Managing Concussions in Pediatric and Adolescent Patients
The New Concussion Management Guidelines

Disclosures
- None
- The information presented does not reflect official policy or endorsement by the U.S. Air Force, the Department of Defense, or the United States Government

Case #1
- You are at the sidelines of a HS football game. The star running back gets clobbered, and doesn’t get up for about 30 seconds. As soon as the trainer gets out there he gets up and walks him to the sideline. The trainer states he did not lose consciousness, just had the wind knocked out of him. Coach comes over and asks you to check him out so they can get him back in the game ASAP.
- What do you do?
- Can you return him to play?

Case #2
- You are seeing a 14 Y/O gymnast who slipped and hit her head last week at a meet. She was dazed for about 15 seconds but had no loss of consciousness. She was seen in the local ED, told she had a grade 1 concussion and would be able to return to active competition after 1 week of rest. She is following up with you to get a note saying she can return to practice.
- What do you do?
- Would you call this a grade 1 concussion?
You are contacted by your kids HS asking if you will join their COT.
What is that?

Concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.
May be caused by a direct blow to the head, face, neck or elsewhere on the body with an “impulsive” force transmitted to the head.

Typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously.

May result in neuropathological changes but the acute symptoms largely reflect a functional disturbance rather than a structural injury.
Concussion is typically associated with grossly normal structural neuroimaging studies.

For the practicing clinician, perhaps a more useful working definition is a trauma-induced alteration in mental status that may or may not involve LOC.

Children aged 0 to 4, adolescents aged 15 to 19, and adults over 65 are most likely to sustain traumatic brain injury (TBI).
Almost half a million (473,947) emergency department visits for TBI are made annually by children aged 0 to 14 years.

*CDC.gov
Falls are the leading cause of TBI. Rates are highest for children aged 0 to 4 years and for adults aged 75 years and older. Falls result in the greatest number of TBI-related emergency department visits (523,043) and hospitalizations (62,334). Motor vehicle–traffic injury is the leading cause of TBI-related death. Rates are highest for adults aged 20 to 24 years.

Twenty percent of traumatic brain injury resulting in loss of consciousness (LOC) occurs during sports activity. Concussions are 6 times more likely to occur in organized sports than in leisure physical activity.

Reported incidence of concussion in high school and college football players is between 4% and 5%. Studies in which players have directly and confidentially reported their symptoms after a blow to the head have revealed much higher rates of concussion, ranging from 15% to 45%.

Boys football and Lacrosse
Girls Soccer
In similar sports concussion rate is almost double in girls vs boys

Baseball/softball, basketball, soccer


May be associated with a blow to the skull; however, direct impact to the head is not required. In fact, in the laboratory setting, concussion can be achieved more effectively by nonimpact rotation of the head than by a blow to the head.

LOC
Amnesia
Disorientation
Dazed
Confused
Emotionality
Poor coordination
Seizure
Slow verbal response
Personality changes
Headache
Dizziness
Nausea or vomiting
Balance difficulties
Vision changes
Photophobia
Phonophobia
Concentration difficulties
Drowsiness
Depression
On a molecular level, there is a disruption of neuronal membranes, resulting in a massive efflux of potassium into the extracellular space. This results in the calcium dependent release of excitatory amino acids, particularly glutamate, which stimulates further potassium efflux. As the concentration of extracellular potassium increases, it triggers neuronal depolarization, which is followed by neuronal suppression.

Sodium-potassium pumps work to restore homeostasis.
Given the degree of the induced ion fluxes, a large amount of energy is expended, which increases glycolysis. This results in local lactic acid accumulation.

To meet these increased metabolic demands and remove accumulated lactate, an increase in cerebral blood flow might be expected. However a decrease in cerebral blood flow has been observed.

Several different systems based on duration of symptoms or loss of consciousness (LOC)
- Examples: Cantu, American Neurological Society, Colorado, etc
- Return to play guidelines time based, depending on grading of initial concussion

Return to play recommendations were not based on research, but expert opinions
2005 Classification System

- At the second International Conference on Concussion in Sport, the use of grading systems was abandoned explicitly in favor of classifying concussions as simple or complex.

2008 Nomenclature

- NO grading system at all
- None of the terminology fully described the entities
- 80% to 90% will resolve in 7-10 days in older athletes – may take longer in younger athletes
- In a small percentage post-concussive symptoms may be prolonged

Using the right words

- Carol A. DeMatteo, Steven E. Hanna, William J. Mahoney, Robert D. Hollenberg, Louise A. Scott, Mary C. Law, Anne Newman, Chia-Yu A. Lin, and Liqin Xu
  "My Child Doesn't Have a Brain Injury, He Only Has a Concussion"
- Should say Mild Traumatic Brain Injury

Concussion in Youth

- Lovell 2004*
  - High School athletes ages 13 to 18
  - Preseason Neuropsychological testing
  - 43 with concussion during season had repeat evaluations at average of 36 hours and Day 6 post injury

Concussion in Youth

- "Grade 1" concussion
  - Transient Confusion
  - No LOC
  - Symptoms resolve within 15 minutes

Memory performance scores

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<th>Baseline</th>
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<th>Day 6</th>
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By old guidelines, these youth could be returned to play during the game as they were asymptomatic at 15 minutes.

Study shows concussion affects will continue to progress over at least the next 36 hours.

Field – 2003*

- 371 college athletes and 183 high school athletes
- Baseline neuropsychological evaluation
- 54 sustained concussions and had serial neuropsychological evaluations

Baseline scores similar in Neuropsych tests.

At 24 hours, significant differences between concussed and control groups at both levels.

At day 3, collegiate athletes same as control group, but High School athletes remained significantly delayed.

Persisted but improving through Day 7.

- 90% of HS and 96% of college injuries were in Football
- High School mean age was 15.9
- College mean age was 19.9
- Matched ages for control group

Post concussion symptoms

- Significantly more in High School athletes at Days 1, 3 and 5, but not day 7.
- Significantly more in college athletes at Days 1 and 3 only.
**Computer-assisted Neuropsychological testing**

- Lovell ‘98
  - 64 HS athletes with concussions (24 controls)
  - Baseline, 36 hours, day 4, day 7
  - Significant memory deficits noted at 3 time points on testing compared to baseline
  - Reported symptoms only at 36 hours, no symptoms noted at Day 4 or 7
  - Memory deficits present even without noted symptoms

**Pre-season Neuropsych testing**

- At College and professional level, pre-season neuropsychological testing is done on all athletes
- If they sustain a concussion during the season, they are retested and only when they return to baseline can they be returned to play

**Pre-season Neuropsych testing**

- Often computer based, but still need a trained person to administer test
- Not practical for most high school or recreational sports

**Computer-assisted Neuropsychological testing**

- Kaminski – 2009
  - Automated Neuropsychological Assessment Metric
  - Automated testing scores stable with repeat measurements
  - Testing at two time periods sufficient for baseline

**Management**

- Each concussion should be managed individually by using multiple means of assessment
- No player should be returned to play until the symptoms of concussion have resolved completely, both at rest and during exercise.
- Because younger athletes require longer recovery times, more conservative return-to-play decisions should be considered for younger athletes.


- The Player should not be allowed to return to play in the current game or practice
- The player should not be left alone, and frequent assessments should be done
- Player should be medically evaluated
- Return to play must follow a medically supervised stepwise process
Return-to-Play Protocol

1. No activity / complete rest. When asymptomatic progress to:
2. Light aerobic exercise such as walking or stationary bike, NO resistance training
3. Sport specific exercise (skating in hockey, running in soccer) progressive addition of resistance training
4. Noncontact training drills; progressively increased resistance training
   - Follow-up with provider
5. Full-contact training after medical clearance
6. Game play

Rehabilitation stage | Functional Exercise | Objective
--- | --- | ---
1. No activity | Complete Physical and cognitive rest | Recovery
2. Light aerobic exercise | Walking, swimming, stationary biking < 70% max heart rate | Increase heart rate
3. Sports-specific exercise | Running / skating, NO head impact activities, Light weights | Add movement
4. Non-contact training drills | More complex training drills – i.e. passing, running plays, Progressive weight training | Coordination and cognitive load
5. Full contact practice | AFTER medical clearance – normal training activities | Restore confidence and assess functional skills by coaches
6. Return to play | Normal game play | 

www.thinkfirst.ca

- Canadian initiative to educate and improve care
- Great website with evaluation tools and return to play protocol handout
Pediatrics Grand Rounds
20 January 2012

University of Texas Health Science Center at San Antonio

Program:
A concussion is a serious event, but you can recover fully from such an injury if the brain is given enough time to rest and recuperate. Returning to normal activities, including sport participation, is a step-wise process that requires patience, attention, and caution. Sometimes these steps can cause symptoms of a concussion to return. This means that the brain has not yet healed, and needs more rest. If any signs or symptoms return during the Return To Play process, the player must be re-evaluated by a physician before trying any activity again. Remember, symptoms may return later that day or the next, not necessarily during the activity.

Step 1: No activity, only complete rest. This means no work, no school, and no physical activity. When symptoms are gone, a physician must be consulted. The physician will be able to clear the player to slowly return to some activities.

Step 2: Light aerobic exercise, such as walking or stationary cycling. The player should be supervised by someone who can help monitor for symptoms and signs. No resistance training or weight lifting. The duration and intensity of the aerobic exercise can be gradually increased over time. If no signs or symptoms return during the exercise or the next day, Symptoms? Go back
Cognitive Rest

- During recovery, an athlete’s academic performance may suffer, and intellectual activity may increase their symptoms. Thus, “cognitive rest” has been recommended for school-aged athletes.

The following recommendations can be instituted to assist in the recovery of the concussion.

- Please allow for the following academic accommodations:
  - ___ Excuse tests, homework, or papers until further notice
  - ___ Un-timed tests, when able to take them
  - ___ Preprinted class notes by either the teacher or copy those of a fellow student
  - ___ Allow to participate in class only by listening with no active note taking
  - ___ Reduced workload whenever possible
  - ___ ½ day school for ___ days
  - ___ Please excuse from school for ___ days
  - ___ Allow to go to the nurses office if headaches increase
  - ___ Allow to go home if headaches don’t subside after resting for 15 minutes
  - ___ Tutoring Start Date: __________ Duration: __________
  - ___ Other

II. ___ must complete return to play protocol prior to returning to play.

Second Impact Syndrome

- Second-impact syndrome occurs after athletes have sustained a concussion from which they are still symptomatic and receive a second injury to the head.
- This second injury may be minor. Even a blow to the chest or trunk that transmits accelerative forces to the brain can result in second-impact syndrome.

Second Impact Syndrome

- Patient rapidly decompensates
- Autoregulatory control over cerebral blood flow is disrupted, causing rapid increase in intracranial pressure
- Widespread anoxic changes and herniation
- Death
**Second Impact Syndrome**
- Controversial diagnosis
- Even those that question if it exists still agree that patients should not return to play until all symptoms and deficits have resolved
- Only reported under age 21

**Post concussion Syndrome**
- In a small percentage of people, symptoms may persist for weeks or months
  - Headaches
  - Cognitive problems
- RTP guidelines apply – no activities risking repeat head injury until asymptomatic
- Prolonged cognitive rest
- Consider Neurology / Neuropsych consultation

**Repeat Concussions**
- After a first concussion, a player is at increased risk for additional concussions.
- Those who experience a LOC are 6 times more likely to sustain another concussion
- The risk of recurrent concussion greatest within 7 to 10 days

**Rules**
- **UIL August 2011**  [www.UILTexas.org](http://www.UILTexas.org)
  - No one returns to play on the same day
  - Must be evaluated by medical provider
- "Natasha’s Law" – Texas HB2038
  - Above, plus School Districts must establish a Concussion Oversight Team
  - Training HCPs, Coaches, COT members
  - Graded return to play protocol
  - Statewide tracking mechanism
  - UIL approved form signed by student/parent

**Equipment**
- Mouthguards – no conclusive evidence that they are protective for TBI, but do help prevent dental and oro-facial injury
- Biomechanical studies have shown a reduction in force to the brain, but this has not translated into reduction in concussions
- RISK COMPENSATION = may cause paradoxical increase in injuries
**Concussion Oversight Team**

- Required of every school district and open-enrollment charter school
- “Each concussion oversight team shall establish a return-to-play protocol, based on peer-reviewed scientific evidence, for a student’s return to interscholastic athletics practice or competition following the force or impact believed to have caused a concussion”

- At least one physician
- If the school district employs an athletic trainer then 1 must be a member
- If possible, should also include:
  - An advanced practice nurse
  - A neuropsychologist
  - A physician assistant

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**Summary**

- New classification scheme:
  - No classification
- New Return to Play guidelines
  - Stepwise approach, proceed when asymptomatic
  - Not time based
- It’s the law in Texas (and most states soon)
Main References


