

## Concussion

Welcome to **Neuroscience Pearls**: A publication from the UW Medicine Neurosciences Institute. Our goal is to provide useful information pertinent to your practice. Here we bring you key points related to concussion recognition and management.

**Anthony M. Avellino, MD, MBA**, Professor, Neurological Surgery; Director, UW Medicine Neurosciences Institute  
**Richard G. Ellenbogen, MD, FACS**, Professor and Chairman, Department of Neurological Surgery  
**Stanley A. Herring, MD**, Clinical Professor, Department of Rehabilitation Medicine, Orthopaedics & Sports Medicine and Neurological Surgery  
**David B. Coppel, PhD**, Professor of Neurological Surgery, Director of Neuropsychological Services and Research, Seattle Sports Concussion Program

Physicians can appropriately identify, diagnose and manage concussion and improve patient outcomes by implementing early management and appropriate referral when concussion is suspected or diagnosed. Concussion symptoms may appear mild, but can lead to significant, life-long impairment affecting an individual's ability to function physically, cognitively, and psychologically. Appropriate diagnosis, referral, and patient and family/caregiver education are critical to achieve optimal recovery.

**WHAT IS A CONCUSSION?** A concussion is a type of Traumatic Brain Injury (TBI) caused by the forceful shaking of the brain in the skull from a blow, fall or collision. A body injury causing the head and brain to move quickly back and forth may produce the same changes. The annual incidence of concussion is unknown precisely because most injuries do not result in ER visits or hospitalizations. However, the CDC estimates several million sports and recreation-related TBIs occur annually, including concussions. The symptom duration is highly variable lasting from several minutes to days, weeks, months or longer in some cases. Recovery time may be longer for children and adolescents. Symptoms or deficits beyond 3 months may signal post-concussion syndrome. With proper diagnosis and management, most patients recover fully.





Unlike more severe TBI's, the disturbance of brain function from concussion is related more to dysfunction of brain metabolism rather than structural injury or damage. Our understanding of the underlying pathology has shifted from a focus on anatomic damage to an emphasis on neuronal dysfunction involving a complex cascade of ionic, metabolic and physiologic events.

**SIGNS AND SYMPTOMS:** Signs and symptoms of concussion generally fall into four categories: (See Table 1)

**DIAGNOSIS:** Diagnosing concussion can be challenging as symptoms are common to those of other medical conditions (such as PTSD, depression, and headache syndromes), and the recognition of symptoms may occur days or weeks after the initial injury.

**WORK-UP:** A systematic assessment of the injury and its manifestations is essential to proper management and reduced morbidity. The CDC's Acute Concussion Evaluation (ACE) form <http://www.cdc.gov/concussion/headsup/pdf/ace-a.pdf> is a useful tool and should be administered to patients with clearly indicated (e.g., LOC or change in mental status, confusion or amnesia) or suspected concussion signs and symptoms (e.g., other traumatic injuries are observed or reported; forcible blow to the head with functional changes). For example, concussions are often not recognized among children with orthopaedic injuries. Use of the Sports Concussion Assessment Tool - 3rd Ed. is also highly recommended. (SCAT3, Child SCAT 3: <http://bjsm.bmj.com/content/47/5/259.full.pdf> <http://bjsm.bmj.com/content/47/5/263.full.pdf>)

**Table 1 COMMON SIGNS & SYMPTOMS**

Thinking/Remembering 	Physical 	Emotional/Mood 	Sleep 
Difficulty thinking clearly	-Headache -Fuzzy or blurry vision	Irritability	Sleeping more than usual
Feeling slowed down	-Nausea or vomiting (early on) -Dizziness	Sadness	Sleep less than usual
Difficulty concentrating	-Sensitivity to noise or light -Balance problems	More emotional	Trouble falling asleep
Difficulty remembering new information	Feeling tired, having no energy	Nervousness or anxiety	

**DETERIORATING NEUROLOGICAL FUNCTION:** Patients should be carefully observed over the first 24-48 hours for the serious signs listed below. If any of these are reported, patients should be referred to the ER for immediate medical evaluation.

- Headaches that worsen
- Repeated vomiting
- Increasing confusion
- Weakness/numbness in arms or legs
- LOC greater than 30 seconds or longer. (Brief LOC-<30 seconds-should be taken seriously and the patient carefully monitored).
- Focal neurologic signs
- Slurred speech
- Significant irritability
- Inability to recognize people/places
- Seizures
- Drowsy or unresponsive
- Unusual behavior change

**TREATMENT:** The first step to improving outcomes for patients with concussion is to determine a plan of action for follow-up. Based on initial evaluation findings, physicians may decide to:

- 1. Monitor the Patient in the Office.** This is particularly appropriate if the number and severity of symptoms are steadily decreasing over time and/or fully resolved within 3 to 5 days.
- 2. Make a Referral to a Concussion Specialist.** Referral is appropriate if symptom reduction is not evident within 3 to 5 days post injury, or sooner, and if the type or severity of symptoms is of concern. Specialists can further evaluate the patient's complex presentation and to help manage certain aspects of their condition (e.g., return to sports, school, and work). The Seattle Sports Concussion Program is a leading patient and physician resource in the Northwest.

<http://www.uwmedicine.org/locations/sports-concussion-program-harborview>

<http://www.seattlechildrens.org/clinics-programs/orthopedics/services/seattle-sports-concussion-program/>

**3. Monitor the Patient in the Office.** During the acute phase, diagnostic tests may include neuroimaging (such as a CT or MRI) or neuropsychological testing. Neuropsychological tests involving performance of specific cognitive tasks, can help confirm self-reported symptoms, track recovery and assess abilities such as memory, concentration, information processing, executive function and reaction time, and help determine the appropriate time for return to safe sports participation, school or work.

## CLINICAL PEARLS: Management Approaches

- It is critical for physicians to guide patient recovery with active management plans based on current symptoms.

- Increased rest and limited exertion are important to facilitate the patient’s recovery. Physicians should be cautious about allowing patients to return to driving, especially if the patient has problems with attention, processing speed, or reaction time. Patients should also be advised to get adequate sleep at night and to take daytime naps or rest breaks when significant fatigue is experienced. Symptoms typically worsen or re-emerge with exertion. Let any return of a patient’s symptoms be the guide to the level of exertion or activity that is safe. Patients should limit both physical and cognitive exertion accordingly. Return to Play Guidelines used in the Seattle Sports Concussion Program (including evaluation of professional athletes) are shown in Table 2 as an example of one management plan. \*

- Children and adolescents need help from parents, teachers, coaches, athletic trainers and teachers to monitor and assist with recovery. Management should involve all aspects of the patient’s life; home, school, work and social-recreational activities.

Washington state is a national leader in legislation addressing youth sport concussion with passage of the Zackery Lystedt Youth Concussion Law in all states. Key provisions of the Lystedt Law are shown below.

## The Zackery Lystedt Law

The Zackery Lystedt Law in Washington state requires education of athletes, parents and coaches about concussions, removal from practice or play if an athlete is suspected of having suffered a concussion and return to practice or play only with the written clearance of a licensed healthcare professional knowledgeable about concussions. The law is named after Zackery Lystedt, a Maple Valley teenager who returned to play while still having symptoms after suffering a concussion. As a result, he sustained a severe traumatic brain injury that could have been avoided. Zackery Lystedt’s life was saved at Harborview Medical Center/UW Medicine by the Neurological Surgery team.

## Key Provisions

- Removal from play after suspected concussion
- Uniformity of rules and implementation
- Informed consent and education for parents, athletes and coaches
- Written clearance by an expert to return to play
- Private sports organizations complying with the same rules as public schools

**Table 2**

Rehab Stages (1-6)	Functional Exercise	Objective
1. No activity	Complete physical & cognitive rest. (No school, if indicated!)	Recovery of cognitive function
2. Light aerobic exercise	Walking, swimming or stationary bike; No resistance training	↑ HR
3. Sport-specific exercise	Running drills; No head impact activity	Add movement
4. Non-contact training drills	Progression to more complex training drills; Start progressive resistance training	Exercise, coordination, cognitive load
5. Full contact practice	After medical clearance only; Normal activity	Restores confidence & assess functional skills
6. Return to play	Normal game/competition	Prevent next injury

**Richard G. Ellenbogen, M.D., F.A.C.S.** is Professor and Theodore S. Roberts Endowed Chair of the Department of Neurological Surgery at the University of Washington School of Medicine. He is Co-Medical Director of the Seattle Sports Concussion Program and Co-Chair of the NFL Head Neck and Spine Committee.



**Stanley A. Herring M.D.** is a UW Clinical Professor in Rehabilitation Medicine, Orthopaedics and Sports Medicine and Neurological Surgery. He is Co-Medical Director of the Seattle Sports Concussion Program and holds the Zackery Lystedt Sports Concussion Endowed Professorship, and is team physician for the Seattle Seahawks and Mariners.



**David B. Coppel, Ph.D** is a UW Professor of Neurological Surgery and Director of Neuropsychological Services and Research for the Seattle Sports Concussion Program. He is a Consulting Neuropsychologist and Clinical/Sport Psychologist for the Seattle Seahawks, and served as the Sport Psychologist for the US Figure Skating Team at the 2002 Winter Olympics.



**ESSENTIAL CITATIONS** - All reference information found at: [http://www.cdc.gov/concussion/headsup/physicians\\_tool\\_kit.html](http://www.cdc.gov/concussion/headsup/physicians_tool_kit.html)  
For doctors, visit and complete a course introduction and overview at: <http://www.cdc.gov/concussion/headsup/clinicians>

<http://www.uwmedicine.org/locations/sports-concussion-program-harborview>

\* Detailed guidelines for returning to school, work or play also can be found in the CDC’s: **Heads Up: Facts for Physicians** - [http://www.cdc.gov/concussion/headsup/pdf/Facts\\_for\\_Physicians\\_booklet-a.pdf](http://www.cdc.gov/concussion/headsup/pdf/Facts_for_Physicians_booklet-a.pdf)

**For emergencies 24/7, Contact the UW Medicine Transfer Center at 1.888.731.4791**

**Request an appointment:**  
**Call 1.877.520.5000 or 206.744.8000 M-F, 8:00 am - 4:30 pm**

**March 2014**  
**Volume 2, Issue 2**

