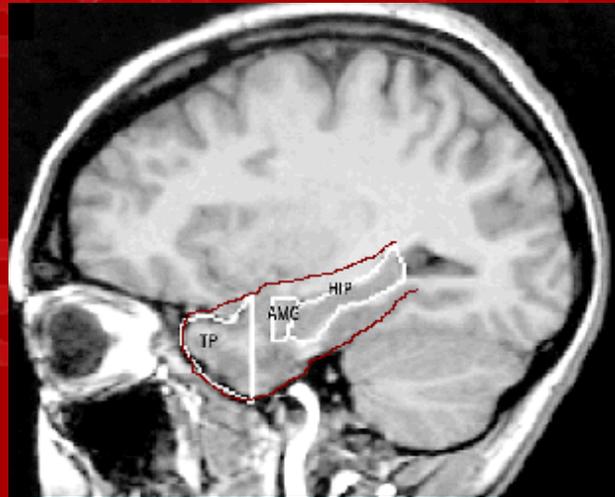


# Concussion Evaluation and Management: A new approach to injury prevention



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## ....a timely topic

- 5/13/10: OHSAA adopted new concussion language
- ‘Any athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be immediately removed from the contest and shall not return to play until cleared with written authorization by an appropriate health care professional.’
- Physician, athletic trainer

# Free Online Course: nfhsearn.com



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## CONCUSSION IN SPORTS - WHAT YOU NEED TO KNOW

### ELECTIVE COURSE



#### Concussion in Sports - What You Need To Know

Sports-related concussion in high school sports can be serious or even life-threatening situations if not managed correctly. National Federation of State High School Associations (NFHS) and Centers for Disease Control and Prevention (CDC) have teamed up to provide information and resources to help educate coaches, officials, parents and students on the importance of proper concussion recognition and management in high school sports. Mick Koester M.D., ATC, Chair of the NFHS Sports Medicine Advisory Committee and Director of the Slocum Sports Concussion in Eugene, Oregon takes you through this course. In this course you will understand the impact sports-related concussion can have on your players, how to recognize a suspected concussion, the proper protocols to manage a suspected concussion, and steps to help your player return to play safely after experiencing a concussion.

[FULL COURSE DESCRIPTION](#)

[PLEASE LOGIN TO ORDER](#)

### NFHS CORE COURSES

Fundamentals of Coaching and First Aid for Coaches provide coaches with content from all eight domains contained in the National Standards for Sport Coaches (NASPE 2006). These two courses form the foundation from which all elective courses and sport-specific courses are developed. Core courses should be completed first to give the coach a better understanding of elective and sport-specific

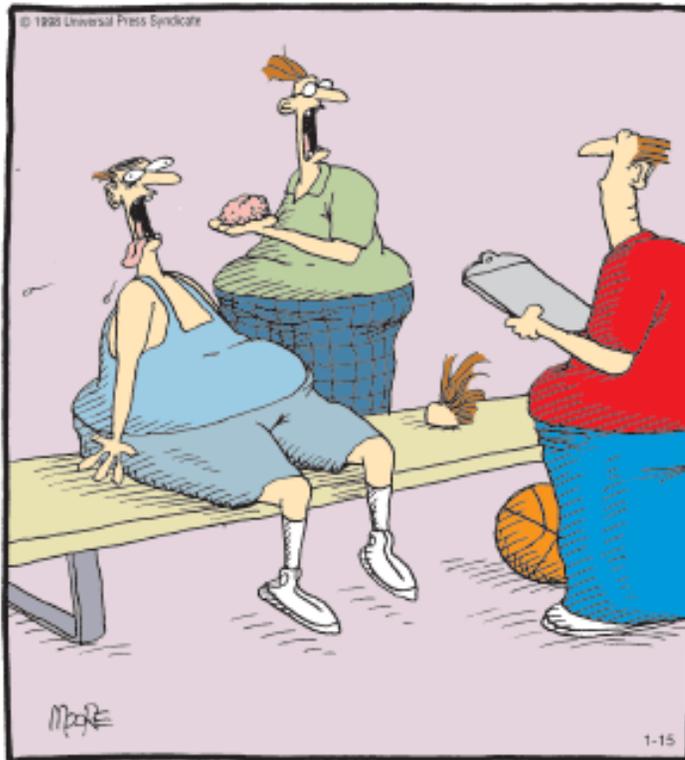
### NEWS FEED

- » Parents Offer Help to Maintain Clarkstown School Sports Programs - Patch
- » CompuMed to Provide CardioGramKids(R) e-Health Services to Lincoln High School ... - MarketWatch (press release)
- » Most fall sports ready to get the ball rolling - Mooresville Tribune
- » Valparaiso High School Fall Sports Start Up Soon - ValpoLife.com (blog)
- » Letter to high school parents: Set an example - AZ Central.com
- » Graduation rates are dismal - Examiner.com

RSS provided by 

# Introduction

- CDC estimates 1.6-3.2 MILLION concussions in sport or recreation each year (adults and children)
  - Previous estimates 300,000



"He can go back in the game. It's just a bruise."

- 50% (*at least*) underreporting rate likely
  - Williamson and Goodman, BJSM 2006
  - Sye et al, BJSM 2006
  - McCrea et al, CJSM 2004
  - Kaut et al, CJSM 2003

# Overview

- The backstory...how concussion management has evolved
- Pathophysiology (brief)
- New management and prevention of problems
- Return to play
- Neurocognitive testing



# Concussion Redefined

- Vienna, November 2001 – First International Symposium on Concussion in Sport
- Prague, November 2004 – Second symposium
- Zurich, November 2008 – Third symposium
  - Recommendations published spring 2009
    - BJSM, CJSM, others



- “A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces”
- Several common features to help define
  - Force transmitted to head
  - Rapid onset of short-lived impairment
  - Acute symptoms reflect functional disturbance
  - Resolution follows sequential course
  - Neuroimaging studies normal



## LOC

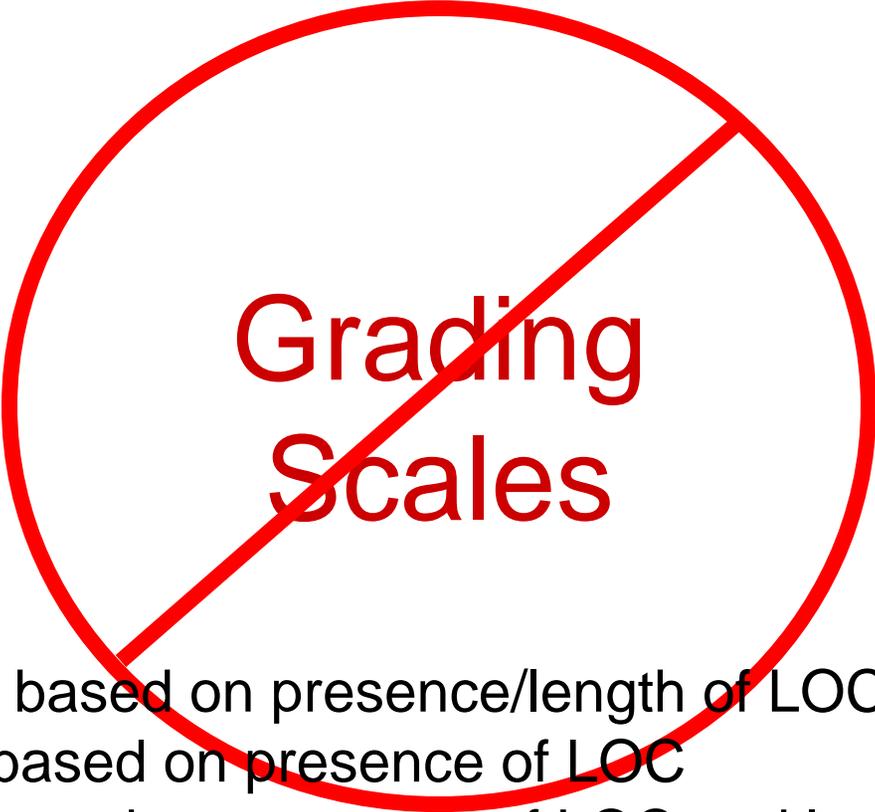
- Doesn't imply severity  
Leninger et al, *J Neurol Neurosurg Psychiatry* 1990; Lovell et al, *CJSM* 1999
- Doesn't classify concussion as complex
- Plays role in moderate to severe injury  
Jennett, *Lancet* 1975

## Amnesia

- Clinical symptoms likely more important  
Lovel et al, *J Neurosurg* 2003; McCrory et al, *CJSM* 2000.
- Retrograde amnesia varies with time of measurement, unclear if reliable  
Yarnell, *New Eng J Med* 1970; Yarnell, *Lancet* 1970
- More research ongoing

A large, solid red L-shaped graphic is positioned in the top-left corner of the slide. It consists of a vertical bar on the left and a horizontal bar at the bottom, meeting at a rounded corner. The rest of the slide is white.

# Evolution of Concussion Management



# Grading Scales

Cantu: grades based on presence/length of LOC and amnesia

CMS: grades based on presence of LOC

AAN: grades based on presence of LOC and length of symptoms

## A New Classification (arbitrary)

### Simple concussion

Progressive resolution over 7-10 days

Rest until all symptoms resolve

Graded program of exertion before RTP

### Complex concussion

Persistent symptoms

Specific sequelae

Prolonged cognitive impairment

May include those with multiple events

Not just simple RTP

# Zurich: No “classification” system

- Concept:
  - Majority (80-90%) resolve in 7-10 days
  - May be longer in children and adolescents (definitely longer)
- EVERYONE deserves individualized management
  - Recovery will vary based on:
    - Prognostic factors (history, comorbidities, etc.)
    - Advice given to athlete
    - Athlete’s willingness/ability to follow advice

# Counseling/Prognosis

- Personal history of concussion
  - Length of recovery period
- Personal history of mood disorders, ADHD, learning problems, headaches
- Family history of headache (particularly migraine)
- Academic history
- Age

# Risk Factors

- Helmet and protective equipment
- Player position
- Game speed
- Field surface
- Playing style
- Prior injuries
- Individual anatomy



# Prevention

- Enforcing rules
- Now have standard helmet use across many sports
- Good skills, high fitness level
- Neck strength?
- Alteration of playing surface not proven effective
  - No change in concussion incidence: grass vs artificial turf Bailes and Cantu, *Neurosurgery* 2001
  - Some playing surfaces unalterable
- Mouth guards
  - No clear evidence to support protective effect  
McCrory, P. *Br J Sports Med* 2001, Labella et al. *Med Sci Sports Exercise* 2002
- Face shields
  - Some protection (hockey) Benson et al. *JAMA* 1999

# Signs/Symptoms

- Functional and mostly cognitive
  - Unaware of game situation, confused
- Typical
  - HA, pressure feeling
  - Balance problems, dizziness
  - Nausea
  - “Dinged, foggy, stunned, dazed”
  - Visual problems
  - Hearing problems
  - Irritability or emotional changes
  - Subjective feeling of slowness or fatigue after impact



# Physical Signs

- Impaired conscious state (may include LOC)
- Slow to answer questions, follow direction
- Easily distracted, poor concentration
- Significantly decreased playing ability
- Poor coordination/balance
- Vacant stare/glassy eyed
- Inappropriate playing behavior
- Inappropriate emotions
- Personality changes
- Vomiting
- Slurred speech
- Impact seizure

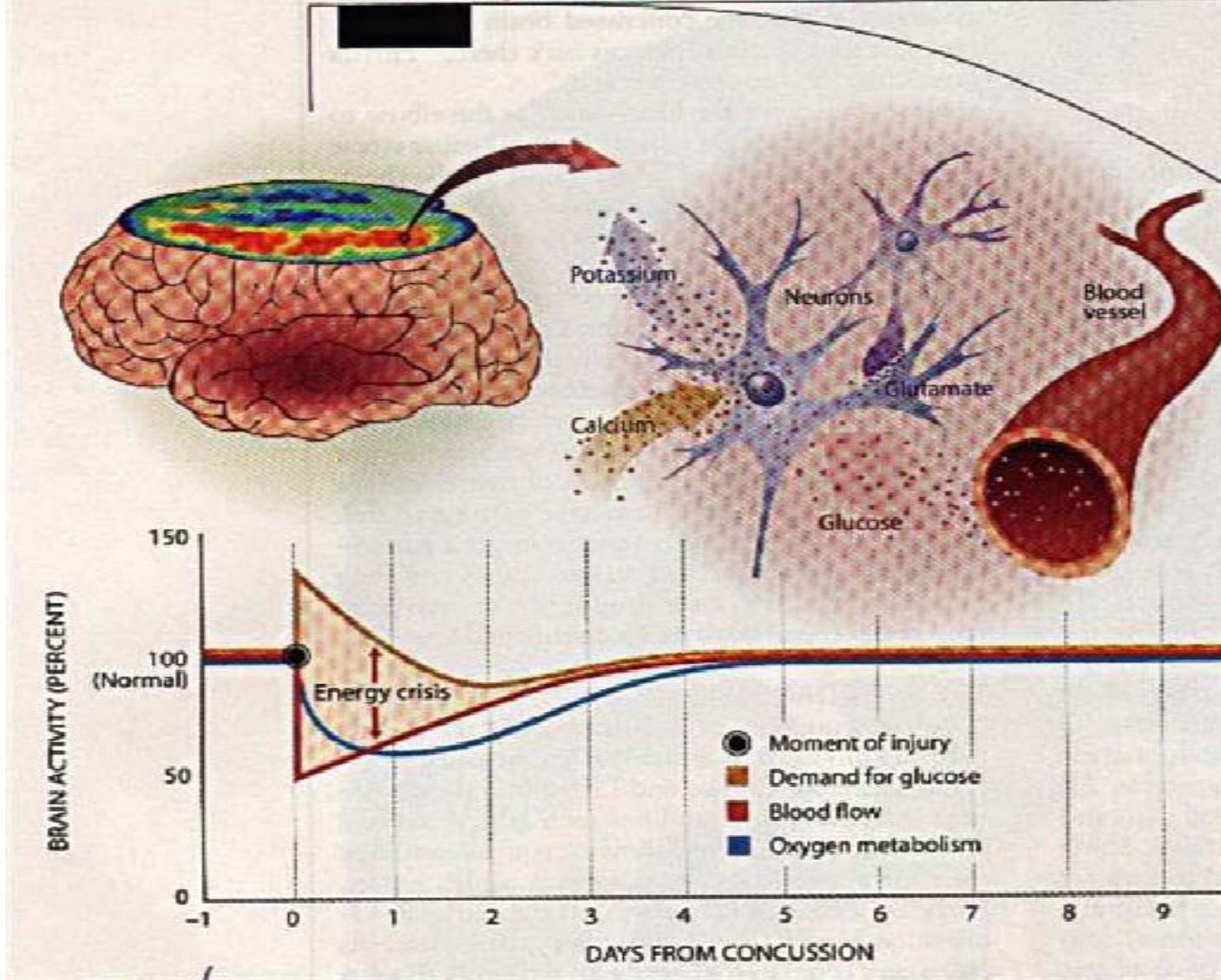


# Acute Injury Management

- “When in doubt, sit them out!”
- Medical evaluation following injury
  - We miss too many!
  - 56% of mTBI cases identified by CDC criteria for concussion missed in ED Powell et al, *Arch Phys Med Rehabil* 2008
- Regular monitoring after event
- Return to play following stepwise process



## Anatomy of a Concussion



Changes	Cause	Effects	First noted	Normalize
Potassium efflux	Mechanical disruption, axonal stretch, opening of potassium channel, increased glutamate	Depolarization, release of excitatory amino acids	Immediate	Variable
Nonspecific depolarization	Trauma	Glutamate release and further potassium efflux	Immediate	Hours
Hyperglycolysis	Increased utilization of ATP	Increased lactate production	Immediate	Up to 24 hours
Increased lactate	Hyperglycolysis, impaired oxidative phosphorylation	Neuron dysfunction, cell damage	Immediate	2-10 days
Impaired oxidative metabolism	Calcium influx, magnesium loss	Increased lactate levels, decreased ATP production, increased glycolysis	24 hours	10 days
Calcium influx	Excitatory amino acid release, receptor activation	Slowed oxidative phosphorylation, cell damage, cell death	Immediate	Up to 10 days
Decreased cerebral blood flow	Impaired autoregulation	Decreased substrate delivery, further impairment of electrolyte balance	Immediate	Several days
Decreased intracellular magnesium	Unsure	Potentiates calcium influx, impairment of glycolysis, impairment of oxidative phosphorylation, impairment of protein synthesis, alteration of membrane potentials	< 1 hour	4 days
Hypoglycolysis	Calcium influx	Slowed cognition	6-24 hours	5-10 days
Hyperpolarization	Excitatory and inhibitory neurotransmitter derangement	Slowed cognition	24 hours	2 weeks or longer
Microtubule and neurofilament damage	Possibly due to calcium influx and loss of magnesium, structural damage from injury	Axonal swelling, axonal bulbs	Hours to weeks	Permanent?

From Grindel, *Current Sports Medicine Reports*, 2003

# So what are we actually preventing?

- Concussions WILL happen
  - There is NO helmet that can prevent all concussions!
- 2 main complications
  - Second Impact Syndrome (SIS)
    - Totally preventable
  - Post Concussion Syndrome (PCS)
    - Most can be prevented

# Energy needed $\neq$ Energy available

- Cognitive activity uses energy
- Energy depleted for neuron healing
- Cognitive stress worsens symptoms
  
- Prolonged symptoms
- “Routine” concussion  $\rightarrow$  post-concussion syndrome
  - Long term problems, permanent injury?

# Symptoms

- Headache
  - Fatigue
  - Poor short term memory
  - Inability to concentrate
  - Slow performance during tasks
- 
- Inability to complete homework
  - Trouble concentrating through class
  - Can't finish tests on time
  - Missing 'easy' questions



# Typical concerns

- Tests
- Return to game play
- Return to work
- Social events



# Difficult Choices

PROM

EMAIL

SOCCER

FIELD TRIP

FACEBOOK

- Teacher
  - “You must take this math final to finish the year.”
  - “I’ll give you an open book test, but you have to take it.”
  - “You get an incomplete if it isn’t finished on time.”
  - “You’re milking this injury.”
  - “Concussions don’t last this long anyway.”

JOB

CHORES

- → Headaches
- → Worse concentration
- → Fatigue
- → Frustration
- → Grades falling

SPORTS CAMP

CHURCH

MOVIE

BAND

THEME PARK

CONCERT

COLLEGE VISIT

- Unseen injury – no outer markers
- Pressures to succeed academically, athletically, socially

TRAVEL TEAM TRYOUT

PLAYING WITH PETS

# Counseling/Prognosis

- Personal history of concussion
  - Length of recovery period
- Personal history of mood disorders, ADHD, learning problems, headaches
- Family history of headache (particularly migraine)
- Academic history
- Age

# Concussion Recovery

- Asymptomatic at rest 
  - No physical symptoms
- Asymptomatic with exertion 
  - No symptoms with schoolwork
  - No symptoms with exertional RTP protocol
- Normal neurocognitive function 
  - Objective findings on testing

# Cognitive Rest

- Limiting mental stress to promote recovery
- Limit exertion with activities of daily living
  - Computer, TV, chores, etc.
- Limit scholastic activities
  - May need to miss school
  - Only go to school if headaches low level (preferably absent) and can concentrate
  - Postpone homework, tests, papers, etc.

# Cognitive rest in school (is this possible?)

Goal: Get the most out of the school day without worsening symptoms

- Limit school time (quarter day, half day)
  - Sleep in, leave early
  - May need to alternate morning and afternoon to cover all classes
- DON'T let student go to all the 'hard' classes!



# Cognitive rest in school (is this possible?)

Goal: Get the most out of the school day without worsening symptoms

- Optimize learning without creating quick fatigue
  - Reading, math WILL cause symptoms
- No note taking in class
- Listening to lectures only
- Limit computer time



# Cognitive rest in school (*is this possible?*)

Goal: Get the most out of the school day without worsening symptoms

- Watch for over-stimulation
  - Reduce sound and light exposure
  - Quiet area to do work
  - Avoid loud hallway, cafeteria, recess area
  - Rest in nurses' office as needed

**QUIET**



**PLEASE**

# Cognitive rest = NO TESTING

Is academic testing in a brain injured patient valid?



# Cognitive Rest Outside of School

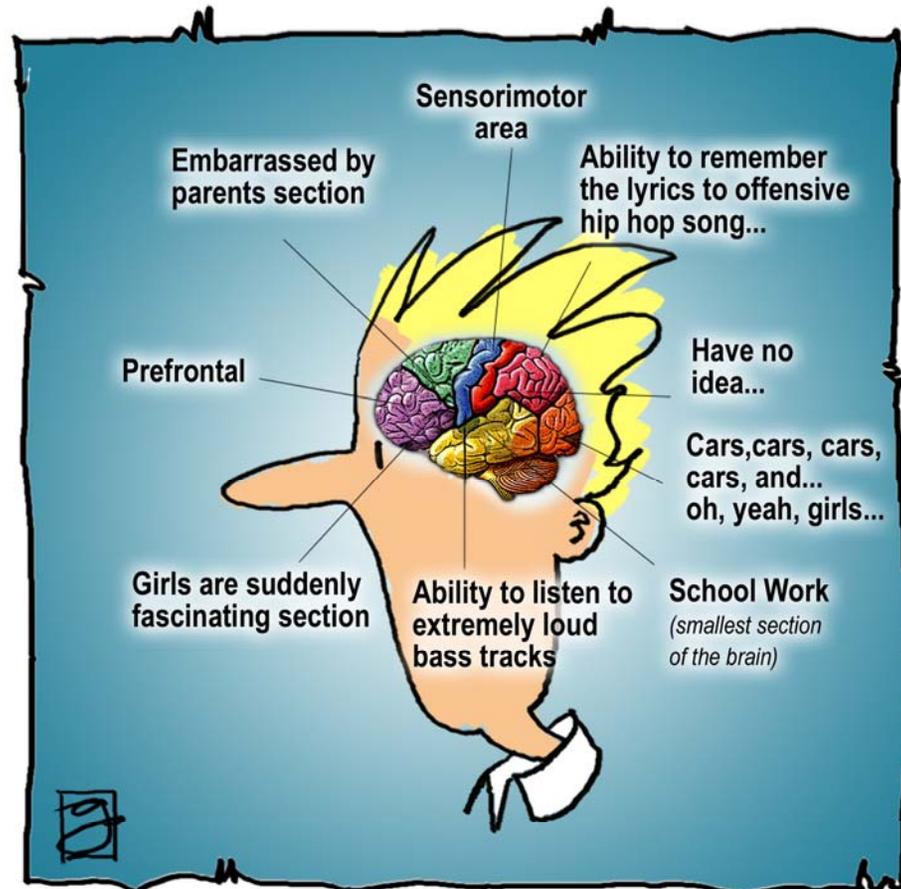
Limit exertion with normal daily activities



Hopeful parents

- Only perform activities that don't exacerbate symptoms
  - Limit IM, texting, computer time, TV, video games
- Preferably only activities when symptom free

# Developmental Barriers



**Anatomy of a Teenager's Brain**

# Developmental Barriers

- Ages 6-11
  - Concrete thinking
  - Not likely to think about activity consequences
  - Easily distracted, short attention span
- Ages 12-14
  - Still concrete thinkers
  - Don't realize possibility of long term problems
- Ages 15-16
  - Testing independence
  - If plan goes against peer group, may not adhere
- Age 17+
  - More likely to understand injury, consequences of actions

# Legal Rights

- Individuals with Disabilities Education Act (IDEA)
- Section 504 of the Rehabilitation Act of 1973 (504 Plan)
- To be eligible for services under IDEA, a child must meet the criteria for one of 13 specific disability categories.
  - Autism, deaf/blindness, emotional disturbance, hearing impairment, mental retardation, multiple disabilities, orthopedic impairment, LD, speech impairment, TBI, visual problems
- Section 504 covers anyone else
  - Students don't meet criteria for special-education IDEA
  - Student still needs accommodations in the classroom, such as extra time on tests

Generally, the younger the athlete, the longer the recovery

– Rough guidelines:

- College: 7-10 days
- High School: 2 weeks
- Junior High: 3 weeks
- Under age 12: 4 weeks or more



# Concussion Recovery

- Asymptomatic at rest 
  - No physical symptoms
- Asymptomatic with exertion 
  - No symptoms with schoolwork
  - No symptoms with exertional RTP protocol
- Normal neurocognitive function 
  - Objective findings on testing

# Return to Play Protocol

- No activity, complete rest
- Light aerobic exercise
  - No resistance training
- Sport-specific exercise – start resistance training
- Non-contact training drills
- Full-contact training
- Game play

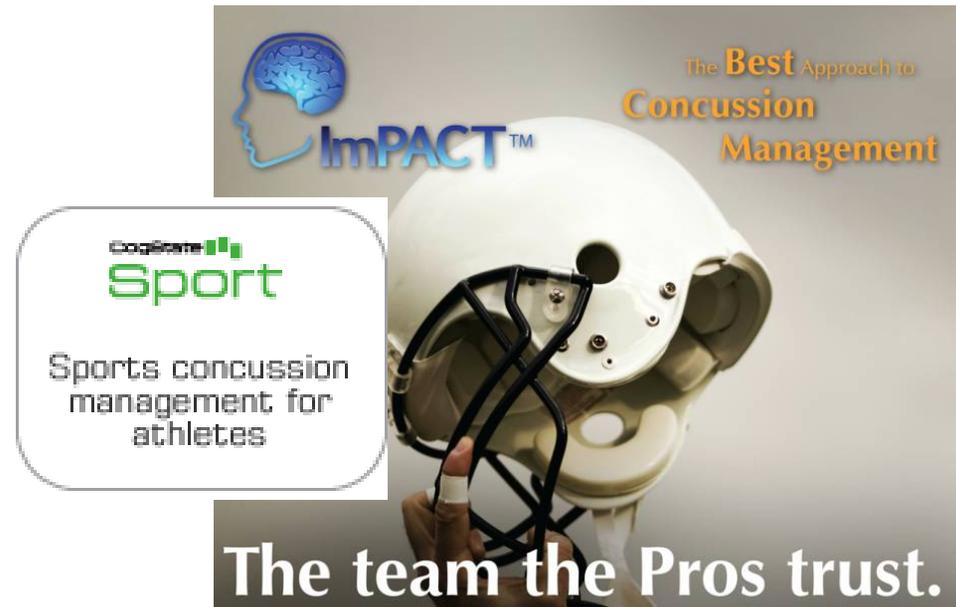


# Neurocognitive testing: Why?

- Neurologic symptoms common with normal imaging and PE
- Brain function abnormal even with no symptoms
  - Broglio, JAT 2007: 38% of asymptomatic athletes still had deficit
  - Collins, JAMA 1999: symptoms gone days 3-5, NC recovery baseline days 5-7
  - Echemendia et al, CJSM 2001; Broglio, Sports Med 2008; McCrea et al, J International Neuropsychological Society 2005
- Helps clarify and *objectify* vague or seemingly minor complaints
  - What if your patient is lying?
  - What if you have a chronic headache (or depression, etc.) patient? How do you know what symptoms are related to concussion?
- Important in determining persistent cognitive function problems

# Neurocognitive Tests Available (Computerized)

- ImPACT
- CogSport
- HeadMinder
- ANAM



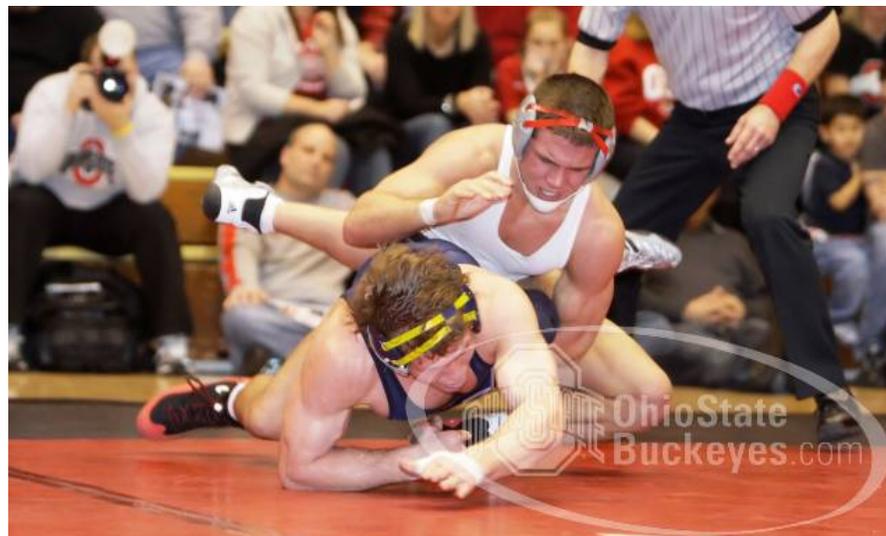
The advertisement features a white football helmet with black facemask. In the top left, there is a blue brain icon with the text 'ImPACT™'. To the right, it says 'The Best Approach to Concussion Management'. In the center, there is a white box with the 'CogSport' logo and the text 'Sports concussion management for athletes'. At the bottom, it says 'The team the Pros trust.'



Automated Neuropsychological Assessment Metrics (ANAM)

## When to DQ from sport?

- RARE
- When a concussion does not resolve
  - Physical, cognitive, emotional symptoms
- When concussions happen with less impact



# Summary

- Concussion assessment and return-to-play on individual basis
- Stress cognitive rest
- Normal neurocognitive testing ideal
- No progression of activities until symptom-free

Thank You!