's bell rung," "clearing the cobwebs," and other such phrases in reference to concussive injuries.⁵ These colloquial terms are antiquated, minimize injury severity, and should not be used to refer to concussion or mild traumatic brain injury.

RECOMMENDATIONS FOR CLINICAL PRACTICE

Education and Prevention

The clinical practice recommendations for each topic have been graded based on the Strength of Recommendation Taxonomy (SORT; Table 1).⁸

1. The AT should use, and educate others in using, the proper terminology of concussion and mild traumatic brain injury as opposed to such colloquial terms as "ding" and "bell ringer."⁹ *Strength of Recommendation: B*
2. The AT should work with the appropriate administrators to ensure that parents and coaches are educated on the following aspects of concussion: prevention, mechanism, recognition and referral, appropriate return to participation, physical and cognitive restrictions for concussed athletes, and ramifications of improper concussion management.^{10–12} *Strength of Recommendation: B*
3. The AT should be aware of and document potential modifying factors that could delay the RTP, and patients should be educated on the implications of these conditions as they affect recovery (Table 2).⁷ *Strength of Recommendation: C*

4. The AT should work to educate coaches, athletes, and parents about the limitations of protective equipment for concussion prevention. *Strength of Recommendation: C*
5. As part of educational efforts, ATs, athletes, coaches, and parents should read all warning labels associated with protective equipment. *Strength of Recommendation: C*

Documentation and Legal Aspects

6. The AT should be aware of any and all relevant governing bodies (eg, state, athletic conference) and their policies and procedures regarding concussion management. *Strength of Recommendation: C*
7. The AT should document the athlete's (and when appropriate, the parent's) understanding of concussive signs and symptoms and his or her responsibility to report a concussion. *Strength of Recommendation: C*
8. The AT should communicate the status of concussed athletes to the managing physician on a regular basis. *Strength of Recommendation: C*
9. The AT should ensure proper documentation of the concussion evaluation, management, treatment, return-to-

Table 2. Factors That May Modify the Risk of Concussion and Duration of Recovery⁷

Risk	Modifiers
Symptoms	Number Duration (>10 d) Severity
Signs	Prolonged loss of consciousness (>1 min), amnesia
Sequelae	Concussive convulsions
Temporal	Frequency: repeated concussions over time Time: injuries close together in time Recency: recent concussion or traumatic brain injury
Threshold	Repeated concussions occurring with progressively less impact, force, or slower recovery after each successive event
Age	Child or adolescent (<18 y)
Comorbidities and premorbidities	Migraine, depressions, or other mental health disorders; attention-deficit hyperactivity disorder; learning disabilities; sleep disorders
Medication	Psychoactive drugs, anticoagulants
Behavior	Dangerous style of play
Sport	High-risk activity, contact or collision sport, high sporting level

participation progression, and physician communications.
Strength of Recommendation: C

Evaluation and RTP

10. Athletes at high risk of concussion (eg, those in contact or collision sports) should undergo baseline examinations before the competitive season.^{5,13,14} *Strength of Recommendation: B*
11. A new baseline examination should be completed annually for adolescent athletes, those with a recent concussion, and, when feasible, all athletes.^{15–17} *Strength of Recommendation: B*
12. The baseline examination should consist of a clinical history (including any symptoms), physical and neurologic evaluations, measures of motor control (eg, balance), and neurocognitive function.^{5,7,18–20} *Strength of Recommendation: B*
13. The baseline and postinjury examinations should be administered in similar environments that maximize the patient's abilities, and all baseline examinations should be reviewed for suboptimal performance.²¹ *Strength of Recommendation: C*
14. Any athlete suspected of sustaining a concussion should be immediately removed from participation and evaluated by a physician or designate (eg, AT). *Strength of Recommendation: C*
15. The concussion diagnosis is made through the clinical evaluation and supported by assessment tools.¹⁹ *Strength of Recommendation: B*
16. When the rapid assessment of concussion is necessary (eg, during competition), a brief concussion-evaluation tool (eg, Standardized Assessment of Concussion [SAC]^{20,22,23}) should be used in conjunction with a motor-control evaluation and symptom assessment to support the physical and neurologic clinical evaluation. *Strength of Recommendation: B*
17. Once a concussion diagnosis has been made, the patient should undergo a daily focused examination to monitor the course of recovery. *Strength of Recommendation: C*
18. During the acute postconcussion recovery stage, daily testing of neurocognitive function and motor control is typically not needed until the patient is asymptomatic.²⁴ *Strength of Recommendation: C*
19. A concussed athlete should not be returned to athletic participation on the day of injury.⁹ *Strength of Recommendation: C*
20. No concussed athlete should return to physical activity without being evaluated and cleared by a physician or designate (eg, AT) specifically trained and experienced in concussion evaluation and management. *Strength of Recommendation: C*
21. Young athletes with a past medical history that includes multiple concussions, a developmental disorder (eg, learning disabilities, attention-deficit hyperactivity disorder), or a psychiatric disorder (eg, anxiety, depression) may benefit from referral to a neuropsychologist to administer and interpret neurocognitive assessments and determine readiness to return to scholastic and athletic activities.^{7,25} *Strength of Recommendation: C*
22. A physical-exertion progression should begin only after the concussed athlete demonstrates a normal clinical examination, the resolution of concussion-related symp-

toms, and a return to preinjury scores on tests of motor control and neurocognitive function.^{7,26} *Strength of Recommendation: C*

23. Concussed athletes who do not show a typical progressive return to normal functioning after injury may benefit from other treatments or therapies. *Strength of Recommendation: C*
24. Concussion-grading scales should not be used to manage the injury. Instead, each patient should be evaluated and treated on an individual basis.^{7,9} *Strength of Recommendation: B*
25. After the injury has resolved, the concussion may be retrospectively graded for the purpose of medical record documentation. *Strength of Recommendation: C*

Other Considerations

Equipment.

26. The AT should enforce the standard use of certified helmets while educating athletes, coaches, and parents that although such helmets help to prevent catastrophic head injuries (eg, skull fractures), they do not significantly reduce the risk of concussions.^{7,27–29} *Strength of Recommendation: B*
27. Helmet use in high-velocity sports (eg, alpine sports,^{30–32} cycling^{33–35}) has been shown to protect against traumatic head and facial injury. *Strength of Recommendation: A*
28. Consistent evidence to support the use of mouthguards for concussion mitigation is not available. However, substantial evidence demonstrates that a properly fitted mouthguard reduces dental injuries.²⁹ *Strength of Recommendation: B*
29. Research on the effectiveness of headgear in soccer players to reduce concussion is limited. The use of headgear is neither encouraged nor discouraged at this time. *Strength of Recommendation: C*

Pediatric Concussion.

30. When working with children and adolescents, ATs should be aware that recovery may take longer than in adults and require a more prolonged RTP progression.^{7,36,37} *Strength of Recommendation: B*
31. Age-appropriate, validated concussion-assessment tools should be used in younger populations.^{7,25} *Strength of Recommendation: C*
32. Assessment of postconcussion symptoms in pediatric patients should include age-validated, standardized symptom scales and the formal input of a parent, teacher, or responsible adult.^{38–40} *Strength of Recommendation: B*
33. Pediatric athletes are undergoing continual brain and cognitive development and likely need more frequent updates to baseline assessments.^{16,41} *Strength of Recommendation: B*
34. Athletic trainers should work with school administrators and teachers to include appropriate academic accommodations in the concussion-management plan.^{7,39,42} *Strength of Recommendation: C*

Home Care.

35. The AT and physician should agree on a standard concussion home-instruction form (eg, Appendix A) that is consistently used for all concussed patients, and a copy should be maintained in the medical record. Both oral and written instructions for home care should be given to the

concussed athlete and to a responsible adult (eg, parent or roommate) who will observe and supervise the patient during the acute phase of the concussion.^{5,43} *Strength of Recommendation: C*

36. After a concussion diagnosis, the patient should be instructed to avoid medications other than acetaminophen. All current medications should be reviewed by the physician.^{5,44,45} *Strength of Recommendation: C*
37. After a concussion diagnosis, the patient should be instructed to avoid ingesting alcohol, illicit drugs, or other substances that might interfere with cognitive function and neurologic recovery.⁵ *Strength of Recommendation: C*
38. After the initial monitoring period, rest is currently the best practice for concussion recovery. As such, there is typically no need to wake the patient during the night unless instructed by a physician.⁵ *Strength of Recommendation: C*
39. During the acute stage of injury, the patient should be instructed to avoid any physical or mental exertion that exacerbates symptoms.^{5,7,28,39,42} *Strength of Recommendation: C*
40. In addition to exclusion from physical activity related to team activities, concussed student-athletes should be excused from any activity requiring physical exertion (eg, physical education classes). *Strength of Recommendation: C*
41. School administrators, counselors, and instructors should be made aware of the patient's injury with a recommendation for academic accommodation during the recovery period.^{7,28,39,42} *Strength of Recommendation: C*
42. A patient with a concussion should be instructed to eat a well-balanced diet that is nutritious in quality and quantity and should drink fluids to stay hydrated.⁵ *Strength of Recommendation: C*

Multiple Concussions.

43. For an athlete with a concussion history, the AT should adopt a more conservative RTP strategy.^{7,46,47} *Strength of Recommendation: B*
44. Referral to a physician or designate with concussion training and experience should be considered when an athlete with a history of multiple concussions sustains concussions with lessening forces, demonstrates increasing severity with each injury, or demonstrates objective or subjective changes in baseline brain function. *Strength of Recommendation: C*
45. The AT should recognize the potential for second-impact syndrome in young patients who sustain a second trauma to the brain prior to complete resolution of the first injury.^{1,48–50} *Strength of Recommendation: C*
46. The AT should be aware of the potential for long-term consequences of multiple subconcussive and concussive impacts.^{51–53} *Strength of Recommendation: C*

SUPPORTING LITERATURE REVIEW

Education and Prevention

When athletes, parents, coaches, administrators, and others discuss concussive injuries, they should use the appropriate medical terminology: *concussion* or *mild traumatic brain injury*. Use of such colloquial terms as

“ding,” “bell ringer,” and “getting your bell rung” has a connotation that mitigates injury severity and should thus be avoided. For example, a noted decline in neurocognitive ability at 36 hours after injury was reported in patients labeled as “dinged” whose symptoms appeared to resolve within 15 minutes.⁹ This finding demonstrates a more serious effect of what was initially considered a minor injury.

Before the competitive season, the AT should review all concussion policies and procedures that outline injury definition, signs and symptoms, and the institution's policy on concussion management (see “Documentation and Legal Aspects” below regarding how state laws and organizational body regulations may influence institutional concussion policy). In many instances, the AT has access to the most up-to-date information on concussion diagnosis and management. This information should be disseminated to all of those involved in athlete health care as rapidly as possible and in an appropriate manner. These individuals include but are not limited to coaches, athletes, parents, administrators, and other medical professionals. In addition to these documents, agencies have developed educational information specific to coaches, athletes, and parents that has been shown to effectively educate the target audience.^{54–56}

Athletes themselves have demonstrated limited knowledge regarding concussion symptoms; more than 50% of high school athletes⁵⁷ and 70% of collegiate athletes⁵⁸ did not report concussions sustained during football. One reason for nonreporting was that athletes were not aware of the signs and symptoms of concussion. Another study⁵⁹ of high school rugby players demonstrated more knowledge of concussion signs and symptoms (61%); however, the athletes had limited knowledge of postinjury concussion-management guidelines. For example, 25% of the athletes believed loss of consciousness was required for the injury to be considered a concussion.⁵⁹ Educational methods are effective in increasing athletes' awareness of concussion symptoms. Goodman et al⁶⁰ found that exposure to a concussion-symptom video game improved symptom identification among youth ice hockey players.⁶⁰ Similarly, Bramley et al⁶¹ noted that high school soccer players who received concussion education were more likely to report concussion symptoms to their coach.

Researchers⁵⁷ have documented athletes' lack of willingness to report concussions to medical personnel, so parents of youth athletes should also be educated to recognize signs and symptoms of concussion. Parents (or guardians) typically have the most contact with young athletes and so are well positioned to report atypical behavior, but many parents are not properly educated on the topic of concussion.⁶² Sullivan et al⁶³ reported that parents of male high school rugby athletes were knowledgeable about the signs and symptoms (83%) and the risks associated with continuing to play while injured (96%), yet only half were aware of the appropriate RTP guidelines after injury.

Even in the presence of an AT, coaches have the responsibility for recognizing the signs and symptoms of concussion in athletes. Several studies, however, have shown that coaches have limited knowledge and many misconceptions related to concussions. In a survey of youth sports coaches, 45% of respondents believed a concussion

did not require immediate removal from a game or practice, and only 62% could correctly identify proper postconcussion management.¹⁰ In another investigation,⁶⁴ high school coaches demonstrated greater overall knowledge of sport concussion (84%); they knew the most about injury recognition (92%) and the least about injury management (79%). Concussion-specific training is effective in improving injury knowledge: those attending a coaching education program¹⁰ or a coaches' workshop⁶⁴ scored higher than nonattendees on their respective surveys. Sarmiento et al¹¹ reported that 34% of high school coaches using the Centers for Disease Control and Prevention's "Heads Up" tool kit for concussion improved their concussion knowledge; specifically, they gained knowledge related to injury signs and symptoms. The coaches also noted that the tool kit changed their attitudes and behaviors related to concussion.¹¹ Similarly, a short (15–20 minute), interactive, online, concussion-education program aimed at youth sports coaches resulted in improvements in symptom knowledge, general knowledge, injury misconceptions, self-efficacy, and behavioral intention.¹² Collectively, these findings suggest that a brief training session on sport-concussion signs, symptoms, and injury management targeted at coaching staff can improve injury recognition. This type of training may ultimately benefit the AT by encouraging coaches to help identify concussed athletes and follow treatment plans.

After a concussive event, the AT should also educate the patient and any additional stakeholders (eg, parents and administrators) about the typical injury recovery. Although injury severity and a precise time to recover cannot be predicted immediately after injury, most concussed athletes return to their preinjury level of functioning within 2 weeks.⁶⁵ However, several factors, including specific symptom patterns,^{7,66} age, and sex,⁶⁷ may influence injury recovery and delay the return to participation (Table 2). Informing the patient about expected outcomes after injury may reduce anxiety about the injury and associated symptoms.^{7,68}

Documentation and Legal Aspects

Certified ATs, team physicians, and other health care providers responsible for the management of patients with sport-related concussion should be aware of potential liabilities involved with delivering medical coverage and making RTP decisions for patients. Concussion management has medical and legal implications, and the threat of lawsuits is increasing for sports medicine professionals. Previous lawsuits against ATs and team physicians have addressed the premature clearing of patients and, surprisingly, withholding patients from play after concussion.^{69–73} Therefore, it is imperative for clinicians to manage these injuries in a systematic manner, using objective assessments, while documenting their daily findings. Certain legal principles are common to the laws of each state, but material differences exist in the decisions of the higher courts for each state and in state statutes.⁷⁴ It is, however, the responsibility of the AT to follow the best-practice guidelines, recommendations, and practice limitations adopted by their respective work setting or oversight organization (eg, National Federation of State High School Associations, National Collegiate Athletic Association,

National Football League) and the best practices for licensed ATs established, in part, by the position statements of the National Athletic Trainers' Association. In addition, ATs working in states with concussion-management legislation are bound to follow those laws in the event of a discrepancy with organizational guidelines or position statements.

To avoid litigation, ATs should understand the general elements of negligence and malpractice that typically govern claims for injury or death caused by improper treatment. A *tort* is a private wrong or injury suffered by a person as the result of another person's conduct. The law gives injured persons the right to be compensated through the recovery of damages. Torts may be intentional, meaning that the person intended to act, or unintentional, in that the person did not mentally intend to cause harm. A tort is committed when an AT fails to act as an ordinary and reasonably prudent person under similar circumstances and causes injury to another person.^{74,75}

Negligence is an unintentional tort. Negligence law was founded on the principle that those who are harmed as the result of others' carelessness or failure to properly carry out responsibilities must be compensated. The person who was harmed has the burden of proving that the 4 legal elements of negligence are satisfied: a *duty of care* was owed as a result of a relationship that existed between the parties; the defendant *breached the duty* owed to the injured party; the breach of the duty is proved to be the *cause of the harm* to the plaintiff; and *actual harm*, not just the potential for harm, must have occurred. All 4 elements of negligence must be proven in order for the plaintiff to be compensated by the defendant for damages.^{75,76}

Athletic trainers employed to treat and manage athletic injuries such as concussion owe a duty of reasonable care to their patients and have been the target of lawsuits alleging failures to meet the standard of care after sport-related injury, especially concussion. Allegations against ATs in cases of negligence after concussion most often include improper evaluation and testing of the patient, improper documentation, misunderstood communications with the patient, and a lack of education of the patient or the patient's family.⁷⁷ For ATs to minimize the risk of becoming defendants and to better defend themselves should a case be filed, they must understand the standard of care for managing specific injuries based on the most recent scientific literature. The *standard of care* in athletic training is defined as a person's "legal duty to provide health care services consistent with what other health care practitioners of the same training, education, and credentialing would provide under the circumstances."⁷⁸ Athletic trainers can learn how the standard of care is applied to legal cases by examining specific cases and the firsthand experiences of those who have defended ATs during the litigation process.⁷⁷

The athletic training profession must identify and adopt standard practice limitations and guidelines to establish the standard of care for managing concussions and other brain injuries. Ambiguity and the lack of a clear standard make it easier for plaintiffs' lawyers to construct theories of liability for lawsuits against ATs, alleging they breached the standard of care after a suspected concussion.⁷⁷ Lawsuits against ATs often involve the evaluation or testing of the patient (or lack thereof), documentation of an

injury, communications with the patient or with a physician about a patient, and education of the patient.

In a 2008 California case, an AT was found liable for failing to properly and promptly evaluate a patient who apparently had sustained a concussion only to later pass out, fall, and suffer a variety of physical injuries as a result of the AT's alleged failures.⁷⁹ The court ordered the defendants to pay substantial damages to the injured patient. In another case, a University of Tennessee football player recovered hundreds of thousands of dollars when an AT allegedly failed to promptly report a patient's initial and ongoing symptoms to a physician. The patient subsequently sustained an acute subdural hematoma in connection with an injury incurred 1 month later.⁸⁰ In another case, a high school football player alleged that his AT failed to properly evaluate him or take seriously his reported headaches and dizziness after a concussion and then prematurely returned him to play, which allegedly caused the patient to suffer second-impact syndrome after a second concussion 2 weeks later.⁸¹ In this case, although the jury awarded no damages to the injured player, the cost to the defendants was 3 years of litigation, substantial legal fees and expenses, and a month-long, stressful, high-profile trial.

Another possible allegation in the cases against ATs involves the lack of documentation in managing a sport-related concussion. For several years, ATs have been advised to document "all pertinent information" surrounding concussions.⁵ The documentation of information surrounding the evaluation and management of any suspected concussion should include but not be limited to (1) mechanism of injury; (2) initial signs and symptoms; (3) state of consciousness; (4) findings of the physical and neurologic examinations, symptoms, neurocognitive function, and motor control (noting any deficits compared with baseline); (5) instructions given to the patient or parent (or both); (6) recommendations provided by the physician; (7) graduated RTP progression, including dates and specific activities; and (8) relevant information on the patient's history of prior concussion and associated recovery pattern(s). Though lengthy, this level of detail can help prevent a premature return to participation, catastrophic brain injury such as second-impact syndrome, and legal liability. The expression "if it's not written, it didn't happen" is often used in legal situations. The question in these cases sometimes becomes whether certain information is or is not "pertinent." For example, at some point during a concussed athlete's RTP progression, he or she will begin performing graduated exertional exercises (see "Evaluation and RTP" below). Daily documentation of the details surrounding this progression will help to avoid potential litigation in the event that the recovery or return to participation does not proceed as expected. For example, the dates on which the testing was performed, the witnesses to the testing, the actual maneuvers the patient performed, and the patient's description of any symptoms during or after activity should be documented. The value of this documentation may not be realized for some time, as legal trials generally occur years after the alleged improper conduct, when it is unlikely that anyone can accurately recall the details if they were not recorded at the time.

At the time of writing, all 50 states have enacted concussion laws. Nearly all of these laws include the components of (1) educating athletes, parents, and coaches;

(2) instituting a concussion policy and emergency action plan; (3) removing the athlete from practice or play at the time of the suspected concussion; and (4) having a health care provider with training in concussion management perform medical evaluation and RTP clearance. The AT must know the laws of the state and recognize that failure to warn or educate the athlete can be the basis for another possible allegation. One simple way to educate athletes about the dangers of concussion and continuing to play while still symptomatic is to require them to read and sign a standard acknowledgment form indicating that they understand the signs and symptoms of concussion and their responsibility to report a concussion (Appendix B). Some legal experts even suggest that athletes should sign an acknowledgment that they understand the warning a manufacturer has placed on a helmet. For example, some football helmets carry warnings such as this:

Contact in football may result in concussion/brain injury, which no helmet can prevent. Symptoms include loss of consciousness or memory, dizziness, headache, nausea, or confusion. If you have symptoms, immediately stop and report them to your coach, [athletic] trainer, and parents. Do not return to a game or contact until all symptoms are gone and you receive medical clearance. Ignoring this warning may lead to another and more serious or fatal brain injury. No helmet system can protect you from serious brain and/or neck injuries, including paralysis or death. To avoid these risks, do not engage in the sport of football. (Reprinted with permission of Schutt Sports.)

In catastrophic cases where such an acknowledgment of understanding has not been secured by the AT, a "failure to warn" claim almost certainly will be made against the AT, especially when the plaintiff alleges that the patient never recovered from an earlier injury. Thus, before each season, at a minimum, the AT should require that each athlete read a concussion fact sheet, read the aforementioned warning on the helmet, and sign an acknowledgment that he or she read and understood both. Not only do these acknowledgments serve as a possible defense to a failure-to-warn claim, but under certain circumstances, they may also be used to establish that the patient is legally responsible for his or her own injuries (if, for example, the athlete reports symptoms to teammates but withholds the information from team personnel and continues to play). When a defendant asserts and can show that the plaintiff's injuries are a result of the plaintiff's own negligence, the defendant may prevail on a theory of contributory negligence or comparative negligence, which could bar the plaintiff from recovering any damages whatsoever.

The more education the AT provides to the patient (and parents of a patient who is a minor) concerning the risks of RTP before a complete recovery after a concussion (eg, the risk of playing while still symptomatic), the greater the likelihood of success the AT will have in defending against a failure-to-warn or failure-to-educate claim. More importantly, enhanced education to athletes should translate into more informed participants, which should lead to fewer catastrophic injuries.⁷⁷ Finally, it is imperative that practicing ATs understand their individual state laws on concussion management because some states have made

Table 3. Suggested Domains of the Clinical History and Examination for Concussion Management

Domain	Features or Examples	How to Assess? ^a
Previous concussions	Date(s) and circumstances; presence and duration of loss of consciousness, amnesia, and symptoms with each injury	Preparticipation examination
Concussion-related personal history	Mood disorder, learning disability, attention-deficit hyperactivity disorder, epilepsy or seizures, sleep apnea, skull fracture, migraine headaches	Preparticipation examination
Family history	Mood disorder, learning disability, attention-deficit hyperactivity disorder, dementia (eg, Alzheimer disease), migraine headaches, complications from concussions	Preparticipation examination
Symptoms	Current and recurrent	Symptom checklist or scale
Mental status	Level of consciousness, attention and concentration, orientation, memory	Standardized Assessment of Concussion
Eye examination	Eye movements with smooth pursuit (cranial nerves III, IV, VI), nystagmus (VIII), pupillary reflex (CN II, III)	Clinical examination
Muscle strength	Strength evaluation of deltoids, biceps, triceps, wrist and finger flexors and extensors ^b ; pronator drift	Clinical examination
Motor control	Balance assessment	Balance Error Scoring System
Cognitive function	Reaction time, working memory, delayed recall	Neurocognitive testing

^a Assessment tools are indicated where available.

^b Notable deficits may be associated with nerve root injury or concussion.

provisions for ATs to clear a concussed athlete to RTP. However, a physician with specific training and experience in concussion management should still be involved in the comprehensive approach to concussion management outlined in this position statement. A concussion-management policy outlining the roles and responsibilities of each member of the sports medicine team should be adopted.

Evaluation and RTP

Approach to Concussion Evaluation. The clinical presentation of concussion varies considerably both between individuals and between injuries in 1 individual. Additionally, the degree of brain dysfunction manifested by concussion often produces signs and symptoms that fall within the range of normal experiences in the population (eg, dehydration, fatigue, anxiety). For these reasons, a concussion-assessment model that uses objective baseline testing and careful postinjury testing is recommended. Although all athletes should ideally undergo a preseason baseline assessment, at a minimum, athletes who are at a high risk of concussion based on their sport^{67,82} should be included in any baseline testing program. Furthermore, athletes with a significant concussion history or other relevant comorbidity, such as attention-deficit hyperactivity disorder, should be considered for testing on an individual basis.

The intent of baseline testing is to aid the clinician in the postinjury management process by providing data that represent an athlete's brain function in an uninjured state. Objective baseline and postinjury information can be highly sensitive to concussive injuries,¹⁹ but the concussion diagnosis is made by clinically evaluating the injured athlete. In this way, postinjury retesting should not be considered a diagnostic tool for concussion, nor should it be used as a sole determinant of when it is safe to return to participation; rather, it is a supplement to support the clinical examination. These data are then best used as part of a comprehensive concussion-management approach that is communicated to the directing physician and other members of the sports medicine team with concussion training and experience.

Baseline Testing. The baseline evaluation of an athlete for the purpose of concussion management should include a

documented neurologic history with symptoms and physical examination (Table 3). Baseline testing should also involve the objective evaluation of multiple spheres of brain function and, at minimum, assess neurocognitive performance and motor control. Obtaining premorbid self-report symptoms is also recommended for comparison with postinjury symptom presentations and for improved interpretation of other test data. Additionally, medication use should be carefully documented and made available for postinjury review.

Numerous testing methods are available for concussion management. When selecting specific tests and procedures for the concussion-assessment and concussion-management protocol, the AT should consult with members of the sports medicine team regarding the best tools for the clinical setting and secure written approval from the administration. When selecting specific assessment tools, the AT must also be aware of the limitations and requirements of the particular baseline test being considered. For example, the reliability of computer-based cognitive tests varies with the test-retest interval,^{83–87} and additional costs may be incurred to interpret test results.^{88,89}

Once the tests are selected, care should be taken to provide each athlete with an environment that is designed to maximize test performance and be easily reproduced in the postinjury setting. Large-group administration of baseline tests is discouraged; small-group administration is preferable. Having a sufficient number of proctors and using standardized procedures are important.²¹ The AT should avoid conducting tests at unusual times of the day to ensure that athletes are reasonably rested and not physically or mentally fatigued after a practice or workout. Whenever possible, athletes should not undergo baseline testing when they are ill or injured in a manner that could influence test results. Lastly, if appropriate resources are available, the AT should conduct annual baseline tests on athletes. This is most crucial in adolescents, whose brains are continuing to develop,^{15–17} and in those who have sustained a concussion since their previous test.

Self-Report Symptom Assessment. Collecting subjective symptom information from a patient is a dynamic and complex process. Using symptom checklists (ie, *yes/no*) or scales (ie, graded and summed responses)

that assess symptom duration or severity (or both) in a standardized manner⁹⁰ is recommended. In general, symptom reports provide good sensitivity to concussive injuries,^{19,20} but the degree to which symptom reports can be a useful part of the neurologic history and examination in concussion management is potentially minimized by their limitations. Because of the nature and physical demands of athletics, an evaluation of concussion-related symptoms can yield low specificity compared with the reference standard of clinician-diagnosed concussion. That is, concussion-like symptoms are also commonly reported in athletes who are dehydrated⁹¹ and those who have performed strenuous activity⁹²; the presence of these symptoms does not mean the athlete will demonstrate balance or neurocognitive impairments.⁹³ In addition, for a variety of reasons, athletes may be motivated to underreport symptoms so they can continue activity after injury.⁵⁷

Numerous concussion inventories are available for clinical use, including the Head Injury Scale,⁹⁴ Graded Symptom Checklist,⁵ Concussion Symptom Inventory,^{7,95} and Sport Concussion Assessment Tool 3 (SCAT-3).⁷ The AT should choose a symptom-evaluation protocol that best suits his or her clinical practice and be consistent in its administration.

Motor Control. The diffuse effects of concussive injuries on brain function can often lead to deficits in motor control. Changes in motor control after injury have been documented in several areas, including gait,^{96,97} postural control,^{65,98–100} and hand movement¹⁰¹. As such, the assessment of 1 or more motor-control systems can provide useful information for concussion diagnosis and management. Perhaps the most common concussion-assessment tool is the evaluation of postural control. Overall balance deficits after injury have been attributed to failure to integrate sensory information arising from the vestibular and visual components of the balance mechanism.^{98–100} The Sensory Organization Test, although used successfully to quantify changes to the balance mechanism,^{19,102} is limited by cost and portability. In the initial days of injury, the Balance Error Scoring System (BESS) demonstrates similar injury sensitivity,^{20,65} is highly portable, and can be administered with minimal cost and training. As with other concussion-assessment tools, the AT should select the tools that best suit the clinical setting, be trained in their proper administration,^{103,104} understand their limitations,^{105–110} and use consistent methods in baseline and postinjury evaluations.

Mental-Status Testing. A change in mental status is the hallmark of concussion,⁶ yet concussed athletes rarely present with easily identifiable signs of injury. In fact, loss of consciousness is present in fewer than 10% of patients and posttraumatic amnesia in 25% of patients.⁴⁶ In the absence of easily identifiable signs after concussion, an objective measure of mental status can significantly aid the AT in making the sideline diagnosis. Traditional questions of mental status involving questions of orientation about time (eg, what time is it?), location (eg, where are we?), and the person (eg, when is your birthday?) are ineffective in the sporting environment.¹¹¹ The SAC was developed as a brief mental-status screening tool and is recommended for sideline use when comprehensive neurocognitive testing (see the next section) is not available or applicable. The

SAC is a 5-minute test that evaluates the domains of orientation, immediate memory, concentration, and delayed recall.²³ As a stand-alone measure used immediately after concussion, the SAC is highly sensitive to injury; its sensitivity is further increased when used with a symptom inventory and motor-control test.²⁰ Sensitivity of the SAC to concussion declines 24 hours after injury; thus, use of the test to evaluate cognitive functioning is not recommended beyond this point.²⁰

Neurocognitive Testing. Neurocognitive testing has historically been viewed as the cornerstone of the concussion-assessment process,¹¹² yet when used in isolation, this technique does not provide clinically adequate sensitivity to concussion.^{19,20,113} Therefore, neurocognitive testing should never be used in isolation but rather in conjunction with symptom and motor-control assessments to support the clinical examination. Historically, pencil-and-paper tests, such as the Digit Span, Controlled Oral Word Association Test, and Hopkins Verbal Learning tests, have been used to evaluate concussive injuries. Several computer-based platforms are now available, including the Automated Neuropsychological Assessment Metrics (ANAM), Cogstate Axon, Concussion Vital Signs, Headminder Concussion Resolution Index (CRI), and Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT). The testing protocol should evaluate those domains known to be affected by concussion: information processing, planning memory, and switching mental set.¹¹² Similar to other assessment methods, neurocognitive testing has limitations,¹¹⁴ and the AT should become familiar with the benefits and limitations of the testing methods selected.^{19,113,115,116}

Regardless of the instrumentation, the emphasis should be on maximizing performance on the baseline and postinjury assessments. The test should be explained to the athlete before the assessment begins, and a distraction-free testing environment should be provided.²¹ After the baseline assessment, test scores should be reviewed using the manufacturer's validity criteria to ensure that the athletes gave maximal effort; those demonstrating suboptimal effort should retake the test.¹¹⁷ Once an athlete is injured, the AT and medical staff should limit the number of tests to time points that are critical to injury management to avoid performance improvements resulting from practice effects.^{118,119} Also, although some tests provide automated pass or fail scoring, these outputs may not accurately reflect the patient's injury status and are not recommended for clinical use.⁸⁶ A neuropsychologist or physician with specific concussion training should interpret the postinjury data.⁸⁹

Diagnosing Concussion. Concussion diagnosis in the athletic environment can be difficult given the pressures and time restrictions of competition. Some sports allow for unlimited injury-evaluation time, but others do not. Regardless of the time allotment, the AT and the medical staff should never feel pressured to complete a concussion assessment. At the time of suspected injury, the initial evaluation should assess acute trauma. If the athlete is unable to leave the field under his or her own power, the AT should perform a primary survey, including evaluation of airway, breathing, and circulation (ie, the ABCs). Whether the patient is conscious or not, the AT should suspect and, if

possible, rule out a cervical spine injury and other more severe injuries. Once no life-threatening injuries are determined to be present, the concussion examination should begin.

Any athlete suspected of having a concussion should immediately be removed from participation and a systematic injury evaluation conducted. The intent of the concussion examination is to establish if the athlete should be removed from further participation. Regardless of the assessment measures used as part of the concussion-management protocol, the concussion diagnosis is made after a thorough clinical examination (Table 3). The clinical examination should include an injury history (including symptoms), observation of the patient, palpation for more severe orthopaedic or neurologic injury, and special tests for mental status and motor control (described earlier).^{120,121} Brief assessments that rely on the patient's response to such simple questions such "Are you OK?" or "Can you go?" are not supported and should not be used. The concussion assessment conducted by the AT should be implemented in a consistent fashion as part of a comprehensive neurologic evaluation. When a physician is not readily available, the AT should be more conservative when interpreting the clinical-examination results and making the injury diagnosis.

Transport to a medical facility for a concussion is not typically required but may be necessary if the patient is unconscious for a prolonged period of time (>1 minute), shows declining mental status during or after the injury evaluation, or demonstrates signs and symptoms of an injury more severe than a concussion. For a patient who is transported, the attending physician may recommend imaging to rule out injuries more severe than concussion, but computed tomography and magnetic resonance imaging add little to the concussion-evaluation process.⁷ Although other diagnostic techniques, such as functional magnetic resonance imaging,¹²² diffusion tensor imaging, magnetic resonance spectroscopy,^{2,123} serum biomarkers,¹²⁴ and biomechanical techniques^{125,126} may be helpful in identifying and diagnosing concussion, their exclusive use as diagnostic tools has not been validated.

Postinjury Management. Once an athlete has been diagnosed with a concussion, he or she should be removed from the sport and not allowed to return to physical activity until cleared by a physician or designate, no sooner than the next day. The patient should not be left unattended on the sideline, and mental status should be regularly monitored. A notable decline in mental status may reflect more severe trauma and indicate that transport to a medical facility is necessary. In most instances, however, the patient can be sent home with appropriate postinjury instructions (see the "Home Care" section).

Once the concussion diagnosis has been made, a focused examination of the patient should be conducted daily to ensure a normal course of recovery. The magnitude of impact^{127,128} or postinjury decrements relative to preinjury testing should not be interpreted as a measure of injury severity or a predictor of how long the patient should be withheld from sport.¹²⁹ Indeed, although the concept of grading injury severity based on such factors as the presence or absence of consciousness, symptom duration, and mental status has previously been supported,⁵ this is no longer the case. Each patient and each injury should be

treated uniquely, focusing on cessation of symptoms and restoration of motor control, and neurocognitive test results should revert to preinjury levels before an RTP progression is implemented.

During the acute recovery period, the patient should be instructed to avoid physical activity (eg, workouts, conditioning, physical education) and limit cognitive activity (eg, academic work, video games, computer use) so as to not exacerbate concussion symptoms. Physical activity during the acute phase can have a detrimental effect on recovery,¹³⁰ but the effect of cognitive stress on concussion recovery is less clear. As such, limiting cognitive activities to avoid worsening concussion symptoms is favored over complete isolation of the patient, which may result in the exacerbation of concussion-like symptoms unrelated to the injury.¹³¹

Once the patient no longer reports concussion-related symptoms and the clinical examination is normal, then objective assessments should be repeated and compared with baseline performance. The patient's reports of concussion-related symptoms are used as the primary measure to advance to the next stage in postconcussion management, so careful attention should be paid to steady resolution over time. In most instances, patients who no longer report concussion-related symptoms demonstrate preinjury performance levels on cognitive and motor control tests, but up to 40% of asymptomatic patients have continued cognitive declines.^{118,119} Therefore, the return-to-activity decision-making process should not begin until the patient no longer reports concussion-related symptoms, has a normal clinical examination, and performs at or above preinjury levels on measures of neurocognitive function and motor control. Although the duration of recovery demonstrated by individual patients on neurocognitive and motor-control tests varies, young adult males typically return to preinjury levels of functioning within 2 weeks.⁶⁵ Female patients and younger patients may suffer from postinjury declines for 14 days or longer.^{36,132} Those reporting dizziness at the time of injury may have a protracted recovery,⁶⁶ and those suffering from concussion symptoms beyond 30 days may be diagnosed with postconcussive syndrome.¹³³ Some evidence suggests that normative data can be used for postinjury evaluations when baseline testing is not available.¹³ This scenario, however, is not ideal, and a more conservative injury-management strategy is warranted in these instances. During the recovery process, the AT should maintain regular contact with the directing physician to track the recovery and ensure that appropriate medical care is provided if recovery does not proceed normally.

Return-to-Play Decision Making

After an athlete is diagnosed with a concussion, the RTP progression should not start until he or she no longer reports concussion-related symptoms, has a normal clinical examination, and performs at or above preinjury levels of functioning on all objective concussion assessments. The exertion progression should follow the pattern outlined in Table 4; the typical time frame consists of 24 hours between levels.⁷ However, if activity at any stage results in a return of symptoms or a decline in test performance,¹³⁴ then the activity should be immediately halted and restarted

Table 4. Return-to-Play Progression

Stage ^a	Physical Activity
1	No activity
2	Light exercise: <70% age-predicted maximal heart rate
3	Sport-specific activities without the threat of contact from others
4	Noncontact training involving others, resistance training
5	Unrestricted training
6	Return to play

^a Stages should be separated by at least 24 hours.⁷

24 hours later. The RTP timing is case dependent, but most patients diagnosed with a concussion can expect to be withheld from competition for at least 1 week. The AT can lengthen the sequence if symptoms return during recovery or the patient has other comorbidities that may affect recovery. The directing physician can shorten the timeline when appropriate. Regardless, no patient diagnosed with concussion should return to physical activity on the day of injury. An extended RTP progression may be necessary if the patient is held out for an extended amount of time and requires reconditioning for sport participation.

Other Considerations

Equipment. It would seem natural that preventing concussion would include the appropriate use of protective equipment or other mechanisms. However, the literature to date does not support equipment as a means of concussion prevention. In a 2009 systematic review, Benson et al²⁹ evaluated 51 studies of protective equipment (helmets, headgear, mouthguards, face shields) to determine if any form of protective equipment was useful in preventing sport-related concussion. Their results suggest that helmet use can reduce the risk of more serious head (eg, skull fracture) and brain (eg, subdural hematoma) injuries in recreational sports such as skiing, snowboarding, and bicycling. Yet the ability of these devices to prevent concussion was inconclusive.²⁹ The authors also assessed the use of mouthguards and face shields and found no strong evidence to suggest that either device decreases concussion risk.²⁹ Nonetheless, some published evidence in ice hockey indicates that, compared with a half-face shield, a full face shield offers a better fit and protection that may decrease the time lost from competition after a concussion.²⁹

More specifically, no differences were noted in the incidence of concussion between American football players^{135,136} or Australian rules footballers¹³⁷ wearing custom or noncustom mouthguards. No differences in concussion incidence were seen in rugby,^{138,139} ice hockey,¹⁴⁰ or basketball¹⁴¹ players who did or did not wear mouthguards. In addition, researchers¹⁴² found no differences in neurocognitive impairment at the day-3 follow-up between athletes who reported wearing or not wearing a mouthguard at the time of concussion.

The use of protective headgear to decrease the risk of concussion in rugby is inconclusive. One group¹⁴³ found a decrease in the risk of concussion among English premier rugby athletes who wore headgear; however, in 3 studies^{139,144,145} of youth or college rugby athletes, no association was noted between wearing headgear and decreased risk of concussion. Studies of headgear use in soccer have largely been laboratory based and focused on

biomechanical variables.^{146–148} In 1 investigation,¹⁴⁹ a small decrease in self-reported concussions was demonstrated in youth athletes wearing soccer headgear, but these results have not been replicated.

Pediatric Concussion. Sport-related concussion is a significant concern in the pediatric population. Data from the National Electronic Injury Surveillance System (NEISS) estimated that concussions in 8- to 19-year-olds resulted in more than 500 000 visits to the emergency department, with close to half (252 807 visits) resulting from a sport-related mechanism.¹⁵⁰ Sport-related concussions—accounted for 58% of all emergency department visits in children (8–13 years old) and 46% of all concussions in adolescents (14–19 years old).¹⁵⁰ Similarly, data from the National Hospital Ambulatory Medical Care Survey⁴³ showed 144 000 emergency department visits for concussion in youth and adolescents (0–19 years old) over a 5-year period (2002–2006). Sport-related concussion was the most common mechanism, accounting for 30% of all concussions in persons between 5 and 19 years old.⁴⁵ In high school athletes, Powell and Barber-Foss¹⁵¹ reported that AT-diagnosed concussions accounted for 5.5% of all sports injuries. More recently, data from High School Reporting Information Online (RIO) indicated that concussions in interscholastic athletes were responsible for 8.9% of all athletic injuries⁶⁷ and that the overall concussion incidence rate according to RIO was 0.23 concussions per 1000 athlete exposures, with a game rate of 0.53 and a practice rate of 0.11 per 1000 athlete exposures.

Structural brain development occurs during childhood and adolescence with increased brain volume and connectivity, as reflected by increased white matter volume, which is apparent on magnetic resonance imaging.^{152,153} Younger athletes may be more vulnerable to concussion because of this structural immaturity, coupled with less myelination, thinner frontal and temporal bones, a greater head-to-body ratio, and weaker neck musculature.^{154–157} Furthermore, functional brain immaturity is present through early adulthood; the brain continues to mature in areas responsible for cognitive processing, such as attention and concentration, learning and memory, reasoning, and executive function.^{16,158} Thus, neurocognitive performance would be expected to change at least until the age of 20 years, requiring baseline levels of cognitive performance to be reassessed periodically, so that they can be compared with postinjury results.

The susceptibility of a child or adolescent to prolonged recovery after concussion may result from the fact that the developing functions of the immature brain are more vulnerable than established functions. Some have also postulated that injury to the brain might interfere with the complex biological processes needed for brain development.^{1,159–162} Concussed high school players took longer to recover from memory dysfunction than did concussed college players.³⁶ Prolonged neurocognitive recovery has also been reported in other studies of high school athletes.^{163,164} Additionally, high school athletes with a history of 2 or more concussions demonstrated poorer cognitive recovery.¹⁶³ However, to date, little evidence is available regarding postconcussion recovery in patients younger than high school age.

A primary concern of premature RTP among pediatric athletes is diffuse cerebral swelling with delayed catastrophic deterioration, commonly referred to as *second-impact syndrome* or *malignant cerebral edema*. The presence of second-impact syndrome has been debated,^{165,166} but in rare circumstances, cerebral swelling or edema can occur after injury to an immature brain.^{162,167,168} Although there may be controversy regarding the need for a second insult to cause the cerebral swelling, there is agreement that this diffuse cerebral swelling occurs more often in patients with immature brains.

The 2012 Zurich consensus statement on management of concussion in sport⁷ and the 2010 American Academy of Pediatrics' clinical report on sport-related concussion in children and adolescents¹⁶⁹ recommended a multifaceted approach to concussion management in pediatric athletes. Yet, some special concerns are relevant to younger athletes. When assessing a concussed child or adolescent, it is important to obtain input from not only the patient but also from parents, health care providers, and teachers, as they may have additional information about the patient's preinjury and postinjury behavior that can be useful in the clinical evaluation and management plan.³⁸

Assessing the patient's symptoms is advocated as a key aspect of concussion management. Numerous symptom checklists and scales have been developed for use in athletic populations,¹⁷⁰ and children and adolescents can reliably report concussion-related symptoms.^{171–173} However, the Zurich consensus panel⁷ suggested that children younger than 10 years may report concussion symptoms differently from adults; therefore, age-appropriate symptom checklists may be needed to track symptoms after a suspected concussion. In light of this, the Health and Behavior Inventory—Child Version,¹⁷⁴ was developed by the National Institutes of Health—National Institute of Neurological Disorders and Stroke to evaluate younger persons. The use of concussion-symptom scales is more appropriate for adolescents (ages 13–22 years) than for children (ages 5–12 years), and research has addressed validity as opposed to reliability.³⁸ The addition of reliable and valid parental reports of postconcussion symptoms is an important adjunct to the report of the child or adolescent. However, in high school athletes, neurocognitive deficits may exist despite the resolution of self-report symptoms,³⁶ suggesting that self-report symptoms should not be the only means of assessment.

Assessment of motor control and neurocognitive function is also important and may be useful in pediatric athletes.^{16,164,175} The method and timing of baseline assessments in children and adolescents require careful consideration because of the cognitive and neuromuscular maturation that occurs during this time.^{176–179} Hunt and Ferrara¹⁶ found that neurocognitive test scores differed between 9th- and 10th-grade students. Therefore, they recommended at least 2 baseline tests for high school athletes: the first as an incoming freshman and the second before sophomore year. A similar trend was noted with the Sport Concussion Assessment Tool-2 (SCAT-2): scores among 9th graders were lower than those among 11th and 12th graders.¹⁸⁰ Lastly, improvements in neurocognitive performance were seen between the ages of 9 and 15 years, suggesting that baseline testing should be done every 6 months, or at least annually, until the age of 15.¹⁷⁶

Although a person's own baseline measurements are the best values for postinjury comparisons, repeated baseline assessments may not be feasible because of administration time, cost, and effort. In these cases, using age-matched norms to supplement the clinical examination plus the patient's self-report and parental report of symptoms may be more cost effective.¹³

Despite the challenges of obtaining baseline neurocognitive or balance assessments in this younger age group, having baseline and postinjury neurocognitive scores can be valuable for managing potential school-related difficulties, such as focusing attention, learning and retaining new information, and managing multiple academic learning demands. The results of specific domain tests (eg, working memory, concentration, new learning and memory retention, and processing speed) can be useful in working with teachers and guidance counselors to develop strategies for successful academic outcomes. For example, temporary accommodations, including the use of written instructions, shorter assignments, and extended time for assignments, might be considered for students recovering from concussion.

Home Care. After a concussion diagnosis, a comprehensive medical management plan should be implemented that follows the institution's concussion policy and includes communication among all those involved. This plan should include the family (ie, patient and parents), school personnel (ie, teachers, administrators, counselors, coaches), school medical personnel (ie, AT, school nurse), and community referral sources (ie, team physician, other health care referral sources). Communication among all these groups is essential for appropriate management of a concussed athlete.

The home care plan should include frequent follow-up assessments and continued monitoring of concussion signs and symptoms.^{5,7} Patients and their parents or roommates should be provided with a list of signs and symptoms that would indicate a deteriorating condition and warrant immediate referral to the emergency department (Table 5). The patient, or a responsible person, should also be provided with a concussion instruction form (Appendix A) and instructed to follow up with the AT the next day he or she is at school.

Medications and Diet. Limited evidence suggests that any medication is beneficial in accelerating the concussion-recovery process. All current medications should be reviewed by the physician, and concussed patients should avoid taking medications containing aspirin or nonsteroidal anti-inflammatory drugs. These medications are known to decrease platelet function and may increase intracranial bleeding, mask the severity and duration of symptoms, and possibly lead to a more severe injury. Acetaminophen may be used sparingly to ease headaches after concussion. During the acute stage of injury, the patient should avoid ingesting other substances that can affect central nervous system function, including alcohol and narcotics, and should be instructed to eat a well-balanced, nutritious diet.

During the subacute stage of recovery, the physician may prescribe medications to reduce specific symptoms, such as headache, sleep disturbances, or anxiety, or to improve symptom resolution.^{7,45} Additionally, medication may be prescribed if the symptoms are affecting broader aspects of the person's life such that the potential benefit of the

Table 5. Observable Red-Flag Items That Warrant Immediate Referral to the Emergency Department via Emergency Medical Transport

Decreasing level of consciousness
Increasing confusion
Increasing irritability
Loss of or fluctuating level of consciousness
Numbness in the arms or legs
Pupils becoming unequal in size
Repeated vomiting
Seizures
Slurred speech or inability to speak
Inability to recognize people or places
Worsening headache

medication is greater than the possible risks.⁴⁵ Pharmacologic management of sport-related concussion should be directed only by those physicians with experience treating concussive injuries who are able to justify the benefit-to-risk ratio. One important consideration with respect to postconcussion medication use is that the patient should be asymptomatic when *not* on the medication before beginning an RTP progression.⁷

Rest. A concussed patient who returns home after the sport event should be monitored by a responsible adult and should have a good night's rest. In general, the patient does not need to be awakened during the night unless he or she experienced loss of consciousness, prolonged periods of amnesia, or significant symptoms before going to bed.⁵ Should the AT or physician prescribe nighttime waking, the responsible adult should be provided with instructions on when to wake the patient and what to observe during periods of waking.

During the acute recovery period, physical rest and cognitive rest are indicated while the patient is symptomatic.^{7,28,39,42} While symptomatic, the patient should avoid physical exertion, including physical education classes and recreational activities. Activities of daily living that do not exacerbate symptoms may be beneficial to the patient's recovery and should be allowed.¹³⁰ When mental activities exacerbate symptoms, cognitive rest, including temporary academic accommodations (see the next paragraph), should be part of the concussion-management plan.^{7,28,39,42} Alterations in the amount of cognitive and physical rest should be made on an individual basis as the patient's symptom reports and adjunct assessment scores (ie, cognitive test scores) change during recovery.

The concept of cognitive rest was initially presented in the Prague consensus document¹⁸¹ and was reiterated in the Zurich consensus statement⁷ and the American Academy of Pediatrics Clinical Report.¹⁶⁹ *Cognitive rest* refers to limiting academic and cognitive stressors in activities of daily living and school activities while the patient recovers from the concussion. Cognitive rest is part of a spectrum that ranges from very limited cognitive activity (ie, absent from school) to full cognitive activity (ie, full school attendance). The goal of cognitive rest is to keep the brain from engaging in mental challenges that will increase symptoms during the postconcussion stage.^{7,42,179} Most concussed patients require some amount of cognitive rest to ensure resolution of symptoms and recovery from the concussion. The type and amount of cognitive rest are individualized but may take the form of limiting mental

exertion, including reading, writing, mathematical computation, and computer work. Limiting social activities requiring concentrated cognitive activity should also be considered, such as watching television, text messaging, playing video games, and listening to loud music. Communication among the medical providers, parents and patient, and school personnel (such as the school nurse, counselors, administrators, and teachers) is crucial to providing temporary accommodations that allow cognitive rest.⁴² To date, however, little empirical evidence supports the utility and efficacy of cognitive rest on recovery outcomes after concussion. Moderate levels of supervised exertion (eg, participating in school and light physical activity) during recovery were associated with better visual memory and reaction time outcomes and may be beneficial to recovery.¹³⁰

Multiple Concussions. Similar to other types of injuries, the best predictor of subsequent concussion is a history of at least 1 concussion. Among collegiate football players, patients who self-reported 3 or more concussions were 3.5 times more likely to sustain a subsequent injury than players with no concussion history, whereas those with 2 concussions were 2.8 times more likely.⁴⁶ An increased risk for subsequent concussions in high school athletes with a history of concussion has also been reported. In a prospective investigation,¹⁸² football players with a concussion history were nearly 3 times more likely to sustain another injury, whereas nonfootball players were 1.2 times more likely. Therefore, current recommendations^{7,47} suggest that modifying factors, including repeated concussions over time, multiple concussions within a short time frame, sustaining concussions with lessening force, or increasing severity of injury, should result in a more conservative management approach. Proper management of a concussion will reduce the risk of a repeat injury.¹⁸³

Second-Impact Syndrome. A primary concern of premature RTP by pediatric athletes is second-impact syndrome, or malignant cerebral edema, which occurs after a second impact while the patient is still symptomatic from a previous injury to the head or body. The condition is characterized by diffuse cerebral swelling with catastrophic deterioration.^{1,48–50}

Long-Term Consequences. The relationship between concussion and long-term cognitive health is not clear. A number of cross-sectional investigations^{184–186} have shown no chronic changes in neurocognitive functioning after concussion in a young adult population. Others, however, have shown changes to neurocognitive functioning,^{187,188} brain function,^{189–191} neuroelectrical activity,^{192–195} and motor control.^{196,197} Yet none of these authors reported an association between the declines and clinical impairment. Results of surveys^{51–53,198} of former professional athletes, however, have suggested the potential for cumulative concussive and subconcussive impacts over an athlete's playing career to be associated with late-life cognitive impairment, depression, and chronic traumatic encephalopathy. Indeed, retired professional football players with a self-reported history of 3 or more concussions were 3 times more likely and those with a history of 1 or 2 concussions were 1.5 times more likely to be diagnosed with depression than their peers who did not report concussions.⁵¹ Similarly, a preliminary report⁵² has

associated retired professional football players who sustained 3 or more concussions with mild cognitive impairment and self-reported significant memory impairments. Others^{53,199,200} have speculated that exposure to concussive and subconcussive impacts may lead to chronic traumatic encephalopathy, a progressive neurodegenerative disorder that results in a buildup of tau proteins in the brain. In large part, persons reporting clinical impairments thought to be associated with concussion are former professional athletes with a uniquely high level of exposure to contact and collision sports that may have been moderated by a number of other intrinsic (eg, genetic profile) and extrinsic (eg, lifestyle) factors.²⁰¹ In addition, longitudinal research that can directly associate concussive and subconcussive impacts with cognitive health, while controlling for normal age-related declines and other factors, has not been completed. As such, the relationship among concussion, subconcussive impacts, and long-term brain health is not clear. These studies are viewed as preliminary; additional research is needed to adequately address this association.

SUMMARY

This document is intended to provide clinical ATs with best-practice guidelines for concussion management based on recommendations derived from the most recent research. The best approach to concussion management involves the entire sports medicine team. The AT should spearhead the development of a detailed written plan outlining the concussion-management strategy and share it with administrators and coaches. The plan should include a baseline evaluation of athletes, including a neurologic history with symptoms and physical examination and objective measures of neurocognitive performance and motor control. Once the concussion diagnosis has been made, the patient should be immediately removed from further participation for at least 24 hours. Follow-up testing, using the same protocol as the baseline examination, can aid in determining when to start the return to physical activity after the patient is cleared by a physician or designate. Lastly, although most concussions resolve in a relatively short time frame, patients who are young, who have had multiple concussions, or who have premorbid factors may require additional attention. The AT should be familiar with these concerns, as well as the potential for long-term consequences, and account for them in the concussion-management plan.

ACKNOWLEDGMENTS

We gratefully acknowledge the efforts of Barry P. Boden, MD; Randall Cohen, DPT, ATC; Michael W. Collins, PhD; Ruben Echemendia, PhD; Michael S. Ferrara, PhD, ATC, FNATA; James S. Galloway, ATC; Margot Putukian, MD; and the Pronouncements Committee in the review of this document.

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Online First

Appendix A. Sample Postconcussion Home Care Instructions

I believe that _____ sustained a concussion on _____.

To make sure he or she recovers, please follow the following important recommendations:

1. _____ must report to the athletic training facility on _____ at _____ for a follow-up evaluation.

2. If any of the problems below develop before the follow-up visit, please call _____ at _____ or contact the local emergency medical system or your family physician.

- Decreasing level of consciousness
- Increasing confusion
- Increasing irritability
- Loss of or fluctuating level of consciousness
- Numbness in the arms or legs
- Pupils becoming unequal in size
- Repeated vomiting
- Seizures
- Slurred speech or inability to speak
- Inability to recognize people or places
- Worsening headache

Otherwise, you can follow the instructions outlined below.

It is OK to

- Use acetaminophen (Tylenol) for headaches
- Use ice pack on head and neck as needed for comfort
- Eat a carbohydrate-rich diet
- Go to sleep
- Rest (no strenuous activity or sports)

There is NO need to

- Check eyes with flashlight
- Wake up frequently (unless otherwise instructed)
- Test reflexes
- Stay in bed

Do NOT

- Drink alcohol
- Drive a car or operate machinery
- Engage in physical activity (eg, exercise, weight lifting, physical education, sport participation) that makes symptoms worse
- Engage in mental activity (eg, school, job, homework, computer games) that makes symptoms worse

Other recommendations:

Recommendations provided to: _____

Please feel free to contact me if you have any questions. I can be reached at _____.

Please follow up in the athletic training facility on _____ (date).

Recommendations provided by: _____

Signature: _____ Date: _____

Appendix B. Sample Information for Patients, Parents, and Legal Custodians About Concussion

What is a concussion? A concussion is an injury to the brain caused by a direct or indirect blow to the head. It results in your brain not working as it should. The concussion may or may not cause you to black out or pass out. It can happen from a fall, a hit to the head, or a hit to the body that causes your head and your brain to move quickly back and forth.

How do I know if I have a concussion? There are many signs and symptoms that you may have after a concussion. A concussion can affect your thinking, the way your body feels, your mood, or your sleep. Here is what to look for the following symptoms:

Thinking	Physical	Emotional/ Mood	Sleep
<ul style="list-style-type: none">• Difficulty thinking clearly• Taking longer to figure things out• Difficulty concentrating• Difficulty remembering new information	<ul style="list-style-type: none">• Headache• Fuzzy or blurry vision• Feeling sick to your stomach/queasy• Vomiting/throwing up• Dizziness• Balance problems• Sensitivity to noise or light	<ul style="list-style-type: none">• Irritability-things bother you more easily• Sadness• Being more moody• Feeling nervous or worried• Crying more	<ul style="list-style-type: none">• Sleeping more than usual• Sleeping less than usual• Trouble falling asleep• Feeling tired

Table is adapted from the Centers for Disease Control and Prevention (<http://www.cdc.gov/concussion/>).

What should I do if I think I have a concussion? If you are having any of the signs or symptoms listed above, you should tell your parents, coach, athletic trainer, or school nurse, so you can get the help you need. If a parent notices these symptoms, he or she should inform the school nurse or athletic trainer.

When should I be particularly concerned? If you have a headache that gets worse over time, you are unable to control your body, you throw up repeatedly or feel more and more sick to your stomach, or your words are coming out funny or slurred, let an adult such as your parent, coach, or teacher know right away, so you can get the help you need before things get any worse.

What are some of the problems that may affect me after a concussion? You may have trouble in some of your classes at school or even with activities at home. If you continue to play or return to play too early after a concussion, you may have long-term trouble remembering things or paying attention, headaches may last a long time, or personality changes can occur. Once you have a concussion, you are more likely to have another concussion.

How do I know when it's OK to return to physical activity and my sport after a concussion? After telling your coach, your parents, and any available medical personnel that you think you have a concussion, you will probably be seen by a doctor trained in helping people with concussions. Your school and your parents can help you decide who is best to treat you and help to make the decision on when you should return to activity, play, and practice. Your school has a policy in place on how to treat concussions. You should not return to play or practice on the same day as your suspected concussion occurred.

You should not begin the return-to-play progression until all symptoms are gone, both at rest and during and after activity. Symptoms indicate that your brain has not yet recovered from the concussion and needs more rest.

Concussion Information Sheet for the Patient and Parent or Legal Custodian

**If there is anything on this sheet that you do not understand, please ask an adult to explain or read it to you.*

Patient Name: _____

This form must be completed for each patient, even if there are multiple patients in the household.

Parent or Legal Custodian Name(s): _____

☐ We have read the "Patient and Parent or Legal Custodian Concussion Information Sheet.
If true, please check box.

After reading the information sheet, I am aware of the following information:

Patient
Initials

Parent or Legal
Custodian
Initials

A concussion is a brain injury, which should be reported to my parents, my coach(es), or a medical professional if one is available.

A concussion can affect the ability to perform everyday activities such as the ability to think, balance, and perform in the classroom.

A concussion cannot be "seen." Some symptoms might be present right away. Other symptoms can show up hours or days after an injury.

I will tell my parents, my coach, or a medical professional about my injuries and illnesses. Not applicable

If I think a teammate has a concussion, I should tell my coach(es), parents, or a medical professional. Not applicable

I will not return to play in a game or practice if a hit to my head or body causes any concussion-related symptoms. Not applicable

I will/my child will need written permission from a medical professional trained in concussion management to return to play or practice after a concussion.

According to the latest data, most concussions take days or weeks to get better. A concussion may not go away right away. I realize that resolution from this injury is a process and may require more than 1 medical evaluation.

I realize that emergency department or urgent care physicians will not provide clearance if the patient is seen right away after the injury.

After a concussion, the brain needs time to heal. I understand that I am/my child is much more likely to have another concussion or more serious brain injury if return to play or practice occurs before concussion symptoms go away.

Sometimes, repeat concussions can cause serious and long-lasting problems.

I have read and understand the concussion symptoms on the Concussion Information Sheet.

Signature of Patient

Date

Signature of Parent or Legal Custodian

Date

Address correspondence to the National Athletic Trainers' Association, Communications Department, 1620 Valwood Parkway, Suite 115, Carrollton, TX 75006.



Consensus Statement: Best Practices for Diagnosis and Management of Sport-Related Concussion



Purpose

The College Athletic Trainers' Society (CATS) and the National Collegiate Athletic Association (NCAA) hosted the *Safety in College Football Summit*, January 22-23, 2014 in Atlanta, Georgia. The purpose of the Summit was to discuss, in an inter-disciplinary manner, the best evidence, consensus, or both, for three paramount safety issues in collegiate athletics: 1) Football practice contact allowance; 2) Independent medical care in the collegiate setting; and 3) Concussion diagnosis and management. This document will address Best Practices for Diagnosis and Management of Sport-Related Concussion in the collegiate setting for *all* sports.

Background

There are over 42 consensus-based definitions of concussion. A recently published, evidence-based definition of concussion follows.¹

Concussion is:

- a change in brain function,
- following a force to the head, which
- may be accompanied by temporary loss of consciousness, but is
- identified in awake individuals, with
- measures of neurologic and cognitive dysfunction.

The diagnosis and management of sport-related concussion is a challenge for athletic health care professionals. Sport-related concussion may manifest with immediate or delayed-onset symptoms, and symptom manifestation can vary not only between individuals, but also within the same individual who has suffered a repeat concussion. Consideration must be given to multiple modifying factors and co-morbidities in making the diagnosis, in providing a management plan, and in making both return-to-play and return-to-academics recommendations.²⁻⁶ Importantly, sport-related concussion diagnosis and management must be individualized to the student-athlete. The 'threshold' above which clinical symptoms or signs of injury is manifest for each person as well as for each concussion within an individual, has yet to be defined.

Due to many factors, the diagnosis and management of sport-related concussion remains among the greatest challenges in sports medicine. First, the clinical effects of concussion are often subtle and difficult to detect with existing sport-related concussion assessment tools. Second, student-athletes commonly under-report their symptoms and falsely inflate their level of recovery in hopes of being rapidly cleared for return to competition. Third, "signal detection" on clinical measures (e.g., cognitive and balance testing) often quickly diminishes in the acute setting of early recovery. Fourth, there is now recognition that our clinical assessment of concussion merely represents a surrogate index of recovery and not a direct measure of brain structure and functional integrity after concussion. In summary, the natural history of concussion is unknown, there are no objective biomarkers of physiological recovery that exist for clinical use, and there remains a strong reliance on self-report of symptoms from the student-athlete.

Diagnosis of sport-related concussion is based on symptoms and signs of injury including abnormalities in neurological exam such as impaired cognitive function and balance dysfunction. The symptoms of sport-related concussion are not specific to concussion and therefore it can be challenging to evaluate a student-athlete who

presents to a clinician with non-specific symptoms after sustaining a direct or indirect impulsive force to the head. The clinician will take a careful history and perform a physical exam, but unless the evaluation is performed within the first 24 hours of injury, the examination is often normal, and additional tests such as brain computerized tomography (CT), brain MRI, electroencephalogram and blood tests are also normal. Although cognitive function and balance assessed within 24 hours with various sideline tests (Standardized Assessment of Concussion[SAC] and Balance Error Scoring System, respectively) have been shown to be useful in diagnosing concussion, these tests often normalize within a few days and cannot be used to make a definitive diagnosis. Although comprehensive neuropsychological tests may be a useful adjunctive tool supporting the diagnosis of concussion, there remains controversy regarding their interpretation and utility as a biomarker. Diagnosis and management of sport-related concussion remains per the judgment of the athletic health care provider.⁷

The *NCAA Concussion Policy and Legislation* mandates the following:⁸

1. An annual process that ensures student-athletes are educated about the signs and symptoms of concussion.
2. A process that ensures a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from athletics activities and evaluated by a medical staff member with experience in the evaluation and management of concussion;
3. A policy that precludes a student-athlete diagnosed with a concussion from returning to athletic activity for at least the remainder of that calendar day; and
4. A policy that requires medical clearance for a student-athlete diagnosed with a concussion to return to athletics activity as determined by a physician or the physician's designee.

Consensus Best Practice

The goals of Consensus Best Practices of Sport-Related Concussion are: (1) establishing a standard of care for diagnosing and managing sport-related concussion; (2) helping athletic health care providers to diagnose sport-related concussion; (3) preventing additional sport-related concussion; (4) promoting sport-related concussion injury resolution; (5) minimizing factors that contribute to prolonged or recurrent symptoms of sport-related concussion; and (6) avoiding repeat sport-related concussion.

Institutions should make available their Concussion Management Plan, either through printed material, website, or both. Best practice components of a Concussion Management Plan are:

Education: Institutions should provide, on an annual basis, applicable NCAA concussion fact sheets or other applicable educational material to student-athletes, coaches, team physicians, athletic trainers, and athletics directors. There should be a signed acknowledgement that all parties have read and understand these concussion facts and their respective institution's Concussion Management Plan.

Baseline Testing: A pre-participation reporting of previous history of traumatic brain injury (mild, moderate or severe) is required of all student-athletes.

An annual pre-participation baseline concussion assessment for varsity student-athletes in baseball, basketball, cheerleading, diving, equestrian, field hockey, football, gymnastics, ice hockey, lacrosse, pole vaulting, rugby, skiing, soccer, softball, diving, water polo, and wrestling should include, but not be limited to:

1. Symptom evaluation.
2. Cognitive assessment.
3. Balance examination.

Team physician judgment will determine pre-participation clearance and/or the need for additional consultation or testing based upon known individual concussion modifiers.⁹

Post-Concussion Management: The foundation of sport-related concussion management is initial physical and relative cognitive rest as part of an individualized treatment plan.⁷ Initial management is based on individual serial clinical assessments that account for concussion history and other modifying factors, all evaluation options, and personal needs of the student-athlete. Such management includes, but is not limited to:

- At time of injury, perform clinical evaluation.
- Assess for head/cervical injury and implement the emergency action plan, as warranted.
- Any of the following signs and symptoms warrant urgent transportation to the nearest hospital: Glasgow Coma score less than 13; prolonged period of loss of consciousness (> 1 minute); focal neurological deficit; repetitive emesis; persistently diminished or worsening mental status or other neurological signs or symptoms; and potential spine injury.
- Any student-athlete exhibiting signs, symptoms or behaviors consistent with a concussion, at rest or with exertion, shall be removed from practice or competition and referred to the team athletic trainer or team physician with experience in concussion management.
- When the rapid assessment of concussion is necessary (e.g., during competition), a brief concussion-evaluation tool such as SAC should be used in conjunction with a motor-control evaluation and symptom assessment to support the physical and neurologic clinical evaluation.¹⁰
- A student-athlete diagnosed with sport-related concussion shall not be allowed to return to play in the current game or practice and shall be withheld from athletic activity for the remainder of the day.
- The student-athlete should be evaluated serially and monitored for deterioration following injury. Upon discharge from medical care, both oral and written instructions for home care should be given to the student-athlete and to a responsible adult (e.g., parent or roommate) who will observe and supervise the student-athlete during the acute phase of sport-related concussion.¹⁰
- An athletic health care provider experienced in the diagnosis and management of concussion should conduct and document serial clinical evaluation inclusive of symptoms, cognition, and balance.

Return to Activity

Return to Academics: Return to academics (return-to-learn) is a parallel concept to return-to-play,^{5,11-13} but has received less scientific evaluation than its counterpart. The foundation of return-to-learn includes:

- Return-to-learn should be managed in a stepwise program that fits the needs of the individual.
- Return-to-learn guidelines assume that both physical and cognitive activities require brain energy utilization, and they similarly assume that such brain energy is not available for physical and cognitive exertion because of the concussion-induced brain energy crisis.²
- Return-to-learn recommendations are based on consensus statements, with a paucity of evidence-based data to correlate with such consensus recommendations.
- Return-to-learn recommendations should be made within the context of a multi-disciplinary team that includes physicians, athletic trainers, coaches, administrators as well as academic (e.g. professors, deans, academic advisors) and office of disability services representatives.
- Like return-to-play, it is not always easy to provide prescriptive recommendations for return-to-learn because the student-athlete may appear physically normal but is unable to perform at his/her expected baseline due to concussive symptomatology.

The first step of return-to-learn is physical and cognitive rest immediately following sport-related concussion, just as the first step of return-to-play is physical and cognitive rest. Cognitive rest means minimizing potential cognitive stressors such as school work, video games, reading, texting and watching television. The rationale for cognitive rest is that the brain is experiencing an energy crisis, and providing both physical and cognitive rest allows the brain to heal more quickly. Data from small studies suggest a beneficial effect of cognitive rest on concussion recovery. For the college student-athlete, cognitive rest following concussion means avoiding the classroom for at least the same day as concussion. The period of time needed to avoid class or homework should

be individualized. The gradual return to academics is based on the return of concussion symptoms following cognitive exposure. The consensus to date includes:¹²

- If the student-athlete cannot tolerate light cognitive activity, he or she should remain at home or in the residence hall.
- Once the student-athlete can tolerate cognitive activity without return of symptoms, he/she should return to the classroom. At any point, if the student-athlete becomes symptomatic, or scores on clinical measures decline, the team physician should be notified and the student-athlete's cognitive activity reassessed.
- The extent of academic adjustments needed should be decided by a multi-disciplinary team that may include the team physician, athletic trainer, faculty athletic representative or other faculty representative, coach, individual teachers and psychologist. The level of multi-disciplinary involvement should be made on a case-by-case basis.

Academic Terminology

The majority of student-athletes who are concussed do not need a detailed return-to-learn program because full recovery typically occurs within two weeks. For the student-athlete whose academic schedule requires some minor modification in the first one to two weeks following a sport-related concussion, adjustments can often be made without requiring meaningful curriculum or testing alterations. Return-to-learn management becomes more difficult when the student-athlete has ongoing symptoms for greater than two weeks. Depending on the institution's policy, there are differing ways to access academic adjustment or accommodations for student-athletes who present with more complicated return-to-learn cases.

For some student-athletes, symptoms can persist for more than two weeks. It is important to verify, as best as possible, the diagnosis instead of assuming that the student-athlete has prolonged concussion symptoms. In some situations, prolonged concussive symptoms may represent post-concussion syndrome, sleep dysfunction, migraine and other headache disorders, or co-morbid mood disorders such as anxiety and depression.¹⁴ Passive management such as prolonged physical and cognitive rest is counter-productive in these scenarios.

Sport-related concussion is a challenging injury for student-athletes and, unlike other injuries, the timeline for return to full activity is often difficult to project. The psychological response to injury is also unpredictable. Sometimes, student-athletes who are kept out of their sport for a prolonged period of time experience emotional distress related to being unable to participate in sport. In addition, student-athletes with sport-related concussion often appear "normal", without casts or crutches or other identifiable clues to being injured, and therefore concussed student-athletes may feel, or perception may develop among teammates, coaches, etc., that they should be participating fully in all activities since they "look normal". Because there have been reports of an increased risk for depression after concussive injury in retired professional football players,¹⁵ it is important that health care providers remain alert to the signs and symptoms of depression and other emotional responses to injury that can be particularly challenging following concussive injury.

When an individual has not recovered in the anticipated period of time, the student-athlete may need a change in his or her class schedule; special arrangements may be required for extended absences, tests, term papers and projects. Many institutions offer 'provisional or temporary' accommodations for individuals who have impairments that are typically short-term in nature – six months or less (such as a broken arm or concussion). Such accommodations can often be accessed through the disability services office.

A more difficult scenario occurs when the student-athlete experiences prolonged cognitive difficulties. Institutions can develop a detailed academic plan that specifies the support services specifically available for that student-athlete. He or she can also choose to disclose the documentation to the disability office in order to seek long-term accommodations or academic adjustments. The disability office will verify if the impairment is limiting a major life activity per the Americans with Disabilities Act. Accommodations or academic adjustments are often

provided in order to 'level the playing field' for the student-athlete with prolonged cognitive difficulties resulting from a concussion. A detailed academic plan coupled with accommodations can provide the needed support for a student-athlete as he or she returns to learning after a concussion.

Campus Resources

The successful implementation of return-to-learn depends on several variables:

- Recognition that concussion symptoms vary widely among student-athletes, and even within the same individual who may be suffering a repeat concussion.
- Identification of a point person or case manager for the student-athlete who must navigate the dual obligations of academics and athletics.
- Identification of co-morbid conditions that may further impair recovery including, but not limited to migraine, attention-deficit hyperactivity disorder, anxiety and depression.
- Identification of campus resources that can help assure that student-athletes are provided their full rights during this transition period.

Campus resources vary, and can include the following:

- *Office of Disability Services.* Most campuses have a disability office that is responsible for verifying each student's impairment under the Americans with Disabilities Act Amendments Act (ADAAA). Sometimes, there is a separate disability office and ADAAA office, and in this case the first resource is the campus disability office. Concussion and mild traumatic brain injury are covered under ADAAA.
- *Learning Specialists.* Many college campuses have certified learning specialists who have specialized knowledge of medical conditions such as concussion and post-concussion syndrome. They usually work directly with the disability office.

It is advisable for the core student-athlete's medical team to identify an academic point person at the beginning of the season, and to be certain this academician is interwoven into the medical management plan. Because return-to-learn is often under-managed and under-recognized, there should also be broad discussions of this important paradigm with athletics departments across the country, leveraging organizations such as the National Association of Academic Advisors for Athletics, the American College Personnel Association, NASPA – Student Affairs Administrators in Higher Education, the Coalition on Intercollegiate Athletics, National Athletic Trainers Association, College Athletic Trainers Society, American Medical Society for Sports Medicine and other allied organizations. Student-athletes are more likely to return to full classroom activity in the setting of a proactive and well-integrated management plan.

Return-to-Play: Once a student-athlete has been diagnosed with sport-related concussion, the return-to-play decision is based on a physician/physician designee-supervised protocol of a stepwise increase in physical activity that includes both an incremental increase in physical demands and an assessment of contact risk.¹⁰ Most return-to-play protocols resemble the Consensus Statement on Concussion in Sport Guidelines,⁷ which outline a progressive increase in physical activity if the individual is asymptomatic. It is noteworthy that all return-to-play guidelines are consensus-based and have not been validated by evidence-based studies.¹⁶⁻¹⁷ McCrea and colleagues¹⁸ note that a symptom-free waiting period had no influence on either clinical recovery or risk of a repeat concussion. Further, student-athletes have variable understanding of the importance of reporting possible concussion symptoms.¹⁹⁻²⁰ In essence, return-to-play guidelines are based on a common sense consensus to a rather complex and heterogeneous condition.

There is emerging evidence that focused exercise or recovery techniques may be utilized before full recovery has occurred, but this lacks validation. . Given the paucity of scientific evidence regarding return-to-play, and given the common sense consensus documents that have been published, we advocate a general acceptance of such common sense guidelines. However, it is critical to stress an individualized approach to return-to-play. Some

student-athletes may have minimal concussive symptomatology with minimal symptom duration and no modifiers (e.g. prior concussion, migraine, ADHD, depression/anxiety); in this scenario, and with experienced clinicians, the return-to-play protocol may include 2-steps per day. In contrast, if a student-athlete has a concussion history, prolonged symptom burden or duration, or has symptoms for three to four weeks with other concussion modifiers, then the return-to-play progression should proceed more cautiously and each stage may take more than a day.¹⁰ Some student-athletes may have a very specific neurological deficit as a result of concussion, and unless this deficit is specifically addressed, return-to-play may be needlessly prolonged. For example, if a student-athlete suffers from vestibular dysfunction as a manifestation of concussion, and because of such symptoms he/she is unable to progress in the return-to-play protocol outlined below, it is important to address the specific vestibular dysfunction rather than to simply return the student-athlete to the previous level of return-to-play progression. In other words, 'rest' can sometimes lead to adverse outcomes if an accurate diagnosis based on neurological dysfunction is not made. The following guidelines serve as a general guide and are not meant to be prescriptive.

Stepwise Progression:

Following concussion diagnosis, the initial management is physical and cognitive rest. Athletes diagnosed with sport-related concussion are removed from play and cannot return to sport related activity for at least one calendar day and should be evaluated by a health care provider with expertise in sport-related concussion. Once a concussed student-athlete has returned to his or her baseline level of symptoms, cognitive function and balance, then the return-to-play progression can be initiated, as follows:

1. Light aerobic exercise such as walking, swimming or stationary bike. No resistance training. If asymptomatic with light aerobic exercise, then
2. Mode, duration and intensity-dependent exercise based upon sport. If asymptomatic with such exertion, then
3. Sport-specific activity with no head impact. If asymptomatic with sport-specific activity, then
4. Non-contact sport drills and resumption of progressive resistance training. If asymptomatic with non-contact drills and resistance training, then
5. Full contact practice. If asymptomatic with full contact practice, then
6. Return-to-play. Medical clearance will be determined by the team physician/physician designee, or athletic trainer in consultation with a team physician.

At any point, if the student-athlete becomes symptomatic, or scores on clinical measures decline, the team physician should be notified and the student-athlete should be returned to the previous level of activity. Final determination of return-to-play shall ultimately reside with the team physician/physician designee.

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This Consensus Best Practice, Diagnosis and Management of Sport-Related Concussion, has been endorsed by:

Checklist

Creating an Athletics Concussion Management Plan



No athletic safety issue has garnered more attention recently than concussions and other traumatic brain injuries. The potential for catastrophic injury coupled with evolving science and legal requirements makes concussions a serious safety and liability concern. The National Collegiate Athletic Association (NCAA) estimates that concussions account for nearly 20 percent of athletic injuries. Over the last five years, all 50 states established standards for handling youth concussions. In that same period, the NCAA has updated its concussion guidelines three times. Despite the attention, an October 2013 report on youth concussion by the Institute of Medicine (IOM) highlights that much is still unknown about the treatment and impact of this injury.

For each question, check the appropriate “yes” or “no” box. Review any box checked “no” to determine whether the suggested practice is possible. Use the “actions needed” box to identify any follow-up actions your institution may wish to take.

1 Pre-participation

Legal Landscape

Has your institution consulted with an attorney about complying with league rules, athletic association requirements, and relevant state laws pertaining to concussions, such as those addressing the:

- Education of coaches, parents, and athletes about the nature and risks of concussions? ☐ Yes ☐ No
- Removal from play of any athlete suspected of having a concussion? ☐ Yes ☐ No
- Requirements for evaluating and returning to play an athlete suspected of having a concussion? ☐ Yes ☐ No

A concussion management plan is critical to colleges in ensuring player safety and reducing liability risks related to concussions in varsity sports. Since 2010, the NCAA has required institutions to have a plan on file. College administrators can use this checklist, which suggests a protocol for pre-participation and response, to develop a sound concussion management plan for intercollegiate athletics. Institution club and recreational sports programs also may find this checklist helpful.

Signs and Symptoms

■ Does your institution's concussion management plan identify the following signs and symptoms of a concussion? ☐ Yes ☐ No

- Loss of consciousness
- Amnesia
- Disorientation
- Drowsiness
- Difficulty concentrating
- Ringing in the ears
- Confusion
- Headache
- Nausea/vomiting
- Fuzzy or blurry vision
- Balance problems
- Sensitivity to light and/or noise

Education and Documentation

Education

■ Does your institution annually educate or train athletes about concussions? ☐ Yes ☐ No

■ Does your institution educate or train the following individuals about concussions: ☐ Yes ☐ No

- Coaching staff (including volunteers)?
- Athletics health care providers?

■ Does your institution make resources about concussions available for the entire campus community? ☐ Yes ☐ No

At a minimum, do your institution's concussion education, training, and resources:

■ Define concussions? ☐ Yes ☐ No

■ Explain the potential seriousness of concussion injuries? ☐ Yes ☐ No

■ Emphasize that purposeful or flagrant head contact is not permitted or safe in any sport? ☐ Yes ☐ No

■ Provide the signs and symptoms of a concussion? ☐ Yes ☐ No

■ Address the importance of promptly reporting concussion symptoms to medical staff? ☐ Yes ☐ No

■ Explain the role of physical and cognitive rest in recovery? ☐ Yes ☐ No

Documentation

■ Does your institution document which individuals it educates about concussions? ☐ Yes ☐ No

Assumption of Risk or Waiver

Do athletes annually sign an assumption of risk or waiver acknowledging:

Actions Needed

Actions Needed

- | | |
|--|--|
| ■ A concussion is a potentially serious head injury that can result in brain injury or death? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Participating in their sport may result in a head injury or a concussion? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ They have received information about the signs and symptoms of a concussion? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Helmets, face shields, mouth guards, and other protective equipment do not eliminate the risk of concussions? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Purposeful head contact in any sport is not permitted? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ They will immediately report to medical staff if they suspect a teammate has a concussion? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ They will immediately report to medical staff if, following a blow to the head or body, they experience signs and symptoms of a concussion? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ They will not return to practices or games if experiencing concussion-like symptoms following a blow to the head or body? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ A repeat concussion is more likely when an athlete returns to play before symptoms resolve? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ The institution has the authority to permanently retire an athlete from sports if it determines the risks of concussive injury present a serious threat to his or her safety and well-being? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ <i>As permitted by state law:</i> They waive their right to sue the institution for losses arising out of a concussion injury? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Given potential differences in the laws where your institution operates and where athletics competitions occur, has your institution consulted with legal counsel about which form—an assumption of risk or a waiver—is preferable for athletes to sign? | <input type="checkbox"/> Yes <input type="checkbox"/> No |

Coach Acknowledgement Form

Do coaches annually sign a form acknowledging that they:

- | | |
|---|--|
| ■ Received information about the signs and symptoms of concussions? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Received and read the institution's concussion management plan? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Understand their role in the institution's concussion management plan? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| ■ Agree to follow the recommendations of athletics health care providers regarding removing athletes from and returning them to play? | <input type="checkbox"/> Yes <input type="checkbox"/> No |

Athletics Health Care Providers Acknowledgement Form

Do athletics health care providers affiliated with your institution annually sign a form acknowledging that they:

- Received information about the signs and symptoms of concussions? ☐ Yes ☐ No
- Read the institution's concussion management plan? ☐ Yes ☐ No
- Understand their role in the institution's concussion management plan? ☐ Yes ☐ No
- Agree to encourage athletes to report to a medical staff member any suspected illness or injury including the signs and symptoms of concussions? ☐ Yes ☐ No

Roles of Athletics Health Care Providers and Coaches

With respect to athletics health care providers affiliated with your institution, does your institution:

- Give them unchallengeable authority to determine the removal and return-to-play of injured athletes? ☐ Yes ☐ No
- Outline their roles in writing? ☐ Yes ☐ No
- Require them to practice within the standards established for their profession? ☐ Yes ☐ No

Are coaches prohibited from:

- Serving as the primary supervisor for athletics health care providers? ☐ Yes ☐ No
- Having sole hiring or firing authority over athletics health care providers? ☐ Yes ☐ No
- Challenging the authority of health care providers to determine the removal and return-to-play of injured athletes? ☐ Yes ☐ No

Medical History and Baseline Evaluations

Medical History

During the pre-participation evaluation of athletes, is information collected about:

- Previous concussions, including: ☐ Yes ☐ No
 - The number of such injuries?
 - Approximate dates?
 - Whether the athlete experienced loss of consciousness or amnesia?
 - The approximate length of time required for symptom resolution?

Actions Needed

Actions Needed

- Learning disabilities? ☐ Yes ☐ No
- Migraine or other headache disorders? ☐ Yes ☐ No
- Psychiatric illnesses? ☐ Yes ☐ No
- Chemical dependency? ☐ Yes ☐ No
- Seizures? ☐ Yes ☐ No

Baseline Assessment

During a baseline test a trained health professional may assess an athlete's history of concussions, balance, and, potentially, cognitive function. Baseline test results are then compared to a similar exam conducted during the season if an athlete has a suspected concussion. Does your institution:

- Use a baseline assessment that consists of:
 - A symptoms checklist? ☐ Yes ☐ No
 - A standardized cognitive and balance assessment? ☐ Yes ☐ No
- Use the same assessment tools post-injury? ☐ Yes ☐ No
- If your institution uses neuropsychological testing as part of its baseline assessment, is a neuropsychologist or a physician experienced in the use and interpretation of such testing consulted in:
 - Developing and administering the test?
 - Interpreting the results?
- Does your institution record a baseline assessment for athletes in each of these sports? ☐ Yes ☐ No

• Baseball	• Football	• Rugby
• Basketball	• Gymnastics	• Soccer
• Diving	• Ice hockey	• Softball
• Equestrian	• Lacrosse	• Water polo
• Field hockey	• Pole vaulting	• Wrestling

Health Care Plan

For each varsity sport, does your institution provide athletes with:

- Access to health insurance? ☐ Yes ☐ No
- Equal access to athletics health care providers? ☐ Yes ☐ No

Emergency Action Plan

For each athletic venue, is there an emergency action plan addressing:

- Methods of emergency communication? ☐ Yes ☐ No

Actions Needed

- Emergency contact information? ☐ Yes ☐ No
- Emergency transportation? ☐ Yes ☐ No
- Available emergency equipment? ☐ Yes ☐ No
- Response to the following catastrophic athletic injuries and illnesses? ☐ Yes ☐ No
- Traumatic brain injuries
 - Heat illness
 - Spine injury
 - Cardiac arrest
 - Respiratory distress, such as asthma
 - Collapses due to sickle cell trait

Is the emergency action plan:

- Reviewed and practiced annually by coaches and athletics health care providers? ☐ Yes ☐ No
- Updated annually? ☐ Yes ☐ No
- Easily accessible (e.g., posted at the venue and on the web)? ☐ Yes ☐ No

2 Response

Removal From Play

Is any athlete suspected of suffering the signs or symptoms of a concussion:

- Removed from play (e.g. competition, practice, and conditioning)? ☐ Yes ☐ No
- Evaluated by a medical professional with experience in the evaluation and management of concussions? ☐ Yes ☐ No

Medical Evaluation

Sideline Evaluation

Does the sideline evaluation of an athlete with a potential concussion include:

- An assessment of airway, breathing, and circulation (ABCs)? ☐ Yes ☐ No
- An assessment of cervical spine and skull for associated injury? ☐ Yes ☐ No
- The same baseline tests used previously on the athlete, such as a:
• Symptoms checklist
• Standardized cognitive and balance assessment

Because amnesia, confusion, and mental status changes are more sensitive indicators of concussion severity, does your institution note the following when evaluating an athlete:

Actions Needed

- The presence of and duration of amnesia? ☐ Yes ☐ No
- The presence of and duration of confusion? ☐ Yes ☐ No
- The time between the injury and the development of symptoms? ☐ Yes ☐ No
- Are athletes immediately referred to emergency medical services if these events occur? ☐ Yes ☐ No
 - Prolonged loss of consciousness
 - Seizure like activity
 - Slurring of speech
 - Paralysis of limbs
 - Unequal or dilated and non-reactive pupils
 - The severity of the injury exceeds the comfort level of the responding athletic or medical staff

Returning to Play From a Sideline Evaluation

- If an athlete is allowed to return to play following a concussion evaluation, does a medical professional monitor performance and periodically re-evaluate him or her? ☐ Yes ☐ No

Concussion Management

Removal From Play Following a Medical Evaluation

For athletes diagnosed with a concussion or exhibiting significant concussion symptoms, does your institution:

- Prohibit them from returning to play until medical clearance is granted and, at a minimum, for the remainder of the day? ☐ Yes ☐ No
- Take one of the following actions? ☐ Yes ☐ No
 - Refer them to a physician or emergency department
 - Continue to observe and monitor them
 - Admit them to a hospital
- Ensure they are not left alone for an initial period of time? ☐ Yes ☐ No
- Provide the athlete and someone who can assist him or her, such as a roommate, with written instructions advising the concussed athlete to: ☐ Yes ☐ No
 - Avoid alcohol or other substances that will impair cognitive function?
 - Avoid aspirin or other medication that increase the risk of bleeding?
 - Immediately contact medical staff if the following problems occur?
 - Worsening headache
 - Increased confusion
 - Dilated pupils
 - Stumbling/loss of balance
 - Decreased level of consciousness
 - Increased irritability
 - Vomiting
- Regularly monitor the athlete for deterioration? ☐ Yes ☐ No

Physical and Cognitive Rest

Until an athlete is asymptomatic, does your institution require those diagnosed with a concussion to:

■ Get physical rest by refraining from athletic play, practice, or conditioning? ☐ Yes ☐ No

■ Get cognitive rest, which may include avoiding these activities? ☐ Yes ☐ No

- Studying
- Class attendance
- Homework
- Video games
- Texting
- Accessing social networking tools

When cognitive rest is required for an athlete, does your institution:

■ Receive permission to share health status with academic advisors and professors? ☐ Yes ☐ No

■ Notify academic advisors and professors about the concussion and related signs and symptoms? ☐ Yes ☐ No

In determining the appropriate amount of physical and cognitive rest, does your institution's medical staff consider the athlete's:

■ Post-concussive clinical symptoms? ☐ Yes ☐ No

■ Previous history of concussions? ☐ Yes ☐ No

■ Severity of previous concussions? ☐ Yes ☐ No

■ Recent physical exam? ☐ Yes ☐ No

■ Sport? ☐ Yes ☐ No

■ Position? ☐ Yes ☐ No

■ Age? ☐ Yes ☐ No

■ Support system? ☐ Yes ☐ No

■ Overall "readiness" to return to sport? ☐ Yes ☐ No

Return to Play

Before an athlete returns to play after a concussion, does your institution require:

■ Clearance by a physician or physician's designee? ☐ Yes ☐ No

■ Completion of a medically supervised stepwise process that begins only after the athlete:

- Is asymptomatic?
- Has post-exertion assessments that are within baseline limits?

Actions Needed

Retiring From the Sport

- Does your institution reserve, in writing, the right to permanently retire an athlete from sports? ☐ Yes ☐ No

Is an athlete's permanent retirement considered if he or she has:

- A history of concussions, particularly when there is evidence that smaller forces are sufficient to cause another concussion? ☐ Yes ☐ No
- Post-concussion symptoms lasting more than three months? ☐ Yes ☐ No
- Evidence of a head or neck injury that would increase the risk of future concussions? ☐ Yes ☐ No

Before your institution permanently retires an athlete from sports, does it consult:

- Legal counsel? ☐ Yes ☐ No
- Applicable medical professionals, such as the team physician, trainer, and a neurologist? ☐ Yes ☐ No
- The athlete? ☐ Yes ☐ No
- The athlete's family? ☐ Yes ☐ No

Documenting Treatment

When treating suspected and confirmed concussions, does your institution document the:

- Incident that caused the injury? ☐ Yes ☐ No
- Evaluation of the athlete? ☐ Yes ☐ No
- Management of the athlete? ☐ Yes ☐ No
- Clearance of the athlete? ☐ Yes ☐ No

Actions Needed



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UE-113144 01/14