

## **Sport-Related Concussion: What Should Swimmers and Parents Know?**

Ian A McLeod, MS, PA-C, ATC; Karen McAvoy, PsyD; Scott Rodeo, MD; Tamara C Valovich McLeod, PhD, ATC, FNATA

### **What is a concussion?**

Approximately 1.1-1.9 million concussions, resulting from participation in sports and recreational activities, are sustained annually among athletic individuals.<sup>1</sup> While most people associate concussion with collision and contact sports such as football and soccer, concussions can occur in swimming. Concussions in swimming occur primarily during practices in association with dryland training or in-water collisions with another athlete or the wall.<sup>2,3</sup> In the 2017-2018 swim season, 234 head and neck injuries were reported to USA Risk Management. Concussion is a condition that affects the brain's ability to function properly. Injuries that athletes report as "dings" or "getting their bell rung" are most often concussions. Several common features<sup>4</sup> that may be used in defining a concussion include:

1. Caused by a direct blow to the head, face, neck, or elsewhere on the body with an "impulsive" force transmitted to the head.
2. Typically results in the rapid onset of short lived impairment of neurological function that resolves spontaneously
3. May result in structural injury to the brain, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury seen on standard imaging, such as a CT scan or MRI
4. Results in a range of clinical symptoms that may or may not involve loss of consciousness. Resolution of the symptoms typically follows a sequential course.

**What should make me suspicious that my child has a concussion?**

Parents and coaches should suspect a concussion if an athlete, who had any impact to the head or torso, complains of any of the symptoms indicated in Table 1. In addition, parents and coaches can look for problems in brain function, such as a confused state, memory problems, lack of sustained attention, slow response to questions, slow slurred speech and slowed reaction times. Concussed athletes may also display unusual behaviors (combative, aggressive, silly), may ask the same questions over and over, or just act out of character. They may also display problems with balance and coordination, such as moving slowly, clumsily, and complaining of dizziness.

*Table 1: Signs and Symptoms of Concussion*

<i>What you may notice</i>	<i>What your child may tell you</i>
<ul style="list-style-type: none"> <li>• Is dazed or stunned</li> <li>• Is confused about events</li> <li>• Moves clumsily or has poor balance</li> <li>• Struggles to answer questions</li> <li>• Repeats questions</li> <li>• Loses consciousness (blacks out)</li> <li>• Acts strangely or personality changes</li> <li>• Forgets events that happened before or after the injury</li> <li>• Forgets class schedule or assignments</li> </ul>	<ul style="list-style-type: none"> <li>• Headache or pressure in the head</li> <li>• Upset stomach or vomiting</li> <li>• Feels unsteady or wobbly</li> <li>• Dizziness</li> <li>• Has double or blurry vision</li> <li>• Lights hurts their eyes</li> <li>• Sounds seem very loud</li> <li>• Feeling drowsy, sluggish, or foggy</li> <li>• Hard to concentrate and forgets things</li> <li>• Feeling more emotional, nervous, angry, irritable or anxious</li> <li>• Does not feel right, confused</li> <li>• Trouble falling asleep or sleeping more or less than usual</li> </ul>

**How can a concussion be detected?**

Concussions are most often diagnosed through the presentation of the signs and symptoms mentioned above. More recently, there has been a trend to add more objective tests that assess cognition and coordination. Simple tests of cognitive function including asking the athlete specific questions about the event, asking them to remember a list of 5 unrelated words, asking them to repeat the months of the year or days of the week in reverse order or by repeating

a short string of numbers in reverse order. Impairments in coordination or balance can be detected by having the athlete touch their finger to their nose, balance on one foot with eyes open, followed by with eyes closed, or walking a line like a tightrope (heel to toe).

Neuroimaging techniques such as CT scan or MRI are not able to detect the functional abnormalities caused by concussion. These techniques are important for ruling out more severe brain injury, but generally do not play a role in diagnosing a concussion, determining the severity of the injury, or for recommendations about when an athlete can return to activity.<sup>5</sup>

### **What do I do if my child may have a concussion?**

If you think your child has sustained a concussion, they should be immediately taken out of participating in the practice or competition. They should be referred immediately (emergency department or urgent care facility) if they are displaying any of the signs and symptoms that warrant immediate medical referral (Table 2). Children and adolescents should *never* be allowed to return to activity on the same day as their suspected injury.<sup>4</sup> Athletes removed from participation due to a suspected concussion should be evaluated by a medical provider, preferably with experience in managing sport-related concussion.<sup>6</sup>

*Table 2. Signs Warranting Immediate Referral*

1. Deterioration of neurologic function
  2. Decreasing levels of consciousness
  3. Decrease or irregularity in respirations
  4. Decrease or irregularity in pulse
  5. Unequal, dilated, or unreactive pupils
  6. Any signs or symptoms of associated injuries (spine or skull fracture, bleeding)
  7. Mental status changes (lethargy, confusion, agitation, difficulty maintaining arousal)
  8. Seizure activity
-

### **When can my child return to sports and school?**

The general rule at all levels of participation is that no athlete may return to full activity if they are still having symptoms. Normal recovery for children and adolescents can take up to 3-4 weeks.<sup>7</sup> After a 24-48 hour period of rest, your child's medical provider may initiate some exercise activities that do not worsen symptoms. Depending on the nature of the symptoms, some other treatments, such as vision and balance training may be prescribed. It is important that you and your child follow the recommendations of the medical provider regarding rest and rehabilitation activities. Once symptoms resolve, the athlete may begin a supervised return to swim progression. The USA Swimming Concussion Task Force has developed a staged approach specific for swimmers. This progression takes place over a period of 4-6 days and allows the swimmer to gradually return to full swimming (Figure 1). The most important factor is to monitor for any symptoms at progressive levels of activity.

While your child may be focused on returning to swimming, it is important to understand that concussion can affect many areas associated with memory, concentration, and attention that can cause problems in school. During the recovery period, academic support may be needed in the classroom. These can include taking frequent "eyes off page/head on desk/water breaks" in the classroom after periods of mental exertions, short proactive rest breaks in the school clinic mid-morning and /or mid-afternoon as needed, a removal of non-essential work, a reduction of semi-essential work, a focus on keeping up with a reasonable amount of essential current work instead of make-up work and an exemption of testing and adjustment of appraisals/grades during recovery from the concussion. The American Academy of Pediatrics Clinical Report states that while full resolution of a concussion may take weeks, it is acceptable for a student to return to

school when symptoms are “tolerable, intermittent and amenable to rest”,<sup>8</sup> especially with academic and physical support provided by the school. In fact, research has shown that a student returning to some level of social and academic re-integration within a few days promotes quicker symptom resolution.<sup>9</sup>

*Figure 1. Return to Swim Progression*

Step	Goal	Example Activities
1	Symptom limited activity	Activities of daily living Light mental activities
2	Light aerobic exercise	20 minutes: kicking with board and snorkel Land-based – bike or elliptical Speed no faster than aerobic speed or 65% of 100 time
3	Sport-specific exercise	30 minutes: limited head movement All four strokes, open turns Speed no faster than aerobic speed or 70% of 100 time
4	Non-contact training drills	30 minutes: more complex interval training All 4 strokes, add coordination and cognitive load, open turns Speed no faster than aerobic speed or 75% of 100 time
5	Unrestricted practice	Full participation in practice Introduce starts and flip turns
6	Competition	

**Where can I get more information?**

Additional information on sport-related concussion can be found at the following websites or by contacting the authors.

1. Center for Disease Control and Prevention Brain Injury Resource Center -

<https://www.cdc.gov/headsup/index.html>

2. National Athletic Trainers' Association - <https://www.nata.org/practice-patient-care/health-issues/concussion>
3. Get Schooled on Concussions - <https://www.getschooledonconcussions.com/>

## References

1. Bryan MA, Rowhani-Rahbar A, Comstock RD, Rivara FP. Sports- and Recreation-Related Concussions in US Youth. *Pediatrics*. 2016;138(1):e2 0154635, DOI: 0154610.0151542/peds.0152015-0154635.
2. Robinson K. *USA Swimming 2017 Reports of Occurrence Summary-Potential Concussions/Head Strikes*. USA Swimming; 2017.
3. Kerr ZY, Baugh CM, Hibberd EE, Snook EM, Hayden R, Dompier TP. Epidemiology of National Collegiate Athletic Association men's and women's swimming and diving injuries from 2009/2010 to 2013/2014. *Br J Sports Med*. 2015;49(7):465-471.
4. McCrory P, Meeuwisse W, Dvorak J, et al. Consensus statement on concussion in sport- the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med*. 2017.
5. McCrea M, Meier T, Huber D, et al. Role of advanced neuroimaging, fluid biomarkers and genetic testing in the assessment of sport-related concussion: a systematic review. *Br J Sports Med*. 2017;51(12):919-929.
6. Harmon KG, Clugston JR, Dec K, et al. American Medical Society for Sports Medicine position statement on concussion in sport. *Br J Sports Med*. 2019;53(4):213-225.
7. Makkdissi M, Schneider KJ, Feddermann-Demont N, et al. Approach to investigation and treatment of persistent symptoms following sport-related concussion: a systematic review. *Br J Sports Med*. 2017;51(12):958-968.
8. Halstead ME, McAvoy K, Devore CD, et al. *Pediatrics*. 2013;132(5):948-957.
9. Thomas DG, Apps JN, Hoffman RG, et al. *Pediatrics*. 2015;135(2):1-11.