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Northwestern Medicine®
Feinberg School of Medicine

Updates in Concussion Management

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Disclosure

I have no relevant financial relationships to disclose

Learning Objectives

- Recognize current recommendations for approaching a patient with a suspected concussion

- Review current concepts on the evaluation and management of concussion in children and adolescents including return to play and return to learn strategies

What is a concussion?

- "A traumatic brain injury induced by biomechanical forces"
- Subset of mild TBI

5 common features

1. Caused by direct or indirect blow to head or body with force transmitted to the head
2. Rapid onset of short-lived impairment of neurologic function that resolves spontaneously (may develop over minutes to hours)
3. Signs and symptoms are from functional disturbance, not structural injury (no changes on standard neuroimaging)
4. Range of signs and symptoms (+/- LOC), Resolution typically follows a sequential course. However, in some cases, symptoms may be prolonged.
5. Can't be explained by something else

Question 1: True or false?

Most concussions occur during sports

1. True
2. False

Image via: https://www.dublinschool.org/boys-lacrosse

False

- >50% NOT related to organized sports
- In contact sports, rates of overall injury and concussion increase with age and pubertal maturation status

Image via: https://www.aboutkidshealth.ca/concussion

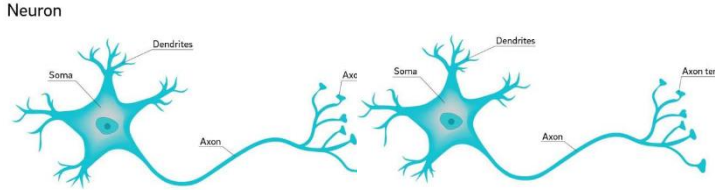
Epidemiology

- 1.1-1.9 million reported concussions per year in kids ≤ 18 yo
- 74 million kids in US
- In last 10 years ED visits for concussion increased >200%!
- 2.2 x higher incidence in girls than boys in comparable sports
- Repeat concussion rates ↓ in the past 4 years

Image via www.pediatricsassociates.com

Pathophysiology

Disruptive stretching of neuronal cell membranes and axons



Complex cascade of ionic, metabolic and pathophysiological events

Glutamate, Ca^{2+}, K^{+}, Na^{+} dysregulation

↓

Low metabolic state
↓ conduction velocity through neurons

↓ intracellular ATP
↓ cerebral blood flow

Symptoms

Somatic

- Headache (86-96%)
- Nausea/Vomiting
- Neck Pain
- Light/Noise Sensitivity

Vestibular/oculomotor

- Dizziness (65-75%)
- Hearing problems/Tinnitus
- Balance Problems

Cognitive

- Difficulty Concentrating (48-61%)
- Confusion (40-46%)
- Mentally "foggy"
- Poor memory
- Answers questions slowly
- Repeats Questions
- LOC (<5%)

Emotional

- Irritable
- More emotional
- Sad
- Nervous/Anxious

Sleep

- Drowsiness/fatigue
- Feeling slowed down
- Trouble falling asleep
- Sleeping too much
- Sleeping too little

Question 2

You are seeing a 12 year old boy 2 days after he suffered a concussion when another child opened their locker door quickly, accidentally striking your patient's head. His father asks you, "how long until he is back to normal?"

1. 3-5 days
2. 1-4 weeks
3. 4-8 weeks
4. 8-12 weeks

Image via: https://fayettewoman.com/middle-school-making-the-leap/

How long until my child is back to normal?

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Most recover within 1-4 weeks

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Evaluation

PECARN Pediatric Head Injury/Trauma Algorithm

Predicts need for brain imaging after pediatric head injury.

INSTRUCTIONS

Note: This only applies to children with GCS scores of 14 or greater.

When to Use | Pearls/Pitfalls | Why Use

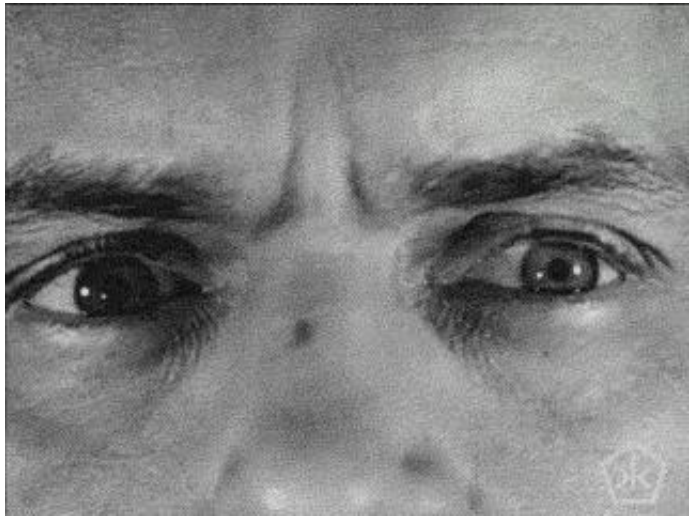
The PECARN Pediatric Head Injury Prediction Rule is a well-validated clinical decision aid that allows physicians to safely rule out the presence of clinically important traumatic brain injuries, including those that would require neurosurgical intervention among pediatric head injury patients who meet its criteria without the need for CT imaging.

Age	<2 Years **≥2 Years**
GCS ≤14 or signs of basilar skull fracture or signs of AMS AMS: Agitation, somnolence, repetitive	**No** Yes

Diagnosis

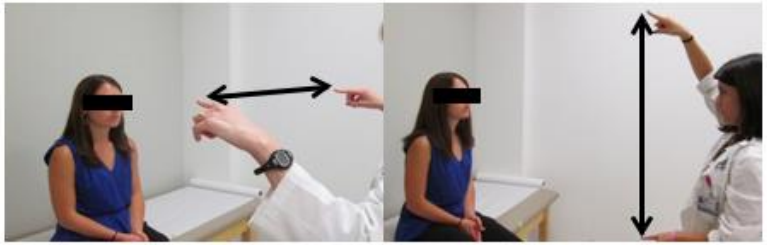
- Clinical diagnosis
- **History**
  - Mechanism
  - Symptoms
  - Baseline problems: headaches, mood, learning problems, neck pain, balance problems
  - Family history: migraines, mood problems

- **Physical Exam**
  - Look for structural injury
  - Neurologic exam
  - Balance
  - Vision



The Vestibular/Ocular Motor Screening-VOMS

Smooth Pursuits



Horizontal and Vertical Saccades

Horizontal Vestibular-Ocular Reflex (VOR)

Near Point Convergence

Visual Motion Sensitivity

Mucha et al., 2014; AJSM

Question 3:

You are watching a local high school hockey game, and you notice a player skating off balance after being checked hard into the boards. After coming off the ice, he says he feels "fine" but "had his bell rung." You perform a quick neurologic exam which is normal. What should you do next?

1. Allow him to return to play now since he is acting normally now
2. Hold him out of play for a minimum of 24 hours
3. Observe him for 20 minutes before allowing him to return to play

When in doubt, Sit them out!

No athlete should be allowed to return to play same day if any concern for a concussion

- If continued to play after concussion → have worse symptoms, 8.8x more likely to have recovery longer than 21 days
- Time from injury to removal from play
  - Immediate: 19 days
  - Within 15 minutes: 28 days
  - >15 minutes: 44.07
- Additional head injury within 24 hours → average recovery time increased from 36.9 to 52.3 days in 1 study

Second-Impact Syndrome

1st concussion (ongoing symptoms)

Cerebral Edema

Possible herniation and death

Treatments: healthy lifestyle

- Adequate sleep: sleep hygiene, limit naps
- Hydration: 2 glasses water before school, H_2O bottle
- Nutrition: Regular, healthy meals & snacks
- Avoid taking ibuprofen/tylenol more than 2-3x per week (rebound HA)

Treatments

- **Reduction (*not elimination) of cognitive and physical activities**
- Strict rest and no rest have the worst recovery times

Concussion Law

2009: Washington State passed the first concussion in sports law, called the Zackery Lystedt Law

Now: All 50 states have some form of sports-related concussion legislation

State policies vary
- *who* can provide clearance
- same day clearance

Illinois Youth Sports Concussion Safety Act (2015): required all Illinois schools to establish "return to sports" and "return to learn" protocols for students with concussions by the start of the 2016/17 school year

Exercise

- Light cardio shortens recovery time up to 3x
- Should not make symptoms worse

What about Screen Time?

- Limit if worsening symptoms
- Television is usually better tolerated than videogames or reading on a screen

Return to School

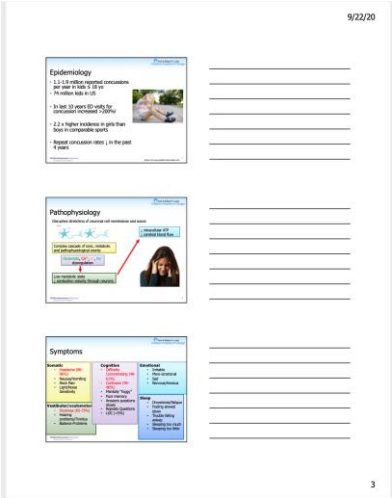
Back in school within 48 hours

Academic Accommodations

- Managed by Return to Learn team at school
- Breaks (5 minutes or full periods)
- Progress to full school days as tolerated

School Accommodations

- Decrease school work to essential amount to demonstrate concept mastery
- Less homework
- Delay big assignments
- No quizzes or tests
- Environmental accommodations
  - Sunglasses
  - Avoid noisy places
  - Pre-printed notes



Concussion Impact on Learning: Age differences

- ELEMENTARY SCHOOL
  - Complain of physical problems
  - Misbehave in response to concussion symptoms
- MIDDLE SCHOOL
  - Sensitive to feeling different
  - May minimize symptoms to avoid standing out
  - Problems w/ executive function (organization/planning) may have a great impact on academic performance
- HIGH SCHOOL
  - Busy schedules, high achievers, larger volume of work, ACT and college planning
  - Prioritizing activities and reducing overall demands important

Virtual School Accommodations

- Pre-printed notes
- Adjust screen brightness
- Frequent scheduled breaks
- Shortened learning activities
- Keep daily "school schedule"
- Frequent check-ins with return to learn team

<u>20-20-20 rule</u>: look away every **20** minutes at an object that is about **20** feet away for a full **20** seconds

Image via: juststand.org

Teen Drivers

- Avoid driving the first few days following concussion
- Do not drive while very symptomatic
- Stick to familiar routes
- Limit driving to when it is necessary
- Avoid driving at night

Image via: https://www.nhpr.org/post/getting-tough-teen-drivers

…but what if they aren't better in 4 weeks?

Evaluate for associated injuries that may benefit from rehabilitation or other treatments

Physical Therapy
- Cervical Strains
- Vestibular problems
- Exercise Tolerance

Sleep Medicine
- Sleep cycle disturbances

Ophthalmology/PT
- Oculomotor disturbances

Psychology/Psychiatry
- Depression
- Anxiety
- Problems with attention

- Reassure that they will improve with time

What to write on the physical therapy prescription?

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1. Vestibular therapy
2. Cervical muscle stretching, strengthening, and massage
3. Sub-symptom threshold exercise training

Physical Therapy

Physical Therapy: cervical strain

Medications

-Tylenol & Ibuprofen: ok to try

-no more than 2-3 x per week (rebound headaches)

-Magnesium 200-400 mg daily & Riboflavin (B2) 200 mg daily (combination medications available)

-daily for > 1 month

Return to Play: When?

- Symptom-free according to child and parent
- At academic baseline WITH catch-up plan in place

Image via: https://sciencenordic.com/denmark-school-society--culture/the-trials-of-being-a-smart-student/1452760

Image via: https://usatodayhss.com/2015/2014-15-gatorade-state-softball-players-of-the-year

Return to Play

Step 1 *- Light aerobic exercise (no resistance training) - Exercises may include walking, stationary bike, light running. PURPOSE: Increase heart rate*

Step 2 *- Sport-specific exercises - running/sprinting, agility drills, skating for ice hockey, individual skill work with ball or puck; may resume weight training. PURPOSE: Add movement*

Step 3 *- Non-contact training drills - passing and catching or shooting drills, continue skills from above. PURPOSE: Exercise, coordination, cognitive load*

Step 4 *- Full contact practice; may resume physical education class. PURPOSE: Restore confidence, assessment of functional skills by coaching staff*

Step 5 *- Game play*

Long Term

- **No one knows how many concussions are too many before permanent damage occurs**
- Nearly everyone recovers completely
- More concern if each repeated concussion takes longer to resolve or if a repeat concussion occurs from a light blow

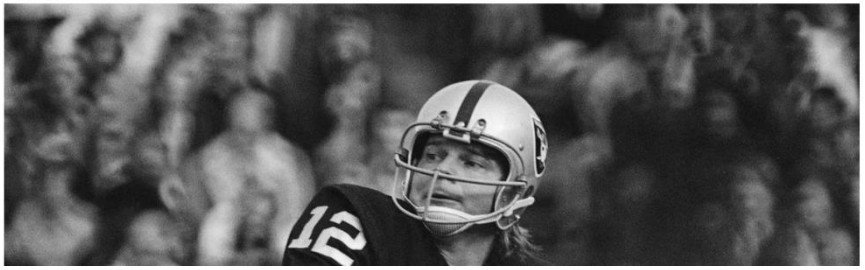
Chronic Traumatic Encephalopathy (CTE)

- Can't diagnose CTE in a living person
- Imperfect evidence

The New York Times

Players With C.T.E. Doubled Risk With Every 5.3 Years in Football

A new study is the first to quantify the number of years linked to measurable brain disease.



Mez J, Daneshvar DH, Kiernan PT, et al. Clinicopathological Evaluation of Chronic Traumatic Encephalopathy in Players of American Football. *JAMA.* 2017;318(4):360–370.

What about subconcussive hits?

- C
  e
- C
- F
- N
  c

"Post-Concussive Syndrome"

- Not in DSM-V
- No consensus on time frame, definition

Concussion Prevention

Rule changes/rule enforcement = most effective

Education for athletes, parents, coaches, etc re: mechanisms, symptoms

Proper injury management is the best form of prevention

Early recognition/treatment reduces chance for prolonged recovery

Protective equipment has limitations and can lead to more risk taking play style

Resources

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Search

Advanced Search

HEADS UP

CDC > HEADS UP > Information for Health Care Providers

HEADS UP

- Brain Injury Basics +
- Helmet Safety
- Youth Sports +
- School Sports +
- Schools +
- Information for Health Care Providers −

HEADS UP to Health Care Providers: Tools for Providers

Acute Concussion Evaluation (ACE) Forms

The ACE (Acute Concussion Evaluation) forms are patient assessment tools.

Download

Emergency Department ACE form

Physician/Clinician office ACE form

Resources: School Letter Templates

Letter to schools to be filled in by healthcare providers

SCHOOL LETTER

Returning to School After a Concussion

CDC HEADS UP
SAFE BRAIN, STRONGER FUTURE.

DEAR SCHOOL STAFF:

This letter offers input from a healthcare provider with experience in treating concussion, a type of traumatic brain injury. This letter was created to help school professionals and parents support students returning to school after a concussion. You can use these recommendations to make decisions about support for your student based on his or her specific needs. This letter is not intended to create a 504 Plan or an IEP unless school professionals determine that one is needed. Most students will only need short-term support as they recover from a concussion. A strong relationship between the healthcare provider, the school, and the parents will help your student recover and return to school.

_____ was seen for a concussion on _____
Student Name — Date

in _____ office or clinic.
Healthcare Provider's Name

The student is currently reporting the following symptoms:

PHYSICAL
- ☐ Bothered by light or noise
- ☐ Dizziness or balance problems
- ☐ Feeling tired, no energy
- ☐ Headaches
- ☐ Nausea or vomiting
- ☐ Vision problems

THINKING OR REMEMBERING
- ☐ Attention or concentration problems
- ☐ Feeling slowed down
- ☐ Foggy or groggy
- ☐ Problems with short- or long-term memory
- ☐ Trouble thinking clearly

SOCIAL OR EMOTIONAL
- ☐ Anxiety or nervousness
- ☐ Irritability or easily angered
- ☐ Feeling more emotional
- ☐ Sadness

SLEEP
- ☐ Sleeping less than usual
- ☐ Sleeping more than usual
- ☐ Trouble falling asleep

The student also reported these symptoms:

_____
_____
_____

CDC

Download

Resources: Parent Handouts

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics
CELEBRATING 10 YEARS

Concussions

A concussion is any injury to the brain that disrupts normal brain function typically on a temporary basis. Concussions are usually caused by a blow or jolt to the head but may occur from a hit to the body that produces a reflex force to the head.

The following is information from the American Academy of Pediatrics about concussions, including guidance on treatment and prevention.

When do concussions occur?

Concussions can happen in any sport but more often occur in collision sports (/English/news/Pages/Younger-Athletes

Resources: Parent Handouts

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics
CELEBRATING 10 YEARS

After a Concussion: When to Return to School

After a concussion (/English/health-issues/injuries-emergencies/sports-injuries/Pages/Concussions.aspx), it is common for many parents and coaches ask when their child/athlete can return to their sport (/English/healthy-living/sports/Pages/When-is-an-Athlete-Ready-to-Return-to-Play.aspx) or to recreational activities. However, it is also important to for parents to remember that children are "students" first and "athletes" second.

The American Academy of Pediatrics (AAP) developed guidance

Take Home Points

- Reduction (*not elimination) of cognitive and physical activities
- Encourage safe exercise early
- Most concussions last 1-4 weeks, but some kids need extra treatments to recover
- Concussion research is rapidly evolving

Resources

For Parents:

- HealthyChildren.org
  - "Concussions"
  - "After a Concussion: When to Return to School"

For Providers

- "Sport-Related Concussion in Children and Adolescents," AAP Clinical Report: 2018
- "Returning to Learning Following a Concussion," AAP Clinical Report: 2013 (reaffirmed 2018)
- American Medical Society for Sports Medicine position statement on concussion in sport, 2018
- Kerr, ZY, et al. Concussion Incidence and Trends in 20 High School Sports. Pediatrics Oct 2019.
- CDC Heads Up
- Illinois High School Association (ISHA)
- When in doubt, please call us or refer to sports medicine

Thank you!