A concussion is a mild traumatic brain injury. It occurs when the brain experiences a blow to the head or a sudden violent rotational force. Any blow to the head which results in symptoms is considered a concussion. Because the brain is complex, every brain injury is different. Concussion results in physiologic changes in the brain metabolism (neuronal hyperexcitation) with subsequent decrease in cerebral blood flow. This increased metabolic demand and decreased energy supply create a "metabolic crisis" within the brain resulting in the common signs and symptoms manifest in concussion.

In the past, concussion severity was related to the presence or absence of loss of consciousness. It is not necessary to lose consciousness to have a concussion. Recent advances in the understanding of concussion have eliminated the familiar grading systems of the past and their dependence on loss of consciousness as criteria in determining severity. Recommendations now emphasize a retrospective determination of severity following patient recovery. Ninety percent of sports concussions are mild and resolve in 7-10 days if given a proper chance to recover. The remaining 10% may require 6 months to a year for full recovery.

Nearly 1.5 million head injuries occur in the United States each year. The Center for Disease Control estimates more than 20% of those injuries (>300,000) are sports-related concussions. More than 5% of high school athletes are concussed each year while participating in collision sports. The most common sports include football, ice hockey, soccer, wrestling, lacrosse, basketball, baseball, softball, field hockey, and volleyball. Risk of injury depends on game, position, and use of helmet.

Adolescent athletes have increased susceptibility to concussions related to immaturity of the central nervous system and lack of recognition of concussion. Many concussions go unreported because of failure to appreciate their seriousness. The old adages “Got your bell rung” or “Got the cobwebs cleaned out” trivialize this potentially serious condition. Make no mistake: a concussion is a brain injury!

The diagnosis of concussion is based on the presence of recognized symptoms during the clinical examination. A complete review of history including previous head injury or concussion with a comprehensive physical examination looking at neurocognitive function is essential to determine a starting point for recovery. The latest recommendations suggest precompetition neurocognitive testing to establish baseline brain function for later comparison in the event of concussion. The use of imaging studies continues to focus on serious sequelae associated with brain injury and not for establishing the diagnosis.

Understanding the signs and symptoms associated with concussion by parents, coaches, and athletes will greatly improve care for the injured athlete. The following table lists common signs and symptoms associated with concussion. Although not exclusive for concussion, in the presence of head injury their existence should be considered diagnostic of concussion.
When head injury occurs, the most common question is when or if the athlete should be evaluated. The athlete will need to be evaluated by a physician comfortable with managing concussion before being allowed to return to competition safely. The following are indicators for physician evaluation.

- Loss of consciousness on the field
- Amnesia lasting longer than 15 minutes
- Deterioration of neurologic function*
- Decreased level of consciousness*
- Decrease or irregularity in respirations*
- Decrease or irregularity in pulse*
- Any signs or symptoms of associated injuries, spine or skull fracture, or bleeding*
- Mental status changes: lethargy, difficulty maintaining arousal, confusion, or agitation
- Motor, sensory, balance or cranial deficits subsequent to initial on-field assessment
- Post concussion symptoms that worsen
- Additional post concussion symptoms as compared with those on the field
- Athlete is still symptomatic at the end of the game (especially at high school level)

* Require immediate transport to emergency department

Return to play is based on symptom-free participation in activity. The athlete is restricted from both physical and cognitive activity while experiencing symptoms. It is important the athlete understand the necessity for cognitive rest in addition to physical activity restriction. Following resolution of symptoms, a graduated program of physical activity is implemented to guide safe return. The stepwise progression is used interchangeably unless otherwise noted.

**Table: Graduated Return to Activity**

<table>
<thead>
<tr>
<th>Rehabilitation Stage</th>
<th>Functional Exercise at Each Stage of Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No activity</td>
<td>Complete physical and cognitive rest</td>
</tr>
<tr>
<td>Light activity</td>
<td>Walking, light jogging, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat)</td>
</tr>
<tr>
<td>Moderate activity</td>
<td>Moderate jogging/brief running, moderate-intensity stationary biking, moderate intensity weightlifting (reduced time and/or reduced weight from typical routine)</td>
</tr>
<tr>
<td>Heavy non-contact activity</td>
<td>Sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills</td>
</tr>
<tr>
<td>Full-contact practice</td>
<td>Following medical clearance, participate in normal training activities</td>
</tr>
<tr>
<td>Return to play</td>
<td>Normal game play</td>
</tr>
</tbody>
</table>

It is OK to: Use acetaminophen (Tylenol) for headaches, use ice pack on head & neck as needed to comfort, eat a light diet, go to sleep, rest (no strenuous activity or sports)

There is NO need to: Check eyes with a flashlight, wake up every hour, test reflexes, stay in bed, take ibuprofen, aspirin, naproxen or other non-steroidal anti-inflammatory medications

Do NOT: Drink alcohol, drive while symptomatic, exercise or lift weights, take ibuprofen, aspirin, naproxen or other non-steroidal anti-inflammatory medications

**Resources**

- Heads Up: Concussion in Youth Sports website with information/handouts for coaches, parents, athletes and physicians [http://www.dhss.mo.gov/SHCN/Publications.html](http://www.dhss.mo.gov/SHCN/Publications.html)
- Immediate Post-Concussion Assessment and Cognitive Testing (ImpACT) website information [www.impacttest.com](http://www.impacttest.com)
- Websites with information on neurocognitive testing for athletes [www.headminder.com](http://www.headminder.com) [www.cogstate.com/go/sport](http://www.cogstate.com/go/sport)
- The Missouri Greenbook: Living with Brain Injury [http://www.dhss.mo.gov/SHCN/Publications.html](http://www.dhss.mo.gov/SHCN/Publications.html)
- Brain Injury Association of Missouri and resources [http://www.biamo.org/Resources.asp](http://www.biamo.org/Resources.asp)

**Adolescent “SHORTS”** is a bimonthly newsletter supported by the Missouri Department of Health and Senior Services about adolescent issues for Missouri providers. Any comments or suggestions are welcome and should be directed to either Daryl Lynch, MD or Patti Van Tuinen.