

It's Enough to Make You Dizzy! Concussion Update 2017

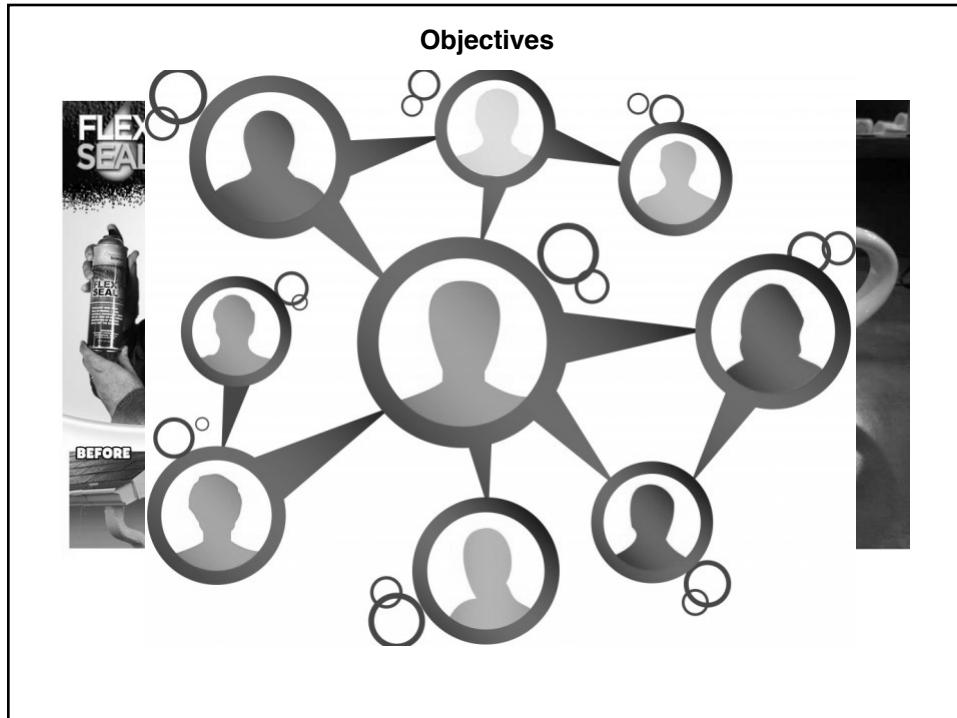
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Medical Director

Acknowledgments: Tracy Zaslow, MD; Greg Canty, MD; Mark Halstead, MD

Disclosures

I, Rachel A. Coel, have no relevant financial relationships with the manufacturers(s) of any commercial products(s) and/or provider of commercial services discussed in this CME activity.

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The “Game Plan”

1. Review presentation of concussion
2. Update on management of concussion
3. Review return-to-play guidelines
4. Discuss injury prevention strategies and equipment
5. My plug for “EARLIER...”

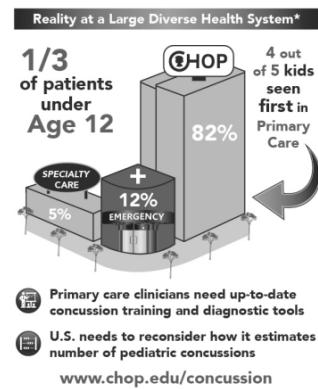


What's this gotta do with me???

5

Point of Entry (2016)

- Primary care (> 3/4 of concussion patients start here)
- Emergency Department
- Sports Medicine
- Neurology
- Physical Medicine & Rehabilitation
- Neurosurgery



Original Investigation

Point of Health Care Entry for Youth With Concussion Within a Large Pediatric Care Network

Kristy B. Arbogast, PhD, Alison E. Curry, PhD, Melissa R. Pfeiffer, MPH, Mark R. Zonfrillo, MD, MSCE, Juliet Haarauer-Krups, PhD, Matthew J. Breiding, PhD, Victor G. Coronado, MD, MPH, Christina L. Master, MD

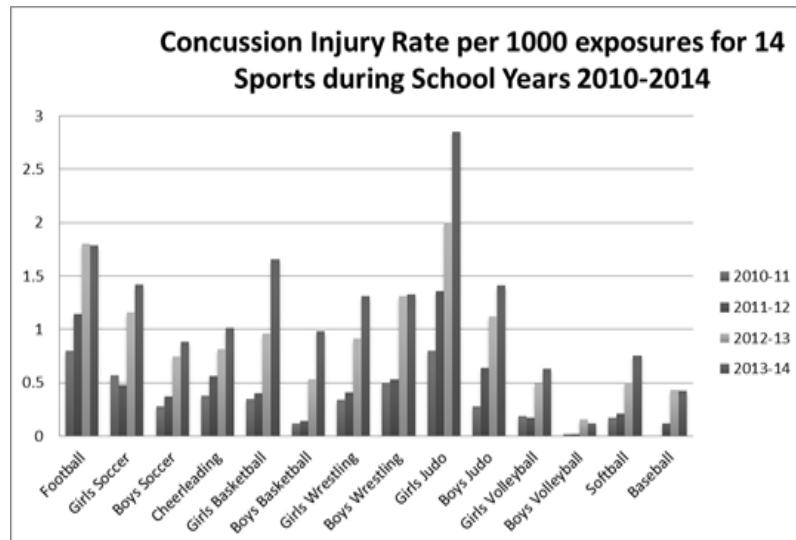
*Researchers from The Children's Hospital of Philadelphia (CHOP) and the Centers for Disease Control and Prevention looked at data from 2010–2014 on 8,000 0-to-17-year-old patients enrolled with a CHOP primary care provider and diagnosed with a concussion.

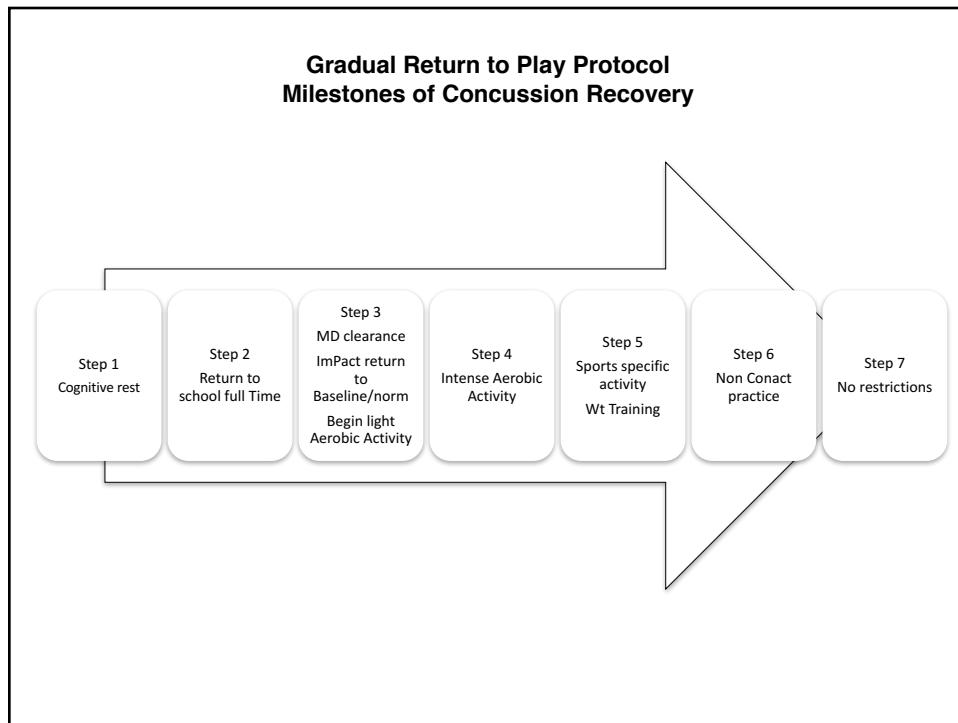
**ImPACT baseline testing for 67 schools
participating state-wide including private schools**

School Year	# of Baselines	# of Concussions
2010-11	4683	446
2011-12	10,113	895
2012-13	10,496	1140
2013-14	10012	1370
2014-15	9451	1052
2015-16	9066	1092



Concussion Injury Rate per 1000 exposures





Average Number of Sport Days Missed

Hawaii Concussion Awareness & Management Program (HCAMP)
 Report from August 1, 2011 to July 31, 2016
 Number of Days Missed

Days Missed	MEAN	SD
August 1, 2015 – July 31, 2016 (n=1092)	21.68	19.08
August 1, 2014 – July 31, 2015 (n=1052)	31.68	21.68
August 1, 2013 – July 31, 2014 (n=1370)	26.15	25.17
August 1, 2012 - July 31, 2013(n=1140)	26.2	18.98
August 1, 2011 - July 31, 2012 (n=845)	23.5	16.5



Relationship Between Time in Each Step

School Year	2010-2012	2013-2014
Onset to Step 1	1.1	1.1
Step 1 to Step 2	3.0	3.0
Step 2 to Step 3 (school/cardio)	9.9	13.7
Step 3 to Step 4	2.0	2.3
Step 4 to Step 5	2.1	2.2
Step 5 to Step 6	2.6	2.8
Step 6 to Step 7	2.7	2.1

How do we get them moving sooner?



What concerns young athletes about concussions?

CJSM study (Stein) of 121 pediatric athlete patients

Worst thing about concussion:

- Symptoms – 58%
- Loss of activity – 56.2%
- Both symptoms and loss of activity – 14%

TABLE 2. Examples of Patients' Free-Text Responses to the Question, "What Is the Worst Thing for You About Having a Concussion?"

"Headache, fogginess"
"Miserable, falling behind in school work, bored, no fun"
"Having to be on brain rest—it is very boring"
"Cannot do anything and cannot drive"
"The worst thing for me is that if I get another one I could potentially not be allowed to play contact sports"
"I cannot watch television, use my phone, or play sports"
"Headaches, bright lights, not being able to concentrate, trouble reading"
"The headaches, not being able to do all of my school work like normal and not being able to play sports"
"Depression issues, low energy, insomnia, not being able to keep up in school"
"Not being able to go to gymnastics or soccer and not being able to be with friends"
"Feeling tired all the time"
"I can't play a sport until I am cleared by a doctor. Which can take forever"
"Not being able to do anything"
"I get really dizzy a lot"
"Headaches, not being able to remember things"
"Feeling like I can think/process something but not being able to do it, painful consistent headaches, and not being able to play soccer"
"I am not allowed to do the things I love"

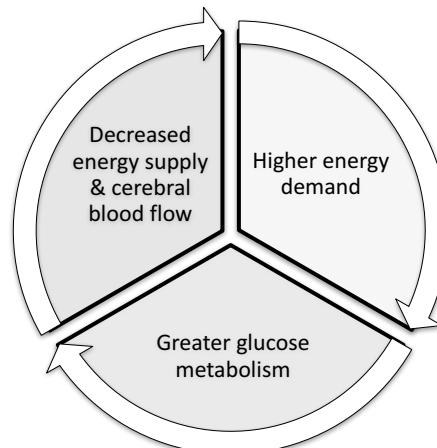
What happens in a concussion?

15

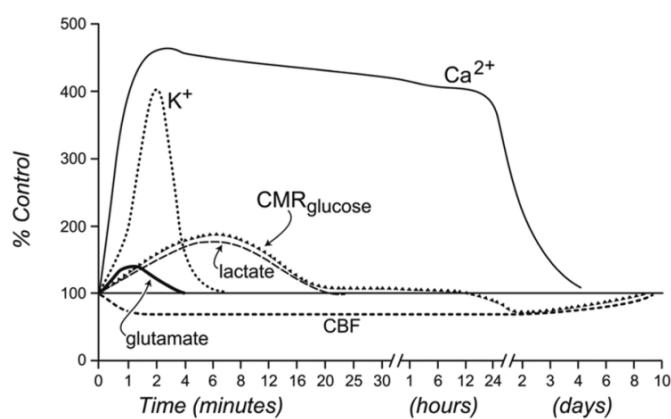


Metabolic Mismatch

BRAIN = ENERGY CRISIS

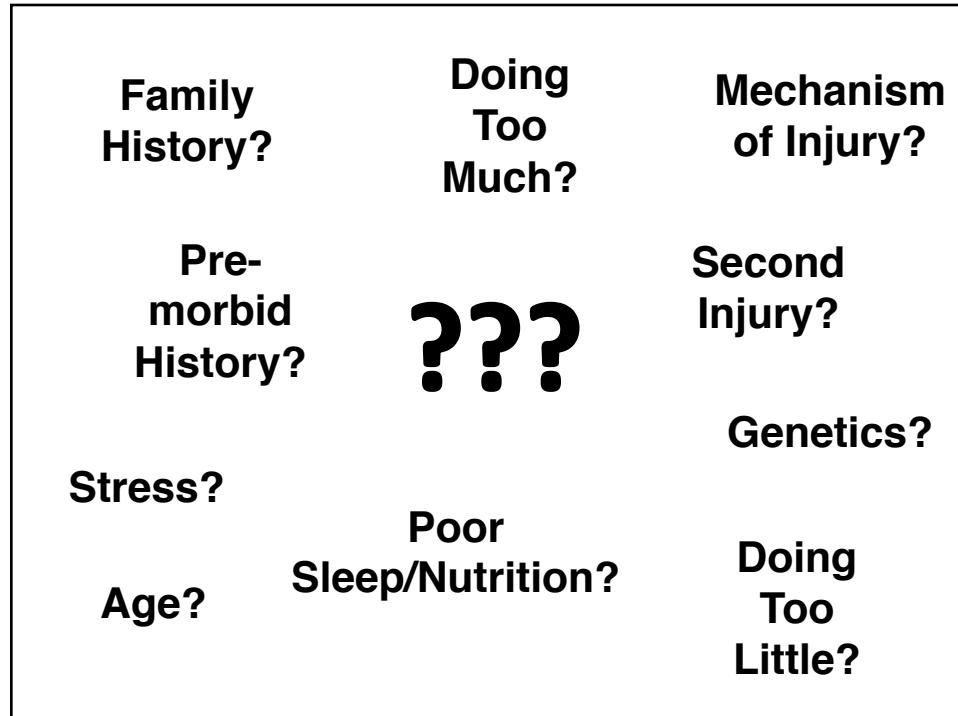


Timeline for Cellular Correction

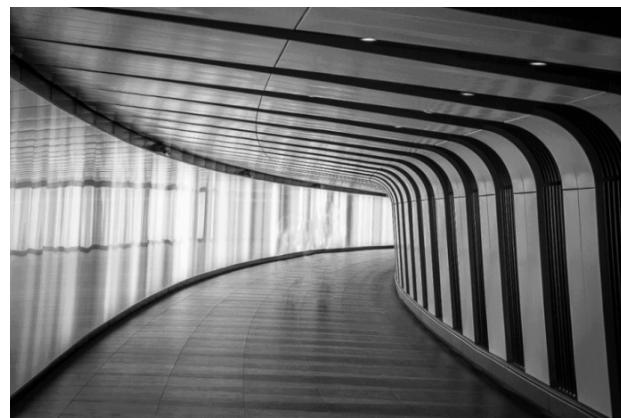


7 – 10 DAYS

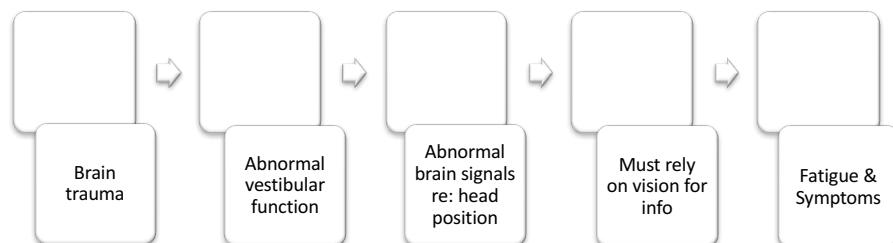
Giza CC, Hovda DA. Ionic and metabolic consequences of concussion. In: Cantu RC, Cantu RI. *Neurologic Athletic and Spine Injuries*. St Louis, MO: WB Saunders Co; 2000:80–100.



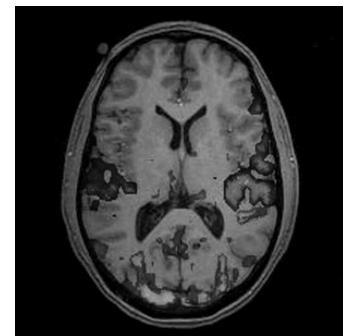
This is vestibular dysfunction!



Concussion & the Vestibular System



What do I dream about?



Where are we currently?

- History & Symptom Checklists
- Physical Exam
- Balance Testing
- Imaging
- Computerized neurocognitive testing
- Neuropsychological testing
- Physical therapy
- Vision therapy
- Medication
- Coping



Child SCAT3

- 5-12 year-olds
- Age-appropriate symptom checklist and questions
- Questions for parents
- Designed to be used by medical professionals

Child-SCAT3™

Sport Concussion Assessment Tool for children ages 5 to 12 years

For use by medical professionals only

What is childSCAT3?

The Child-SCAT3 is a standardized tool for evaluating injured children for concussion and can be used by medical professionals. It incorporates the original SCAT and the SCAT2 published in 2005 and 2009, respectively. For older persons, ages 12 years and over, please refer to the Child-SCAT3-12+ (Child-SCAT3-12+). The Child-SCAT3 is a modified version of the original SCAT designed specifically for children between testing with the Child-SCAT3 can be helpful for interpreting concussive injury in youth.

What is a concussion?

It results in a variety of non-specific signs and symptoms like those listed below and most often occurs without loss of consciousness. Concussion should be suspected in the presence of any one or more of the following:

- Symptoms (e.g., headache, dizziness, nausea)
- Behavioral changes (e.g., irritability, or
- Impaired brain function (e.g., confusion, forgetfulness, difficulty concentrating).

SIDELINE ASSESSMENT

Indications for Emergency Management:

If a child has suffered a head injury and any of the following, then do not proceed with the Child-SCAT3, instead activate emergency procedures and urgent transport:

- Glasgow Coma Score less than 15
- Loss of consciousness
- Potential spinal injury
- Persistent vomiting
- Evidence of skull fracture
- Convulsions
- Coma
- Coughing/tightness in the chest (eg. Shortness of breath)
- Multiple injuries

1 Glasgow coma scale (GCS)

Best eye response (E)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
No eye opening	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Eye opening to pain	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
Eye opening spontaneously	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
Best verbal response (V)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Incomprehensible sounds	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
Inappropriate words	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
Oriented	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6
Best motor response (M)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
No motor response	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Abnormal gait	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
Abnormal flexion to pain	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
Rezon/Withdrawal to pain	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6
Obey commands	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7
Glasgow Coma score (E + V + M)	<input type="radio"/> 8	<input type="radio"/> 9	<input type="radio"/> 10

GCS should be recorded for all athletes in case of subsequent deterioration.

Potential signs of concussion?

If any of the following signs are observed after a direct or indirect blow to the head, then the child should be evaluated by a medical professional and should not be permitted to return to sport the same day if a concussion is suspected.

- Any loss of consciousness? Yes No
- If so, how long? _____
- Headache or neck pain? Yes No
- Disorientation or confusion (able to respond reasonably to questions)? Yes No
- Loss of memory? Yes No
- "Dazed" or "concussed"? _____
- Nausea or vomiting? _____
- Drowsiness? _____
- Balance or coordination? Yes No
- Visible facial injury in combination with any of the above? Yes No

2 Sideline Assessment – child-Maddocks Score*

*I am going to ask you a few questions, please listen carefully and give your best effort.

Medical Holdbox question (I point for each correct answer)

- Where are we? I 0
- Is it day or night? I 0
- What day is it? I 0
- What is your teacher's name? I 0

child-Maddocks score: _____

Child-SCAT3 is to obtain degree of concussive risk and is not used for send home

BACKGROUND

Name: _____ Date/Time of Injury: _____

Examiner: _____ Date of Assessment: _____

Age: _____ Gender: M F

Current school year/grade: _____

Left-handed? right left neither

Mechanism(s)/way("when/he/happened?") _____

For Parent/Caregiver to complete:

How many concussions has the child had in the past? _____

When was the most recent concussion? _____

How long was the recovery from the most recent concussion? _____

Has the child ever had a CT scan or had medical imaging done (CT or MRI) for a head injury? Yes No

Has the child ever been diagnosed with headaches or migraines? Yes No

Does the child have any other medical conditions such as asthma, ADD/ADHD, seizure disorder? Yes No

Has the child ever been diagnosed with depression, anxiety or other psychiatric disorder? Yes No

Has anyone in the family ever been diagnosed with any mental health condition? Yes No

Is the child on any medications? If yes, please list: _____

CHILD-SCAT3 SPORT CONCUSSION ASSESSMENT TOOL 3 / PAGE 1 © 2013 Concussion in Sport Trust

Computerized Neurocognitive Testing (ie. ImPACT)

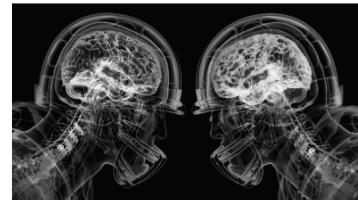
- First used in 1982
- Attempts to measure attention, memory, problem solving, and reaction time
- Baseline? Who? How often?
False sense of security?
- Validity?
- Not formally recommended
- Comprehensive plan required
- Neuropsychologist evaluation is preferable

Concussion test may not be panacea

ImPACT sells tests and training to thousands, but some question program's validity

By Peter Keating | ESPN The Magazine

Updated: August 26, 2012, 11:21 AM ET



Aryati Christie Design; reference imagery: Purdue Biostatistics Group / Purdue University



Treatment Options

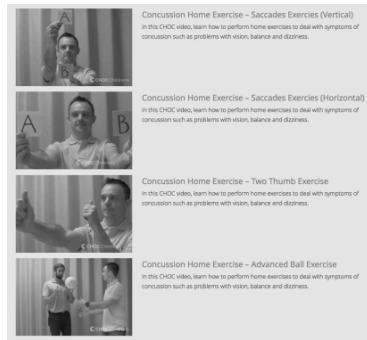
- Physical Rest
- Cognitive Rest
- Vestibular therapy
- Cervical physical therapy
- Speech pathology
- Vision therapy
- Medication
- Exercise
- Coping / Psychology / Cognitive Behavioral Therapy
- Reassurance & Time



My Current Approach...

- Close observation first 24-72 hrs!
- Limited medications (no defined role)
- Emphasize nutrition/stress/sleep hygiene
- Some cognitive and physical rest: decrease electronics, music, physical activity, and cognitive stress
- Return to school within 48-72 hours
- Return to symptom-limited light exercise within 3-5 days
- Exertional stress testing to determine tolerance
- Review expectations and return-to-play guidelines!
- Must return to school fully prior to returning to sports!

Vestibular Therapy & Buffalo Stress Test



From Children's Hospital of Orange County website

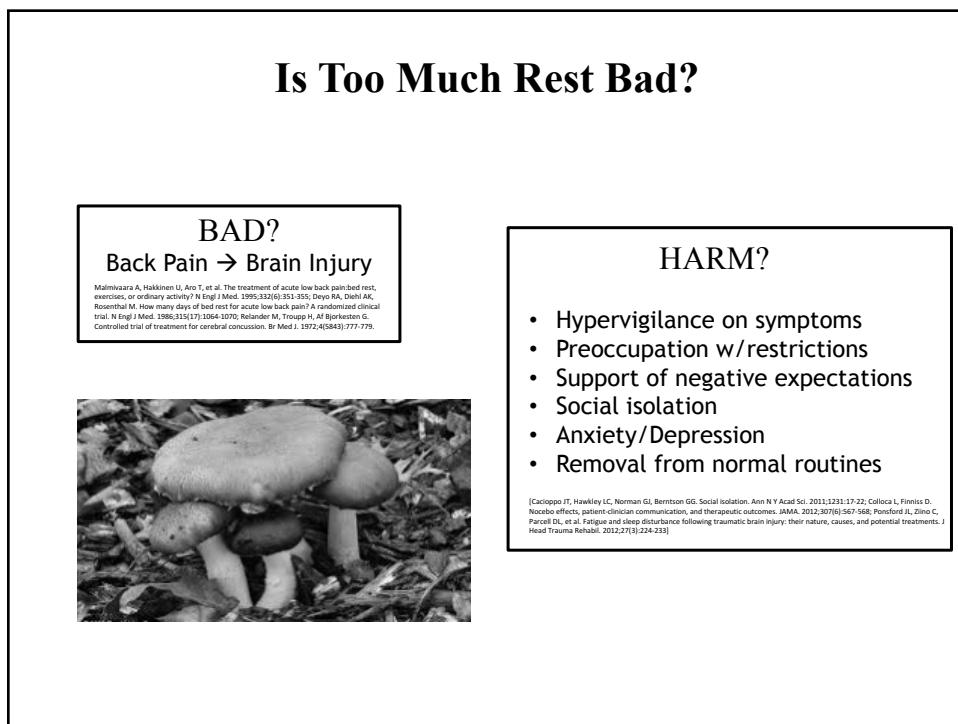
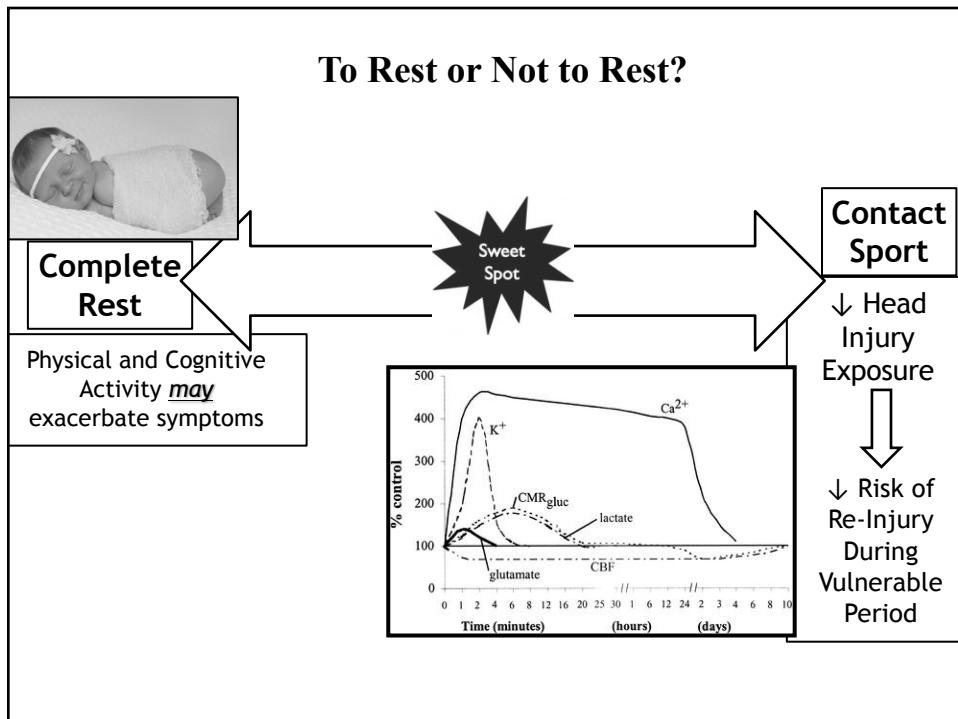
What happened to...



Concussion Management



Physical and cognitive rest
until symptoms resolve



Cocoon vs. Light Activity

- Prolonged rest and inactivity do not speed recovery time.
 - *Kids who returned to light activity (rest only 1-2 days) felt better faster than kids who underwent prolonged rest (5 days of strict rest).*
 - *Kids who rested longer had more severe symptoms and had longer lasting symptoms than the active kids.*

Hammeke et al. (2015) Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial. *Pediatrics*. Vol 135, No 2.

Early Non-Contact Physical Activity

Safe

Effective

Better than
rest alone

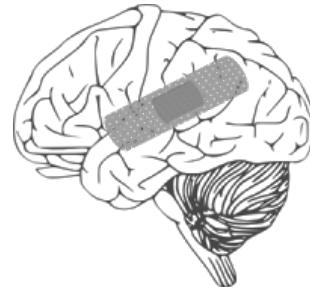
May
shorten
symptom
duration

Collins MW, Statements of Agreement From the Targeted Evaluation and Active Management (TEAM) Approaches to Treating Concussion Meeting Held in Pittsburgh, October 15-16, 2015. Neurosurgery. 2016 Oct 12.]
 Leddy JJ, Kozlowski K, Donnelly JP, Pendergast DR, Epstein LH, Willer B. A preliminary study of subsymptom threshold exercise training for refractory postconcussion syndrome. Clin J Sport Med. 2010;20(1):21-27.
 Gagnon I, Grilli L, Friedman D, Iverson G. A pilot study of active rehabilitation for adolescents who are slow to recover from sport-related concussion. Scand J Med Sci Sports. 2016;26(3):299-306.
 Leddy JJ, Sandhu H, Sodhi V, Baker JG, Willer B. Rehabilitation of concussion and post-concussion syndrome. Sports Health. 2012;4(2):147-154.
 Silverberg ND, Iverson GL. Is rest after concussion "the best medicine?": recommendations for activity resumption following concussion in athletes, civilians, and military service members. J Head Trauma Rehabil. 2013;28(4): 250-259.
 Zafonte R. Diagnosis and management of sports-related concussion: a 15-year-old athlete with a concussion. JAMA. 2011;306(1):79-86.

Normal Time to Recovery

Children/Adolescents: 3 - 4 Weeks

Adults: 10 - 14 days



35

The Challenge

Need to Return to School

Minimize disruption

Accumulating
learning load

Socialization

Symptoms

Headaches

Anxiety

Sensitivity to
light/sound

Difficulty
concentrating



Halstead, et al. Returning to
Learn Following a Concussion.
Pediatrics, Nov 2013, 132 (5) 948-
957

HEADACHES

Limit over-stimulation

Frequent breaks

Identify Aggravating Factors
* Smart boards, screens, etc. *

↓ **Stressors**



Halstead, et al. Returning to Learn Following a Concussion. *Pediatrics*, Nov 2013, 132 (5) 948-957

DIZZINESS

Limit over-stimulation

Avoid rapid transitions

Allow to put head down in class


© Alamy

Avoid crowded hallways

Vestibular HEP

Halstead, et al. Returning to Learn Following a Concussion. *Pediatrics*, Nov 2013, 132 (5) 948-957

 **VISUAL SYMPTOMS**

Light sensitivity, double vision, blurry vision

↓ Screen Exposure & Brightness

Hat/Sunglasses

Use audiobooks

Turn off fluorescent lights



Double vision: Cover one eye

Halstead, et al. Returning to Learn Following a Concussion. *Pediatrics*, Nov 2013, 132 (5) 948-957

 **NOISE SENSITIVITY**

Limit/Avoid Band, Choir, Shop Classes

Lunch in quiet area

Avoid noisy gyms, practices & games

Avoid crowded hallways

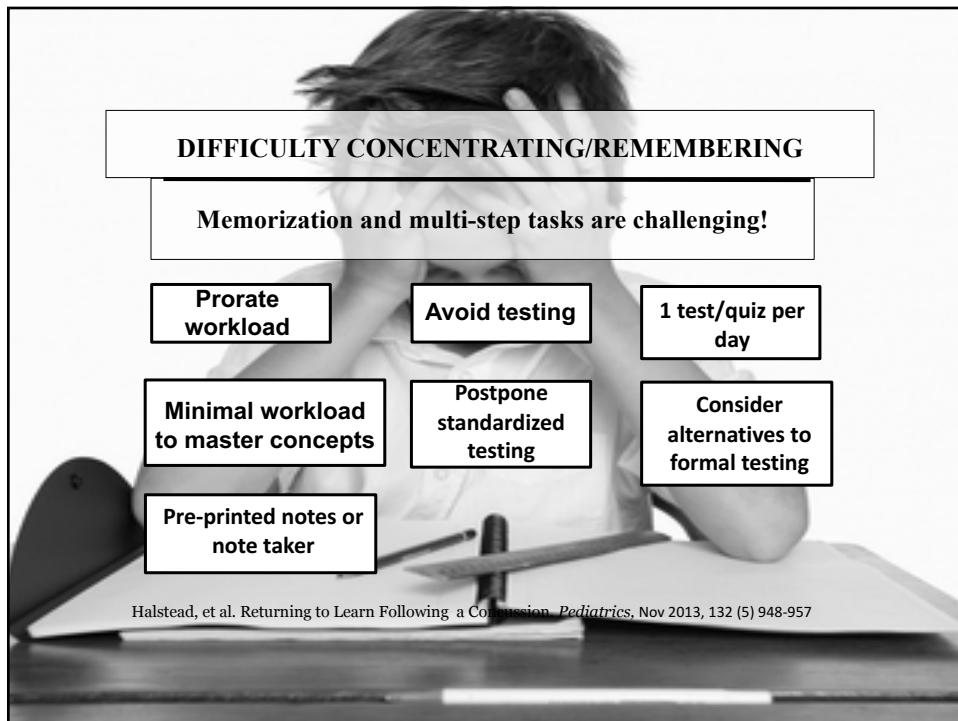


Ear plugs

Halstead, et al. Returning to Learn Following a Concussion. *Pediatrics*, Nov 2013, 132 (5) 948-957

DIFFICULTY CONCENTRATING/REMEMBERING

Memorization and multi-step tasks are challenging!



Prorate workload Avoid testing 1 test/quiz per day

Minimal workload to master concepts Postpone standardized testing Consider alternatives to formal testing

Pre-printed notes or note taker

Halstead, et al. Returning to Learn Following a Concussion. *Pediatrics*, Nov 2013, 132 (5) 948-957

Not all symptoms are concussion!

Sports must wake up about depression

By Reid Forgrave FoxSports

MENTAL HEALTH
BEST PRACTICES

INTER-ASSOCIATION CONSENSUS DOCUMENT: BEST PRACTICES FOR
UNDERSTANDING AND SUPPORTING STUDENT-ATHLETE MENTAL WELLNESS



Speaking of Depression...

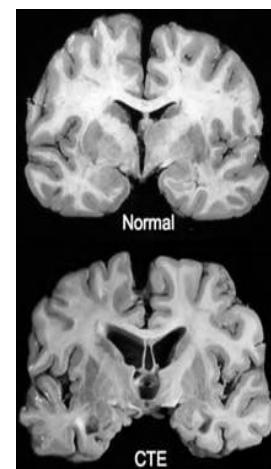
Mom Suing Pop Warner Wants to Stop Pre-Teen Tackle Football

Study: Former NFL Players Who Played Tackle Football Before Age 12 at Increased Risk of Memory and Thinking Problems Later



Chronic Traumatic Encephalopathy (CTE)

- Neurodegenerative disorder
- Microscopically defined POST MORTEM by accumulation of tau-based neurofibrillary tangles
- *Linked* to repetitive head trauma
 - No direct cause-effect relationship demonstrated
 - Selection bias
- Symptom profile
 - Dementia
 - Aggression
 - Depression
 - Other emotional changes



CTE: Our Conflicting Knowledge

Proposed Theory:

Concussions and/or subconcussive blows start a neurodegenerative process

- Tau deposition found in brain of *collision athletes*
- Tau deposition Mortality and Suicide rates in former NFL player **are lower** than the general population
[Baron, S.L., Hein, M.J., Lehman, E., & Gersic, C.M. (2012). Body mass index, playing position, race, and the cardiovascular mortality of retired professional football players. American Journal of Cardiology, 109, 889–896.]
 - *Tau deposition is found in other neurodegenerative diseases*
 - *Tau deposition found in similar areas in individuals with symptoms of CTE without Tau changes*
 - *CTE symptoms are **not** specific to this proposed entity*
- Some athletes with tau changes do not have CTE symptoms

What is risk of problems later in life?

- Study evaluated football players from 1956-1970
 - 296 football athletes, 190 other athletes
 - Compared to varsity swimmers, wrestlers and basketball players
 - Head injury more likely reported in football
 - *No increased risk in football players of neurodegenerative diseases and specifically dementia, Parkinsonism, and ALS*

Janssen PH, Mayo Clin Proc, 2017

CTE Questions

- *Which athletes are at greatest risk?*
- *Is the age at sustained head trauma significant?*
- *What amount of head trauma produces the CTE changes?*
- *Is tau protein a problem or just a finding on autopsy?*
- *Do sports with inherent high head impact forces need to be changed?*
- **CTE Limitations:**
 - No controlled epidemiological data
 - Only anecdotal case reports and selection-bias limited studies
 - Post mortem diagnostic criteria
- **What's needed....**
 - Prospective, longitudinal, population-based, blinded neuropathological studies evaluating athletes involved in high- and low-impact sports
 - Clinical or pathological criteria to diagnose CTE while symptomatic

It's Not Just the Brain We Should Be Worrying About...

Concussion Increases Odds of Sustaining a  Lower Extremity Musculoskeletal Injury After Return to Play Among Collegiate Athletes

M. Alison Brooks, MD, MPH*, †,‡, Kaitlin Peterson, BS§, Kevin Biese, BS||,

In 90 days following concussion: 2.5x increased risk of lower extremity MSK injury
(Brooks, 2016)

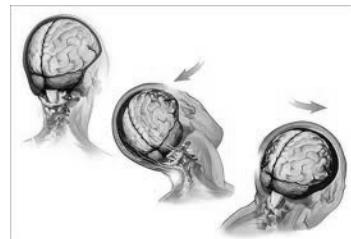
So... Can We Prevent Concussion?



49

There is no concussion-proof helmet or head gear...

Helmets and head gear DO reduce the risk of skull fractures, severe head injury, eye injuries.



They DO NOT reduce the risk of concussion!

Gear should fit & be worn properly



3rd Party Add-Ons Don't Work

Guardian Caps



Unequal Technologies



What about mouthguards???

Proven protection against dental and orofacial injury



Mouth guards DO NOT reduce risk of concussion

These don't prevent concussion!



Head Gear in Soccer

- Insufficient evidence that current headgear prevents head injury
- May increase how aggressively athletes play?



Niedfeldt MW. Head Injuries, Heading, and the Use of Headgear in Soccer. CSMR 2011;10(6): 324-29

Is Heading Dangerous Play?

Recent systematic review included 310 articles

Heading **Riskiest part of soccer**
* Due to athlete-athlete contact

↓ Athlete-Athlete contact may be more effective than heading bans to prevent concussion, and other injury
Comstock RD, An Evidence-Based Discussion of Heading the Ball and Concussions in High School Soccer. JAMA Pediatr. 2015.

Children are more susceptible than adults to concussion from heading
* Primarily in game situations

Contributing factors include:

- Biomechanical forces
- Less developed technique
- Immature brain's susceptibility to injury

O'Kane, JW. The Physician And Sportsmedicine, 2016; Comstock RD, An Evidence-Based Discussion of Heading the Ball and Concussions in High School Soccer. JAMA Pediatr. 2015.

Prevention

Correct heading technique

- Practice with rag, nerf, and inflatable balls
- Do not force young athletes to head the ball
- Avoid excess heading training in practices
- Strengthen “heading” musculature





Change the Sport?

- U11: no heading
- U12 & U13: max 30 minutes heading training/week
(max 15-20 hits/player)



AAP Policy Statement

American Academy
of Pediatrics



DEDICATED TO THE HEALTH OF ALL CHILDREN™

Tackling in Youth Football

COUNCIL ON SPORTS MEDICINE AND FITNESS

Pre-participation Exams

- Concussion history: #, length of symptoms
- Baseline SCAT5?
- Baseline symptom checklist?
- Computerized neurocognitive baseline?

34. Have you ever had a head injury or concussion?
35. Have you ever had a hit or blow to the head that caused confusion, prolonged headache, or memory problems?
36. Do you have a history of seizure disorder?
37. Do you have headaches with exercise?
38. Have you ever had numbness, tingling, or weakness in your arms or legs after being hit or falling?
39. Have you ever been unable to move your arms or legs after being hit or falling?

Educate, educate, educate...

U.S. athletes still reluctant to admit head injuries: report

BY SUSAN HEAVY
WASHINGTON | Thu Oct 31, 2013 10:26am EDT

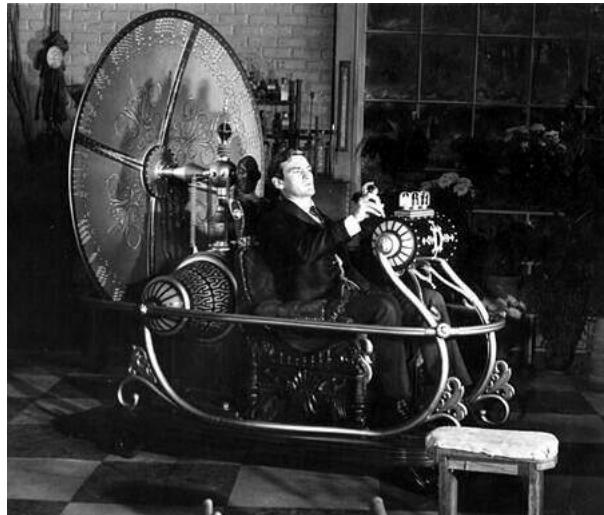
0 COMMENTS | [Tweet](#) 26 | [Share](#) 5 | [Share this](#) 8 | [Email](#) [Print](#)



1 OF 1 Seventeen year-old Hannah Steenhuysen watches her high school's girls soccer team prepare for a game against Bishop Fenham in Attleboro, Massachusetts October 25, 2013.
CREDIT: REUTTERSSHANNON BRYDges

The Case of Judo Jane





1. Remove from play & initiate medical care in the first few days



 **Avoid "Playing Through It"**

Journal of Athletic Training, 2016, 51(4):329-335
doi: 10.4080/jat.2016.3026
© 2016 American Academy of Orthopaedic Surgeons. All rights reserved.
www.joint.org

original research

"Playing Through It": Delayed Reporting and Removal From Athletic Activity After Concussion Predicts Prolonged Recovery

Bretton M. Asken, MS, ATC¹; Michael A. McCrea, PhD, ABPP/CN²

51.5% did *not* immediately report symptoms

- ~5 more missed practice days
- 2.2x ↑ prolonged recovery

Abstract for When to Remove Athletes From High Risk group and prolonged (8 or more days) versus normal (7 or fewer days) recovery time.

Results: Fifty (51.5%) of the 97 athletes did not immediately report concussion symptoms. The DHR athletes averaged 4.3 report concussion symptoms. The DHR athletes averaged 4.3

Key Points:

- A substantial number of athletes did not immediately report or report concussion symptoms.
- Athletes who delay reporting concussion symptoms are at risk for protracted recoveries.
- Athletes who continue to participate in athletic activity during the immediate postconcussion period potentially exposes the athlete to already fatigued brain to additional neuronal stress that can compound neurometabolic/physiologic processes.

Asken B, McCrea M, Clugston J, Snyder A, Houck Z, Bauer R. "Playing Through It": Delayed Reporting and Removal From Athletic Activity After Concussion Predicts Prolonged Recovery. *Journal Of Athletic Training* (Allen Press) [serial online]. April 2016;51(4):329-335.

Optimal Recovery begins at time of injury!

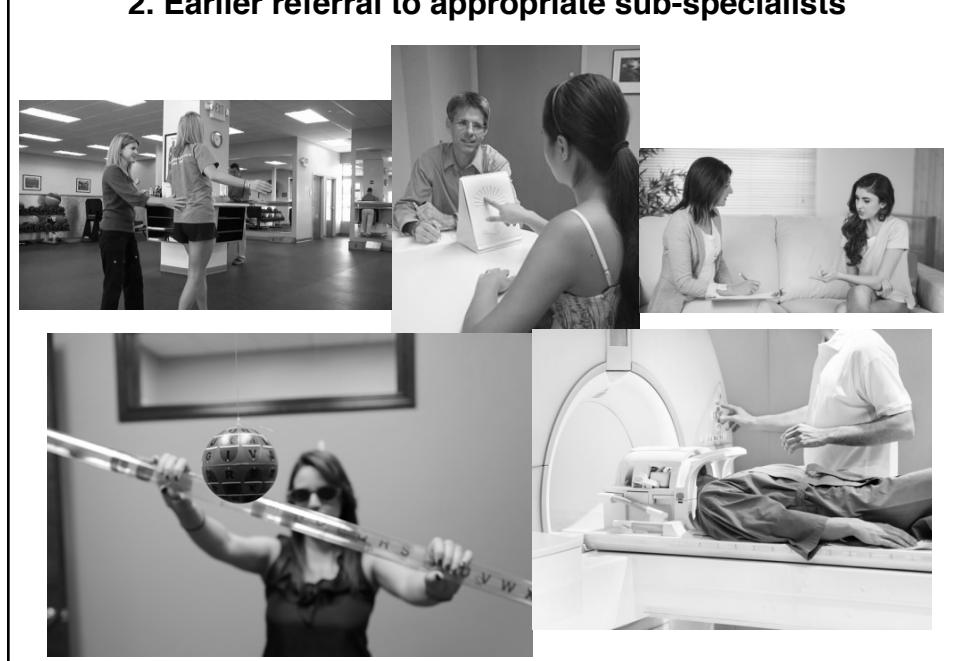
High school athletes who continued to play with concussion symptoms

**= 8.8x more likely to have protracted recovery
> 21 days**

Elbin RJ, Pediatrics.



2. Earlier referral to appropriate sub-specialists



3. Earlier collaboration with school



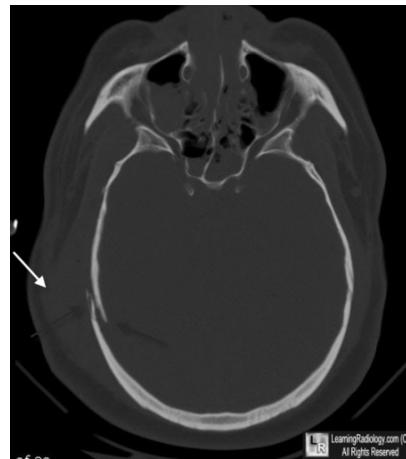
4. Earlier return to routines



5. Earlier lifestyle interventions



6. Earlier care coordination of co-morbidities and RTP planning



Summary

Earlier referral to concussion specialist may:

- Reduce post-concussive sequelae
- Reduce time to return to play
- May facilitate earlier return to school
- Improve patient's mood
- Improve coordination between providers



Resources

CDC Head's Up Campaign

<http://www.cdc.gov/concussion/headsup>

National Federation of State High Schools

<http://nfhslearn.com/>

STOP Sports Injuries campaign

<http://www.STOPSportsInjuries.org>



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THANK YOU!

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