Sport Related Concussion: An Overview

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Disclosures

Medical Advisory Board, Coach Safely Foundation





What is a Concussion?

- A concussion is a mild traumatic brain injury that interferes with normal function of the brain
- Evolving knowledge
 - "dings" and "bell ringers" are serious brain injuries
 - Do not have to have loss of conciousness
- Young athletes are at increased risk for serious problems









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Epidemiology

- Estimated 1.6-3.8 million sports related concussions/year
- Men: football, hockey, lacrosse, soccer
- □ Women: soccer, basketball, hockey
- Variable by epoch, high school vs college, AT coverage, coaching education, culture of reporting, parental awareness
- What about youth sports?
- Likely underestimates magnitude of problem





Extent of the Problem

- Professional athletes get a great deal of attention
 1600 NFL players
- Much more common in high school than any other level- due to large number of participants
 - HS Sports Participants
 - Football- 1.14 million
 - Boys Soccer- 384,000
 - Girls Soccer- 345,000
 - Boys Hoops- 545,000
 - Girls Hoops- 444,000
 NFHS 2008-09







Extent of the Problem





19.3% of all FB injuries in 2009!!!

Likely at least 100,000 concussions in HS athletes yearly based on CDC estimates





Not Just a Football Problem

47

36

22

21

18

Injury rate per 100,00 player games in high school athletes

Football Girls soccer Boys soccer Girls basketball Wrestling Boys basketball Softball



Data from HS RIO

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Long Term Effects of Concussion

Growing body of evidence suggests long term effects of multiple concussive impacts in animal models

Increased evidence of association between repetitive concussive and subconcussive impacts and higher risk of developing post-traumatic stress disorder, depression, parkinsonian movement disorder, cognitive decline and early dementia in NFL players, returning military veterans

□ Chronic traumatic encephalopathy..





Concussion Is An Invisible Problem







Definition

Consensus statement on concussion in sport– the 5th international conference on concussion in sport (Berlin 2016).¹

Sport related concussion is a traumatic brain injury induced by biomechanical forces. Several common features that may be utilized in clinically defining the nature of a concussive head injury include:

Caused by direct blow (head, face, neck) or by transmitted forces to the head

Usually rapid onset, short lived neuro impairment, resolves spontaneously

Functional disturbance (vs. structural injury)

*So... won't show up on standard neuroimaging Range of signs/symptoms (+/- LOC)



Acute head injury + change in mental status = Concussion

The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc) or other comorbidities (eg, psychological factors or coexisting medical conditions).







Neurometabolic Cascade Following Cerebral Concussion/MTBI



Cerebral Blood Flow













CLINICAL diagnosis

- Some are obvious (e.g.., LOC, confusion)
- Many are not
- No definitive lab test(s)
- No imaging study
 - Head CT does not rule in or out a concussion!
- Concussion is an evolving injury in acute stage





Symptoms

Headache "Pressure in Head" Neck Pain **Nausea or vomiting** Dizziness **Blurred vision Balance problems** Sensitivity to light Sensitivity to noise **Feeling slowed down** Feeling "in a fog"

"Don't feel right" **Difficulty concentrating Difficulty remembering Fatigue/low energy** Confusion Drowsiness **Trouble falling asleep More emotional** Irritability **Sadness Nervous or Anxious**



Sport Concussion Assessment Tool

BJSM Online First, published on April 26, 2017 as 10.1136 bjspone-2017-0975065CATS

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Assessment



- Obtain history
 - Chronologic
 - Detailed
 - Amnesia (retrograde, anterograde)
 - Symptoms
 - Confusion (dazed, "not right", "slowed", perseveration)
 - Dizziness
 - Headache
 - Exacerbating factors of symptoms (e.g., light, noise)
 - Query others (parents, teammates, coaches)





Physical Exam

- HEENT

- Pupil size and reactivity
- EOMI
- Nystagmus
- Funduscopic
- Vestibular/Ocular Motor
- Neck
 - Tenderness (Midline vs. myofascial)
 (Occipital Neuralgia)
 - ROM

- Neurologic
 - Orientation
 - Cranial Nerves
 - Motor and Sensory
 - Reflexes
 - Radicular signs
 - Balance
 - Gait
- Psychiatric
 - Affect
 - Interaction w/ examiner
 - Answers appropriately



- Glasgow Coma Scale
- Orientation questions
- Symptom Evaluation
 - # of symptoms
 - Severity (scale 1-6)
- Cognitive
 - Orientation
 - Immediate memory
 - Concentration

- Neck exam
- Balance
- Coordination
- Delayed Recall
- Background questions





Acute (on field, sideline, etc.)

- Ask for them to recount what happened
- Symptoms (HA, dizziness, visual changes, neck pain)
- Assess cervical spine
- Memory
- Orientation
- Concentration
- Balance/Coordination
- Remove from sideline for further evaluation





- After evidence of concussion on field
 - Immediate removal from play
 - Evaluation by qualified medical personnel
 - Assessment of concussive injury with standardized tool (SCAT₂, ACE)
 - Serial monitoring for deterioration over several hours following injury
 - A player with diagnosed concussion should not be allowed to return to play on the day of injury.
 Return to play and return to think decisions should be made using standardized tool.
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Escalating headache

Decreasing consciousness (difficult to arouse)

Worsening confusion (can't recognize people or places)

Weakness, numbness in extremities

Repeated vom

Seizures

Abnormal sper Transport to ED

Personality changes (increased irritability)

Vision Changes





VOMS

vestibular-oculomotor screen



Horizontal & Vertical Pursuits



Horizontal & Vertical Saccades



Horizontal & Vertical VOR



Near Point Convergence



Visual Motion Sensitivity

- A brief 5 minute *clinical screening* tool to identify additional vestibular and ocular motor impairment and symptoms following concussion
- Used in conjunction with symptom reporting, neurocognitive assessment, balance testing, cervical and exertion screening in order to provide more complete clinical picture





Neurocognitive Computerized Testing

PACT Module	Neurocognitive Functioning	Composite Score
d memory	Immediate and delayed verbal memory	Verbal memory
gn memory	Immediate and delayed visual memory	Visual memory
ınd O's	Reaction time, working memory, sustained attention	Visual memory, reaction time, visu motor processing speed, and impuls control
bol match	Visual processing speed, learning, and memory	Verbal memory, reaction time, and visual motor processing speed
r match	Reaction time, response inhibition, and focused attention	Reaction time and impulse control
e letters	Sustained attention, working memory, and visual-motor speed	Verbal memory ar visual motor processing speed







Postural Stability Testing

- Useful as one component of evaluation
- Multiple systems available
- Baseline measurements are ideal
- BESS

Scores in concussed athletes change from baseline on average by 5.7 points (McCrea et al. 2003)

Baseline score returns by 3 to 7 days after injury

Comparable to Sensory Organization Test (SOT) and other force plate systems Useful with and without symptom screens









Acute

- No return to play same game or same day
- Remove expectations for return to play
 - Take helmet
 - Communicate with coach
- Cognitive and physical rest
- Aftercare
 - Arrange follow up
 - Concussion education with someone who can monitor overnight







Cognitive and Physical Rest

- Relative
- Until asymptomatic (or back to baseline)
- Until symptoms stabilize. Then, gradual return to cognitive and physical activity below symptom thresholds

Identify areas affected by the concussion where you can intervene

Return to Learn → Return to Play Protocol





Concussion RehabilitationRehabilitation StageObjective

- 1. No activity
- 2. Light aerobic exercise
- 3. Sport specific exercise
- 4. Non-contact training drills
- 5. Full contact practice
- 6. Return to play

- -Recovery
- -Increase Heart Rate
- -Add Movement
- -Exercise, Coordination, and cognitive load
- -Assess Functional skills and restore confidence





Return to Learn

- Refers to resumption of cognitive activity such as attending classes, reading, studying, homework, tests.
- Begins with a period of relative cognitive rest and progresses in a stepwise fashion to more demanding cognitive activities
 - Passive vs. active learning
 - 1/2 days vs. full days
 - Abstaining from certain classes (e.g., computer, math, band)
- There will be no academic activity on same day as concussion.

Facilitate communication and transition back to school	
Notify school personnel after injury to prepare for return to school	
Obtain consent for communication between medical and school teams	
Designate point person to monitor student's status related to academics, recov	ery, and coping with injury and communicate with medical team
School health professional, guidance counselor, administrator, and athletic tra	iner
· Develop plan for missed assignments and examinations	
Adjust schedule to accommodate reduced or modified attendance if needed	
Classroom adjustments	School environment adjustments
Breaks as needed during school day	 Allow the use of headphones/ear plugs to reduce noise sensitivity
Reduce in-class assignments and homework	 Allow the use of sunglasses/hat to reduce light sensitivity
 Allow increased time for completion of assignments and testing 	 Limit the use of electronic screens or adjust screen settings, including font size, as needed
 Delay exams until student is adequately prepared and symptoms do not interfere with testing 	 Allow student to leave class early to avoid crowded hallways
Allow testing in a separate, distraction-free environment	 Avoid busy, crowded, or noisy environments—music room, hallways, lunch room, vocational classes, and assemblies
 Modify due dates or requirements for major projects 	
Provide preprinted notes or allow peer notetaker	
Avoid high risk or strenuous physical activity	
Clinicians should individualize adjustments based on patient-specific symptoms, symptom	severity, academic demands, and pre-existing conditions, such as mood disorder, learning



Return to Play

- 1. Asymptomatic at rest
- 2. Asymptomatic with full physical and cognitive exertion
- 3. Balance testing returned to baseline
- 4. Neurocognitive testing returned to baseline





Return to Play

Graduated Return to Play Protocol

- Stepwise, incremental
- Begins with light aerobic activity
- Progresses to full RTP over stages 2-5 stepwise
 - Should be at least 24 hours for each stage
 - Do not attempt to progress from 1 to 2 if worsening sx with 1. Rest before re-attempting 1
 - If worsening sx while in 2-5, then back up to previous asymptomatic level and then attempt to progress again after a period of rest

Stage	Description	Objective
1	Symptom-limited activity	Reintroduction of normal activities of daily living. Symptoms should not worsen with activity.
2	Light aerobic exercise	Walking, stationary biking, and controlled activities that increase heart rate.
3	Sport-specific exercise	Running, skating, or other sport-specific aerobic exercise avoiding risk of head impact.
4	Noncontact training drills	Sport-specific noncontact training drills that involve increased coordination and thinking. Progressive introduction of resistance training.
5	Full-contact practice	Return to normal training activities. Assess psychological readiness.
6	Return to sport	

RTS progressions should be individualized based on the injury, athlete's age, history, and level of play, and the ability to provide close supervision during the return to activity and progressions may vary between athletes. Each stace is cenerally 24 hours without return of concussion symptoms. Consider written clearance from a health care professional before RTS as directed by





The Future: New Classifications







The Future: Neuroimaging









Diffusion Tensor Imaging

Blood Oxygenation Level Dependent Functional MR

MR susceptibilityweighted imaging Perfusion Weighted Imaging.





The Future: Biomarkers

S100 beta is a central nervous system protein found primarily in the brain.

Tau is a protein found within the central nervous system..

UCHL1 (ubiquitin carboxyl-terminal hydrolase isoenzyme L1) is a protein found in the cytoplasm of neurons.¹

UCHL1 shows some promise in diagnosing concussions in youth athletes⁴ and has recently been approved by the FDA for use in emergency rooms to detect the presence of a bleed in the brain.

NSE (neuron-specific enolase) is an enzyme found in cell bodies of neurons.

GFAP (glial fibrillary acidic protein) is a filament protein exclusively expressed in astrocytes within the central nervous system. tem increase, which can be detected within the cerebrospinal fluid and in lower concentrations in the blood.

GFAP may show more promise in the prognostication and monitoring recovery rather than diagnosis concussions.⁴GFAP was also included with UCHL1 in the blood test which has been approved by the FDA to assist in the detection of brain bleeds.





The Future: Biomarkers

Concussion Biomarkers Assessed in Collegiate

Student-Athletes (BASICS) I

Normative study

Breton M. Asken, MS, ATC, Russell M. Bauer, PhD, Steven T. DeKosky, MD, Zachary M. Houck, MS, Charles C. Moreno, MS, Michael S. Jaffee, MD, Arthur G. Weber, BS, and James R. Clugston, MD, MS

Neurology 2018;91:e2109-e2122. doi:10.1212/WNL.000000000006613 Correspondence Breton M. Asken basken8@phhp.ufl.edu





The Future?????



By Nadle Kounang, CNN Updated 6:54 PM ET, Wed Pebruary 14, 2018

Manufactured by Abbott Laboratories, the i-STAT Alinity TBI plasma test measures glial fibrillary acidic protein (GFAP) and ubiquitin carboxyl-terminal hydrolase L1 (UCH-L1) in plasma





The Future: Research

NCAA-DOD Grand Alliance CARE Consortium					Intranet Access		
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http://www.careconsortium.net/

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What If It Is Not A Concussion?

Interview

Kearnan Myall: 'Being concussed is not the issue. It's the repeated hits'

Robert Kitson

The recently retired lock wants the rugby authorities to realise what is leading to players suffering from early onset dementia



Chronic Traumatic Encephalopathy: A Potential Late Effect of Sport-Related Concussive and Subconcussive Head Trauma

Brandon C. Gavett, Mo^{ste}, Robert A. Stern, Mo^{ste}, Ann C. McKee, Mo^{ste}, data

"The exact relationship between repetitive mild TBI, with or without symptomatic concussion, and CTE is not entirely clear, although it is possible that repetitive axonal injury sets up a series of metabolic, ionic, and cytoskeletal disturbances that trigger a pathologic cascade, leading to CTE in susceptible individuals."





What If It Is Not A Concussion?

The effect of repetitive subconcussive collisions on brain integrity in collegiate football players over a single football season: A multi-modal neuroimaging study

Semyon M. Slobounov ^a 쯔, Alexa Walter ^b 은 쯔, Hans C. Breiter ^c 쯔, David C. Zhu ^d 쯔, Xiaoxiao Bai ^e 쯔, Tim Bream ^f 쯔, Peter Seidenberg ^f 쯔, Xianglun Mao ^g 쯔, Brian Johnson ^b 쯔, Thomas M. Talavage ^h 쯔

Significant MRI changes seen after one season

Changes were greater in athletes with larger numbers of high-G impacts (>80G)





What If Not A Concussion?

Division I Football Oversight Committee recommends preseason changes:

Prohibiting drills that create unneeded contact, particularly straight-line contact that is not common to the game.

Reducing the maximum number of contact practices from 21 to 18, requiring at least seven helmet-only days (with optional spider pads) and restricting full-pads days to nine.

Increasing the acclimatization period from five to seven days.

Additional limits on full-contact practices, including no more than two consecutive fullcontact practices, a total of no more than 75 minutes of full contact within any practice session and no more than two scrimmages in the preseason.







The Landscape Has Changed



NFL :Independent Neurologist No RTP same day

NCAA and High Schools have adopted similar measures

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Goal is to make contact sports, especially football, safer



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2010 – 2011 NFHS Rule Book Changes on Concussion

Any athlete who exhibits signs, symptoms, or behaviors consistent with a concussion (such as loss of consciousness, headache, dizziness, confusion, or balance problems) shall be immediately removed from the contest and shall not return to play until cleared by an appropriate health care professional. (Please see NFHS Suggested Guidelines for Management of Concussion).

- Approved by NFHS Sports Medicine Advisory Committee October 2009
- □ Approved by the NFHS Board of Directors October 2009





What about Alabama?

AHSAA Concussion Policy

- Established in 2010
- "Any athlete who exhibits signs, symptoms, or behaviors consistent with a concussion shall be removed from the contest and not return to play until a medical release is issued by a medical doctor."



- "Once concussive signs are identified, only a medical doctor can clear the athlete for return to play"
- Annual concussion training for coaches

Alabama is one of 48 states with concussion legislation restricting same day RTP



Alabama Legislation

ature and was signed into law

- Lead by Alabama Sports Concussion Task Force
- Bill (HB 108) passed both sides of state l

in June 2011-

- □ Act #2011-541
- Provisions of Bill
 - Defines concussion
 - Mandates guidelines and forms to educate young athletes and parents on nature and risk of concussion
 - Yearly, signed concussion information sheet prior to participation
 - Annual training for coaches

Education

- Coaches
- Parents
- Athletes
- Enforcement
- Penalties
- Role of ATC's



THE ALABAMA LAW AND STAY AHEAD OF CONCUSSION

WHAT IS A CONCUSSION?

- A concussion is caused by a blow or motion to the head, neck, or body that causes the brain to move rapidly inside the skull. A concussion can happen to anyone and can happen during practice or play in any sport or any athletic activity.
- The U.S. Centers for Disease Control and Prevention (CDC) estimates that close to 4 million sports- and recreation-related concussions occur each year.
- Concussions can result in a number of physical, cognitive/thinking, mood and sleep symptoms. While loss of consciousness can occur, it's important to know that you can still get a concussion even if you don't lose consciousness.
- Alabama passed its own Sports-Related Concussion Law in June 2011.

What does the Alabama Law say?

- Each local school system and community sport or recreational organization must develop guidelines as well as educational materials (e.g., forms) to distribute to youth athletes and their parents or guardians. Materials must cover the nature and risk of concussion and brain injury, especially with continuing to play after a suspected concussion or brain injury.
- A concussion and head injury information sheet must be reviewed, signed and submitted by the youth athletes and their parent or guardian prior to any practice or competition.
- Each local school system and community sport or recreational organization must ensure that coaches undergo annual training to learn how to recognize concussion symptoms and to seek proper medical treatment.
- Each local school system and community sport or "recreational organization must establish, by rule, their training requirements and, to the extent possible, ensure that all coaches complete the training before the beginning of the team practice.
- If a youth athlete is suspected of having a concussion or brain injury during practice or competition, they must







A concussion is an injury caused by a blow to the head in which the brain moves rapidly and may collide with the inside of the

- skull. Even minor "dings" or "getting your bell rung" may be of concern, so be alert to such symptoms as headaches,
 - unsteadiness, confusion or other types of abnormal behavior. Any athlete with a suspected concussion:

Should be IMMEDIATELY REMOVED FROM PLAY

- Should be urgently assessed medically
- Should not be left alone
- Should not drive a motor vehicle

SIGNS TO WATCH FOR

Problems could arise over the first 24-48 hours. You should not be left alone and must go to a hospital at once if you:

- Are very drowsy or can't be awakened (woken up)
- Can't recognize people or places
- Have repeated vomiting
- Behave unusually or seem confused; are very irritable
- Have seizures (arms and leas jerk uncontrollably)
- Have weak or numb arms or leas
- Are unsteady on your feet; have slurred speech





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ALABAMA HEAD INJURY Task Force

HOME CARE

REST Lie down and rest until symptoms have cleared. This may take days to weeks depending on the severity of the injury. If activities such as reading or watching TV worsen symptoms, avoid those activities as well.

Remember, it is better to be safe.

Consult your doctor after a suspected concussion.

If you have a seizure

over time

YOUR COACH, ATHLETIC TRAINER

OR PARENT SHOULD SEEK

IMMEDIATE MEDICAL ATTENTION

If you become unconscious or unresponsive

If your headache becomes worse over time

If any of your symptoms become worse

- SLEEP Sleeping is encouraged. You do not have to be awakened throughout the night; however, having your parents check on you periodically is recommended.
- MEDICATION If the headache is bad enough to require medicine, you may have Tylenol (acetaminophen) only. Take as the bottle says according to your weight – and at the appropriate time intervals.
- DIET You may feel nauseous due to the injury. Clear fluids and bland

RETURN TO PLAY

- You should not be returned to play the same day of injury. When returning to play, you should follow a stepwise symptom-limited program, with stages of progression. For example:
- 1. Rest until asymptomatic (physical and mental rest)
- 2. Light aerobic exercise (e.g. stationary cycle)
- 3. Sport-specific exercise
- Non-contact training drills (start light resistance training)
 Full contact training after medical clearance
- Full contact training after medical of
 Return to competition (game play)
- C. Kelorit to compension (game play)

You should allow approximately 24 hours (or longer) for each stage and you should return to Stage 1 if symptoms recur. Resistance training should be



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HEADS UP



Keeping children and teens healthy and safe is always a top priority. Whether you are a parent, youth sports coach, school coach, school professional, or health care provider, this site will help you recognize, respond to, and minimize the risk of concussion or other serious brain injury.

http://www.cdc.gov/headsup



Summary

Concussion is a complex, transient, heterogenous injury to the brain

Diagnosis can be challenging

- Invisible injury
- Overlap of symptoms with other conditions
- Every concussion is unique

Management usually involves brief rest followed by a gradual increase in cognitive and physical activity

Team approach and good communication offer the best care for the athlete





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Thank You!!













