

Concussion:

Prevention, assessment, and management

Early recognition is the first step to proper care.

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CONCUSSION, a subset of mild traumatic brain injury, can lead to long-term effects, including chronic traumatic encephalopathy. (See *Concussion's impact*.) The Centers for Disease Control and Prevention (CDC) estimates that approximately 30 million children in the United States participate in sports that put them at risk for head trauma and concussion. And many young athletes who experience mild head trauma don't report symptoms until hours after the injury.

Prevention is the first step to reducing concussions among children and adolescents, but early-recognition will help ensure that young athletes receive proper care when they are injured.

Evolving guidelines

Although assessment and management of sports-related concussion in children and adolescents has evolved, no definitive, evidence-based protocols exist. Several assessment algorithms and treatment protocols have been developed, but most recent studies have concluded that more research is needed.

In 2013, the Report of the Guideline Development Subcommittee of the American Academy of Neurology (AAN) published an update on the evidence regarding sports concussion recognition and treatment. (See *AAN guidelines*.) This comprehensive literature review from 1955 through 2012 found that although several factors influence recovery, no conclusive evidence supports specific post-concussion activities to mitigate developing chronic complications.

Practice recommendations gener-

ated from the data were organized into three categories: pre-participation counseling; assessment, diagnosis, and management of suspected concussion recommendations; and management recommendations for diagnosed concussion, including acute care, return to play (RTP), and retirement from play. Many of the recommendations are considered standard of care and are used across the country where sports concussion programs exist.

Pre-participation counseling

The role of prevention can't be overstated. Research has led to the implementation of bans on body checks in PeeWee ice hockey, required helmet use when skiing or snowboarding, and mandatory car seats for children under a certain age or weight. Since 2009, most states have passed legislation on concussion in youth and high school sports, focusing on education, removal from play, and RTP.

The CDC Heads Up initiative and other programs offer comprehensive concussion education to students, parents, coaches, school personnel, and sports officials. Mandatory educational programs, through local or state agencies, are available for coaches, trainers, and healthcare providers.

Recent data demonstrate that many parents of young athletes aren't well-informed about concussion facts. One study showed that only 25% of parents "had a basic understanding of sports-related concussion." About 50% of the same group indicated their interest in learning more.

Another study revealed variability among school nurses about concussion recognition and management. Areas for improvement include continued training in recognition and management, establishing return to learn (RTL) school policies, and providing individualized approaches to concussion management. School nurses can play a leadership role in concussion recognition, care, and referral, and in coordinating and monitoring proper cognitive rest and academic accommodations.

Athletes and coaches also require concussion education. Many students don't recognize or report an injury or symptoms, and coaches don't always react quickly to a student's complaints. Some coaches pressure healthcare providers for premature permission to RTP.

Assessment, diagnosis, and management

The most recent guidelines are from the American Medical Society

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1.47 contact hours

LEARNING OBJECTIVES

1. Identify steps for preventing concussion.
2. Describe how to assess a child or adolescent for concussion.
3. Discuss the management of concussion.

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Concussion's impact

For centuries, most healthcare professionals believed that concussion didn't cause brain damage. Even today, some concussions are described as mild because of the absence of structural brain damage on radiographic examination. However, current understanding of pathophysiology suggests a cascade of events that occurs in the brain during a concussion that may result in poorly understood primary and secondary mechanisms, including impaired neurotransmission, loss of ion regulation, deregulation of energy use and cellular metabolism, and reduced cerebral blood flow.

for Sports Medicine, the American Academy of Neurology Summary of Evidence-Based Guideline Update, and the Consensus Statement on Concussion in Sport. All were published in 2013, and they all concur on early assessment and treatment goals.

Any youth athlete who's suspected of head trauma must be immediately removed from play. This first step in recognition and care of suspected concussion protects the individual from sustaining further injury. Although rare, additional injury may lead to second impact syndrome (SIS) or other complications of concussion. (See *What is SIS?*)

Assessment

Using sideline assessment tools, coaches, trainers, nurses, and providers can perform preliminary evaluation for concussion. (See *Signs and symptoms of concussion.*) Assessment tools include symptom scales, balance and gait testing, and cognitive assessments. Remember, these tools may help in early recognition, but they aren't a substitute for a thorough medical or neurologic evaluation by a trained provider.

The Sport Concussion Assessment Tool—3rd Edition (SCAT3™) combines elements of several other assessments, creating a comprehensive evaluation both initially and in comparison serial follow-ups. A version

of the tool has been designed for use with children under 13 years old. SCAT3 recommends emergency management in those with a Glasgow Coma Scale of less than 15; a deteriorating, progressive, or worsening mental status; a potential for spinal cord injury; or new neurologic signs. Although SCAT3 is a common part of sports concussion programs, support for its use is inconclusive. Further research is recommended to improve SCAT3 for detecting acute concussion and as a serial assessment tool during monitoring.

Parents, coaches, trainers, teachers, and all others involved in youth sports must learn about “red flag” symptoms. (See *Red flag on the play.*) These symptoms, either one by itself or several, may signal that the injury has caused something more serious than a concussion and requires evaluation in the emergency department.

Diagnosis

A concussion diagnosis is considered when an individual presents with any of the following signs and symptoms: mental status changes (such as amnesia or confusion), physical signs (such as fatigue, blurred vision, or headache), or behavioral effects (such as irritability or personality changes).

Referral to a healthcare provider trained in concussion management

will result in a systematic evaluation that includes symptom review, patient observation, palpation of the head for more severe neurologic and orthopedic injury, and specific tests for mental status and motor control. A thorough history, specifically related to prior head trauma and other pre-injury conditions, is important. Evidence suggests that patients who've had a concussion in the previous year are at increased risk for prolonged recovery, and those who've returned to play before fully recovering are at increased risk for SIS. Other research shows that patients with pre-injury learning or behavioral disabilities may have more difficult recoveries with more symptoms. However, knowing the exact description of the pre-injury disabilities will help avoid attributing those symptoms to the concussion.

Computed tomography (CT) and magnetic resonance imaging aren't recommended for diagnosis. Diagnostic imaging is reserved for individuals who experience extended alteration of consciousness, focal neurologic deficits, or worsening symptoms; the provider may recommend a CT scan if he or she suspects intracranial bleeding, fracture, or other structural abnormality.

Neuropsychologic testing, administered via paper and pencil or computer, may be useful in recognizing early concussion. However, current evidence shows that most concussions can be managed without this type of testing. Also, although anyone can administer the tests, a licensed clinical neuropsychologist must interpret the results.

The provider will create an individualized treatment plan, including removal from play, symptom checklists, serial patient monitoring, and a gradual return to physical and cognitive activities. Patient monitoring includes provider follow-up visits, school employee evaluations with assessment tests, and school nurse monitoring with checklists.

AAN guidelines

The American Academy of Neurology (AAN) investigated four key concepts in developing guidelines for sports-related concussion recognition and management.

Risk factors increasing or decreasing concussion risk

- Increased risk for female athletes participating in soccer and basketball, with greatest risk for those playing soccer
- Increased risk with “American” football and “Australian” rugby
- Decreased risk for baseball, softball, volleyball, and gymnastics
- Decreased risk with the use of headgear in rugby, but not with mouth guards
- No difference in risk with different types of football helmets
- Increased risk for the following positions in football, compared to receivers: linebackers, offensive linemen, and defensive backs
- Increased risk with body checking in ice hockey
- Increased risk with body mass index (BMI) > 27 kg/m²
- Increased risk with training time < 3 hours/week

Diagnostic tools that identify those with concussion and those at increased risk for poor postconcussion outcomes (but are not to be used in place of a thorough medical/neuropsychologic evaluation)

Diagnostic of concussion:

- Postconcussion symptom scale
- Graded symptom checklist
- Standardized assessment of concussion (SAC)
- Neuropsychologic testing (paper and pencil or computer) requires results analysis by neuropsychologist
- Balance error scoring system (BESS)
- Sensory organization test (SOT)
- Combination of testing improves diagnostic accuracy

Identifies poor concussion outcome:

- Elevated postconcussion symptoms
- Lower SAC scores
- Deficits on BESS and SOT

Clinical factors that identify those at risk for poor postconcussion outcomes

Severe or prolonged impairment:

- Ongoing clinical symptoms
- History of concussion
- Early posttraumatic headache
- Fatigue/fogginess
- Early amnesia, alteration in mental status, or disorientation
- Younger age/level of play
- Prior headache, dizziness
- Playing quarterback in football
- Playing football on artificial turf
- Neurologic catastrophe (subdural or other intracranial bleeding)—insufficient data to identify specific risk factors

Recurrent concussion:

- History of prior concussion
- First 10 days of initial concussion
- Longer length of participation
- Quarterback position in football

Chronic neurobehavioral impairment:

- History of prior concussion
- APOE e4 genotype
- Pre-existing learning disability

Interventions that enhance recovery and reduce or mitigate poor postconcussion outcomes

No evidence supports that postconcussion activity affects chronic complications.

Source: Giza et al. 2013.

What is SIS?

Increased intracranial pressure, decreased blood flow, and anoxia are concussion complications that may be the etiology of second impact syndrome (SIS). Some believe SIS occurs when a second concussion is sustained before symptoms from a first concussion have resolved and recovery is completed, preventing the brain from autoregulating intracerebral pressure and cerebral perfusion pressure, which may result in profuse cerebral swelling and brain herniation. This rare sequela demonstrates the importance of timely assessment, intervention, and continued monitoring after the initial injury. Others believe that a rare physiologic vulnerability places some patients at risk of developing cerebral edema after a single minor head trauma.

Signs and symptoms of concussion

Signs and symptoms of concussion are grouped into four categories: physical, cognitive, emotional, and sleep disturbance. Youth athletes with these signs and symptoms should be referred for evaluation by a healthcare provider trained in concussion management.

Signs

- Can't recall events before or after a hit or fall
- Appears dazed or stunned
- Forgets an instruction, is confused about an assignment or position, or is unsure of the game, score, or opponent
- Moves clumsily
- Answers questions slowly
- Loses consciousness (even briefly)
- Shows mood, behavior, or personality changes

Symptoms

- Reports headache or "pressure" in the head
- Nausea or vomiting
- Balance problems, dizziness, double or blurred vision
- Bothered by light or noise
- Sluggish, hazy, foggy, or groggy
- Confusion, concentration, or memory problems
- Reports "not feeling right" or "feeling down"

Source: Centers for Disease Control and Prevention. 2015.

Management

Both physical and cognitive activity can worsen concussion symptoms and even delay recovery, so rest is the cornerstone of management. Cognitive rest includes decreasing activities that involve attention and concentration, such as reading, schoolwork, watching TV, using a computer, and playing video games. Youth athletes with neurologic effects of concussion should stay home for the first 2 to 5 days after injury, especially if symptoms persist.

However, data from the Targeted Evaluation and Active Management (TEAM) Approaches to Treating Concussion suggest that too much rest may be detrimental to some children and young adults with concussion, including those with symptoms but

no early signs, such as loss of consciousness, posttraumatic amnesia, disorientation, or confusion. If the data show that cognitive and physical activity combined with social interaction is associated with improved outcomes in the chronic stages of traumatic brain injury (TBI), it follows that these treatment strategies may enhance recovery and decrease self-report of symptoms in some patients. The TEAM approach emphasizes using an individualized care plan. More randomized controlled trials are needed to provide data based on the evidence.

Return to learn

RTL should be tailored to the individual and carefully monitored, with any necessary academic ac-

commodations coordinated by the nurse. Step-by-step protocols for RTL guide the progression of cognitive work. These protocols vary, but they typically include increases in learning activities for 24 hours while monitoring for symptoms. If no symptoms occur, the patient can progress. Any activity that provokes symptoms requires a step back on the protocol for 24 hours.

Return to play

Physical activity must be curtailed to prevent further injury that might result in a second concussion. When the youth athlete has been cleared to fully participate in academics and no longer requires medication to control symptoms, physical activity can be resumed slowly and gradually.

Current recommendations regarding RTP are based on consensus statements. The guidelines evolve as new data emerges. (See *Emerging science*.) However, the first 10 days after the initial injury pose the greatest risk for sustaining a second concussion. Stating with certainty the number of days an individual must refrain from sports participation is difficult, so RTP plans should be individualized. The 4th International Conference of Concussion in Sport states that no one with a concussion should RTP on the same day the injury is sustained. And because of the possibility of delayed symptoms, sideline testing may not fully assess the injury's extent. Children and adolescents have longer concussion recovery times and exhibit different physiologic responses to head trauma than adults, so they should not be treated the same.

Before initiating the RTP protocol, youth athletes must be symptom free without the use of sedatives or pain medications. Before progressing to each step in the protocol, the athlete must be symptom free for 24 hours. (See *RTP protocol*.)

No strong evidence supports specific timing for making decisions about ending sports involvement after mul-

tiple concussions. Neuro-psychological testing may help. However, most experts agree that multiple concussions increase the risk for long-term, permanent neurobehavioral and cognitive dysfunction, and youth athletes and their families must be counseled.

Medication debate

Many concussion experts debate the use of medication after mild head trauma, with inconclusive evidence supporting the use of several classes of medications.

- Acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs) are recommended for headache in the acute phase, although they may mask the worsening of symptoms. NSAIDs should be used with caution because they may increase the risk for bleeding.
- Amitriptyline, classified primarily as an antidepressant, has been used to manage postconcussion symptoms such as irritability, dizziness, and depression.
- Methylphenidate, classified primarily as a central nervous system stimulant, has been used to treat attention and processing-speed deficits.
- Amantadine, an antiviral and anti-parkinsonian agent, has been used to improve cognition.
- Melatonin, an endogenous hormone used for the treatment of short-term sleep disturbance, is safe for use with postconcussion patients. Some evidence shows that it may play a beneficial role in brain trauma recovery. Most patients who experience concussion have a quick recovery, so the benefit/burden of medication should be discussed with them and their family.

Nurses' role

Nurses in school, acute care, and primary care settings are in key positions to involve interdisciplinary teams, which includes families, coaches, educators, and other healthcare providers. Nurses also

Red flag on the play

Anyone who exhibits sudden onset of any of these red flag symptoms after head trauma requires evaluation in the emergency department.

- Change in level of consciousness
- Doesn't recognize people or places
- Focal neurologic signs
- Headache that worsens
- Increasing confusion/irritability
- Looks very drowsy/can't be wakened
- Neck pain
- Repeated vomiting
- Seizures
- Slurred speech
- Unequal pupil size
- Unusual behavioral change
- Watery discharge from nose or ears or bloody discharge from ears
- Weakness or numbness in arms or legs

Sources:

Centers for Disease Control and Prevention. Acute concussion evaluation. cdc.gov/headsup/pdfs/providers/ace-a.pdf. Cleveland Clinic. 10 signs your child's concussion is serious—and what to do. August 31, 2015. health.clevelandclinic.org/2015/08/10-signs-your-childs-concussion-is-serious-and-what-to-do/



Emerging science

New evidence shows that the biomarker Tau (the same protein found in the brains of athletes with chronic traumatic encephalopathy) can aid in deciding whether a youth athlete can return to play (RTP).

A recent study by Gill and colleagues found that concussed athletes (male and female) with a higher blood concentration of Tau protein at 6, 24, and 72 hours after their injury (as compared to Tau levels in a control athlete group) were the same athletes who needed more time before RTP because of continued symptoms. However, results of cognitive tests in these athletes didn't necessarily reflect the need for longer recovery times.

Increased Tau levels are thought to indicate processes at the cellular (neuronal) level resulting from both injury and exertion. Injury at the cellular level isn't easily assessed with current diagnostics used in concussion recognition. This emerging data show promise for safer concussion management.

RTP protocol

To ensure youth athlete safety, return to play (RTP) should follow this protocol. The athlete must be symptom free for 24 hours before moving to each step.

- No activity with symptom-limited physical and cognitive rest
- Light aerobic exercise
- Sport-specific exercise
- Noncontact sport-specific training drills
- Full-contact practice after medical clearance

Source: Provance AJ, et al. 2016.

can advocate for increased recognition and standardized treatment, making a significant impact on the health of young athletes. ★

Visit americannursetoday.com/?p=37486 for a list of selected references.

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Please mark the correct answer online.

1. Which statement about concussion risk is correct?

- Receivers in football are at increased risk compared to linebackers.
- Female athletes who play basketball or soccer are at increased risk.
- "Australian" rugby is associated with a decreased risk of concussion.
- Those engaging in softball, baseball, and gymnastics have a higher risk.

2. A factor that increases the risk of concussion is a training time of

- 2 hours per week.
- 6 hours per week.
- 8 hours per week.
- 10 hours per week.

3. Which statement about the Sport Concussion Assessment Tool—3rd Edition (SCAT3) is correct?

- It can be used only in children who are at least 15 years old.
- More research is needed to clarify its role for detecting concussion on the sidelines.
- It can be used only in children who are at least 17 years old.
- SCAT3 recommends emergency management with a Glasgow Coma Scale of 20.

4. A sign or symptom that does NOT indicate a need for referral to a healthcare provider trained in concussion management is

- dizziness or double or blurred vision.
- loss of consciousness for less than 10 seconds.
- forgetting an instruction or being unsure of the game score.
- being able to recall events immediately before the hit.

5. Which of the following statements about diagnosing concussion is correct?

- Computed tomography is recommended within 16 hours of the injury.

- Magnetic resonance imaging is recommended within 8 hours of the injury.
- Neuropsychologic testing is not helpful in recognizing early concussion.
- Diagnosis includes signs and symptoms, history, and tests for motor control.

6. A clinical factor associated with risk of poor postconcussion outcomes is

- participant age of early 20s.
- playing football on natural turf.
- playing quarterback in football.
- no history of a prior concussion.

7. Which statement related to return to play (RTP) after concussion is correct?

- A child may be taking a pain medication when the RTP protocol is started.
- No one with a concussion should RTP on the same day the injury is sustained.
- A strict standard protocol should be adhered to, avoiding individualization.
- Children and adolescents have shorter concussion recovery times than adults.

8. When concussion occurs, acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs)

- are helpful because they do not increase the risk of bleeding.
- are not recommended for headache in the acute phase.
- can be used for headache in the acute phase.
- have the advantage of not masking worsening of symptoms.

9. Which drug is used to treat attention and processing-speed deficits related to a concussion?

- Methylphenidate
- Melatonin
- Amitriptyline
- Amantadine

10. Which of the following is safe for use in postconcussion patients and may play a beneficial role in recovery?

- Methylphenidate

- Melatonin
- Amitriptyline
- Amantadine

11. Which statement related to cognitive rest after a concussion is correct?

- Playing video games is an example of what a child can do several times a day while on cognitive rest.
- Watching TV is an example of what a child can do several times a day while on cognitive rest.
- Cognitive rest should last at least 14 days.
- Too much cognitive rest may be detrimental for some children with concussion.

12. In a typical RTP protocol,

- the athlete must be free of symptoms for 24 hours before moving to each step in the protocol.
- the athlete must be free of symptoms for 48 hours before moving to each step in the protocol.
- the second step is noncontact sport-specific training drills.
- the second step is sport-specific exercise.

13. The biomarker Tau

- is the same carbohydrate found in the brains of those with dementia.
- is lower in concentration when more time is needed before RTP.
- may be helpful for determining when a young athlete can RTP.
- may be misleading for deciding when a young athlete can RTP.

14. All of the following are red flags for when someone who experienced head trauma needs to be evaluated in the emergency department, except

- headache that improves.
- leg or arm numbness.
- neck pain.
- slurred speech.