

# Contemporary Neurology

20  
25

Updates in Diagnosis &  
Management of  
Concussion

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**Clinical  
Neurological  
Society of America**

# Disclosures

## **Consulting Fee (e.g., Advisory Board)**

Pfizer, Abbvie

# Objectives

## Updates on Concussion

- Explore the established definition of concussion across the institutional boundaries of Sport, American Congress of Rehabilitation Medicine, and the American Academy of Neurology.
- Explain how to fine-tune diagnosis of concussion using clinical tools in a variety of settings.
- Describe the management and complications of concussion

# Clinical Vignette

19yo collegiate student-athlete is referred for Post Concussion Syndrome

Date of Injury: "during walkthroughs", no LOC

The initial appointment occurred nearly two months after injury

Mechanism of Injury: Elbowed above the right eye by a teammate accidentally

Complaints: Headaches, dizziness, nausea, confusion, fatigue, worsening anxiety, neck pain

Denies history of migraine, denies family history of migraine

Started Escitalopram over the summer, and Bupropion started within one month

New prescription of Amitriptyline one week prior to office visit

Accompanied by Athletic Trainer – Certified (ATC) – provides most of the history

has missed class, has headaches with exercise, more with certain exercises

cardio gives mild headache

weights give more severe headache, but head position dependent

Had a concussion in prior football season, recovered in 2 weeks

"Any other history you would like to share with me?"

No, doc, that's it.

What are your goals of care?

I want my headaches to stop, and I want to play football again"

# Define Concussion

## Concussion In Sport Group

Patricios et al 2023

- \*did not reach 80% consensus
- "Sports related concussion is a traumatic brain injury (TBI) caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities"
  - Leaves out indirect blows that transmit to the head – blast injury, IEDs, breacher's syndrome, deck slap, etc
- "No abnormality is seen on standard structural neuroimaging studies (CT or T1 and T2 weighted images), but in the research setting, abnormalities may be present on functional, blood flow, or metabolic imaging studies."
  - "Doctor, I need an MRI to prove I had a concussion to my Worker's Comp"

# Concussion In Sport Group

Sports Concussion Assessment Tool (SCAT)6 – up to 72 hours

Sports Concussion Office Assessment Tool (SCOAT)6 – 3-30 days

Child SCAT6, Child SCOAT6 – ages 8-12

Rest only in first 24-48 hours

Reduced screen time in first 48 hours

Progress exercise as tolerated after that - "sub-symptom threshold"  
progression within 2-10 days is safe

If sx's persist >4 weeks, consider a referral

- Vestibular Rehab

- Oculomotor Rehab

- Cognitive Rehab



# Define Concussion

## American Congress of Rehabilitation Medicine

Silverberg et al 2023

- Concussion as a subset of Mild Traumatic Brain Injury (MTBI)
  - MTBI can have imaging changes (fracture, intracranial blood), concussion does not
- MTBI should come from an external force causing physiological disruption of brain function. Examples **include** direct blows to the head, acceleration/deceleration forces and blast waves
- Diagnosing requires a reasonable mechanism of injury AND
  - Signs (one or more) – LOC, amnesia, neurological deficits
  - Symptoms (at least 2) – HA, dizziness, cognitive slowing
  - Findings – balance impairment, biomarker elevation
- Terms – “mild TBI with neuroimaging evidence” is a reasonable way to distinguish “complicated mild TBI”
- Confounded by – stress, intoxication, pre-existing health issues
- If formal diagnostic criteria are not met, then call it “suspected mild TBI”

# American Congress of Rehabilitation Medicine

Expanding criteria to include **mechanisms** such as blast wave and **biomarkers** pave the way for future avenues of study – GFAP, UCHL-1, NFL, etc.

Evidence-based consensus achieved to standardize diagnosis across clinical and research settings

An attempt to cross civilian, sports, military context of practice with the hope to improve diagnosis, research comparability, and equitable care



# Define Concussion

## American Academy of Neurology

### Austin et al 2020

- Concussion is a form of mild traumatic brain injury resulting from a direct or indirect impact to the head or body, and is a common consequence of sport participation.
  - Approximately 1.6-3.8 million concussions occur annually
- Children are vulnerable to concussion
  - Risks – chronic headache, cognitive dysfunction, behavioral changes
    - Approximately 283,000 children visit the ED annually for sports related concussion
- Long term impacts are not fully understood, especially repetitive head impacts without symptoms of concussion
  - Multiple concussions increase risk of recurrent injuries
- All 50 states have variants of the Lystedt Law, requiring concussion education, removal from play for suspected concussion and return to play protocols after medical clearance (provider varies from state to state)
- Preparticipation education is a critical part of safety during the season
  - Players, parents, coaches, teachers can all benefit from this education

# American Academy of Neurology

Remove From Play should be immediate if concussion is suspected

Return to play should concur with symptom resolution, medication cessation and clearance from a trained health care provider \*

Return to Learn should occur prior to Return to Play

Academic Accommodations during recovery

Standardized data collection and tracking is important

Neurologists can play a pivotal role in Concussion management

# Clinical Diagnosis

## Sideline

### Lystedt Law

- All 50 States
- Named for Zachary Lystedt, who RTP in the same game he was injured in, and suffered from Second Impact Syndrome
- You are protected for being a sideline Samaritan. If you mention your concern to a referee, they can confer with sideline ATC and coaching, but if the concern is stated, the player has to be removed from the game and monitored.
- Mimics of concussion include painful injuries such as stingers/zingers, getting the wind knocked out, seizure, malingering (to run time on the clock)
- Interruption of neurological function including but not limited to posturing, loss of consciousness, headache, emotional dysregulation, alteration of awareness, etc.
- Posas & Guidry 2024

# Old School

“When in doubt, sit ‘em out”

Why doesn't this work?





# Clinical Diagnosis

## Urgent/Emergency Department

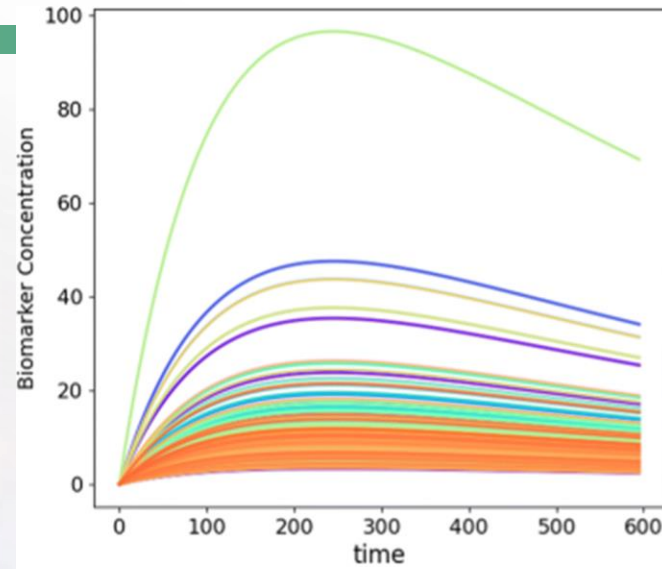
### Fast Forward from Friday Night Lights

- Patricios et al 2022, Silverberg 2023
- Imaging is for evaluation of Moderate/Severe TBI, and if relatively intact neurological function, Mild complicated TBI
  - Imaging is not for diagnosis of Concussion

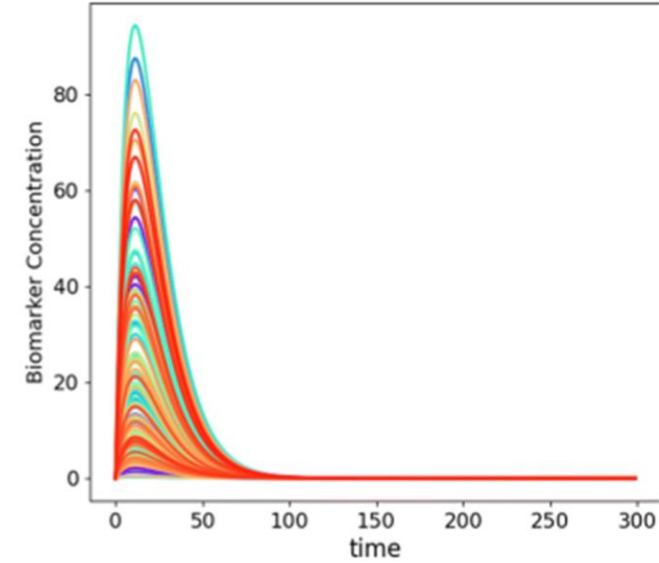


# Blood Based biomarkers in the ED

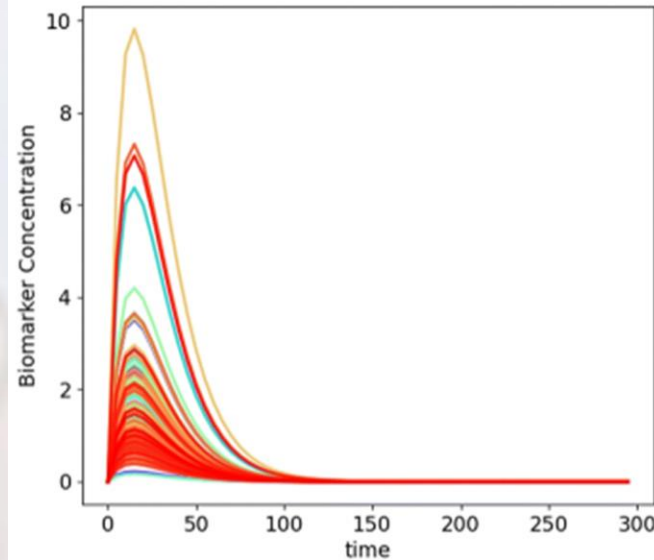
Are NFL, UCH-L1, GFAP and tau appropriate for diagnosis of concussion in the ED?



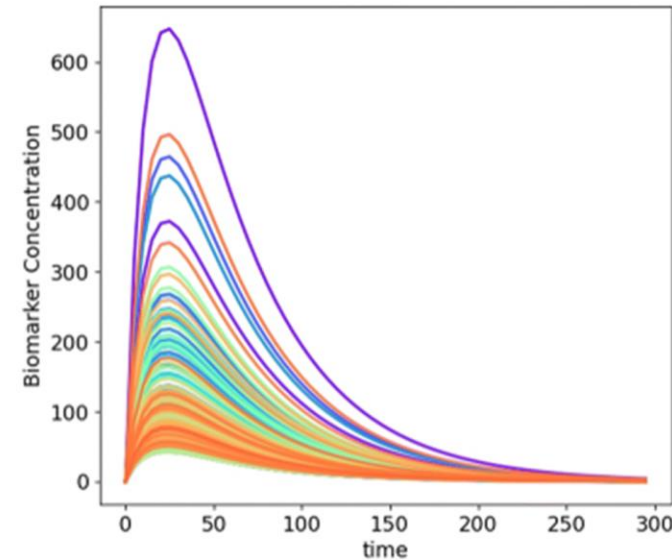
NF-L



UCH-L1



tau



GFAP





# Clinical Diagnosis

## Office Visit

Collection of data, limitation of catastrophizing, validation of lived experience

- DOI, mechanism of injury, LOC, potential for litigation, work status, work related injury, pre existing issues prior to injury
- Posas & Guidry 2024, Austin et al 2020
- History of concussion, migraine, anxiety, depression, ADHD, cervical spine issues, etc
  - These diagnoses can confound the prognosis of concussion
  - These diagnoses can relapse and remit.
- Iverson et al 2017
- Concussion, by definition, should be time limited, most improving by 30 days
- Liebel et al 2024
- This can vary by sport, 90.80% male wrestlers asymptomatic at 28 days, 98.83% female basketball players at 28 days.

# Asymptomatic and Return to Play

Liebel et al 2024

- Majority of collegiate athletes asymptomatic at 14 days, have returned to play at 28 days
- Not all patients are healthy collegiate athletes

**Table 2 Percentage of athletes to reach asymptomatic and return-to-play by 7, 14, 21, and 28 days postinjury**


**From: Sport-Specific Recovery Trajectories for NCAA Collegiate Athletes Following Concussion**

	Asymptomatic				Return-to-play			
	7	14	21	28	7	14	21	28
F Basketball	62.02	93.82	98.20	98.83	11.58	57.59	78.99	87.95
F Lacrosse	58.63	92.09	97.43	98.27	15.79	69.80	88.67	94.79
F Soccer	53.21	88.73	95.72	96.95	10.15	52.57	74.25	84.12
F Softball	57.96	91.72	97.25	98.14	10.74	54.71	76.32	85.83
F Volleyball	55.11	90.00	96.39	97.48	9.76	51.11	72.79	82.89
F Water Polo	43.47	80.60	90.62	92.73	10.55	54.01	75.66	85.29
M Basketball	58.13	91.82	97.30	98.17	14.06	65.22	85.35	92.62
M Football	43.32	80.45	90.51	92.64	9.63	50.61	72.29	82.46
M Lacrosse	49.40	85.89	94.08	95.63	10.03	52.13	73.82	83.76
M Soccer	49.93	86.31	94.33	95.84	8.63	46.70	68.16	78.83
M Wrestling	40.49	77.51	88.39	90.80	7.60	42.33	63.26	74.29

# Management

## Return to Function

What if they are not improving? – Persisting Symptoms after Concussion

- Posas & Guidry 2024
- Making referrals for appropriate associated symptoms
- Vestibulopathy – referral to vestibular PT
- Convergence Insufficiency – referral to oculomotor OT
- Cognitive slowing – referral to Speech therapy for cognitive rehab and/or referral to Neuropsychology
  
- We no longer “cocoon” to “mushroom” therapy patients
  - Total cognitive rest until asymptomatic 

# Progressive Return to function

Return to Cognitive Tasks

Return to Learn

Return to Work

- Consider environment
  - Screen time
- Manual/physical aspects
- Reduce chance for accidents
  - Limit Overstimulation

Concussion

1. Rest – 24-48 hours at most  
- Symptom limited

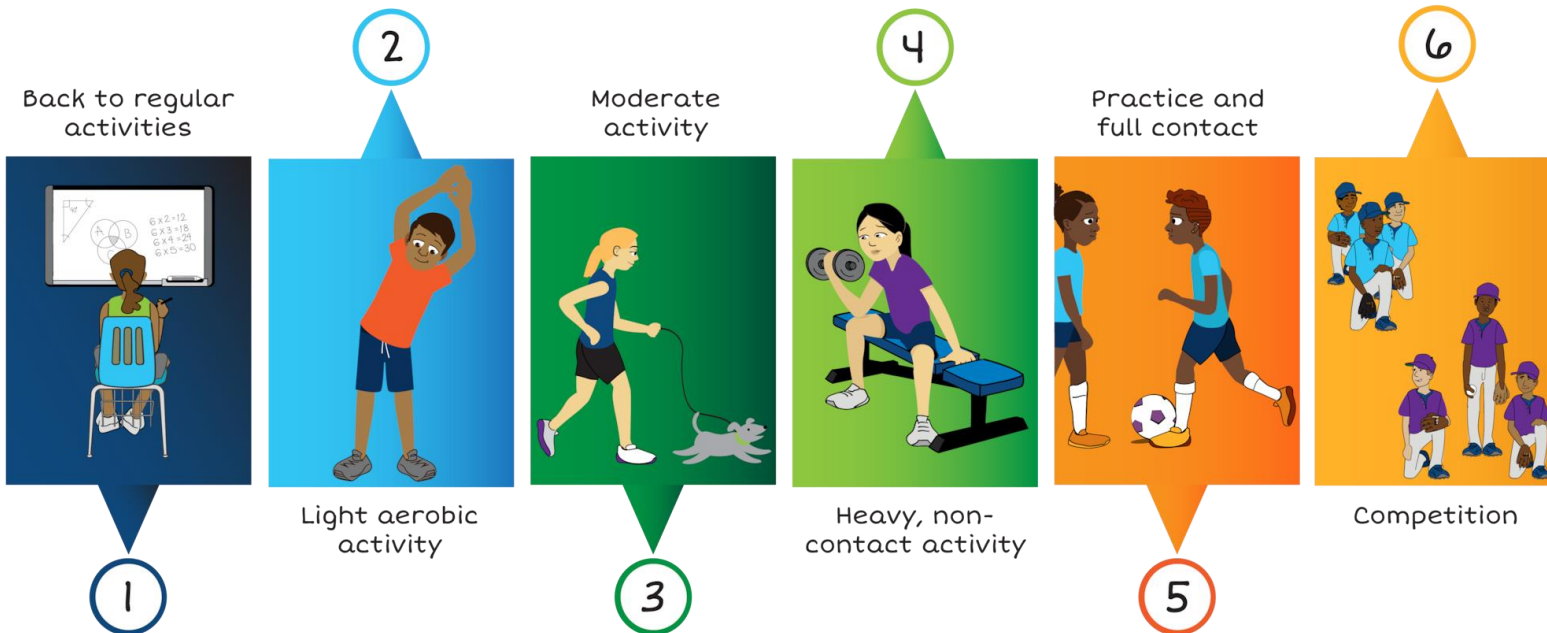
2. Gradual return to  
school/work  
- Symptom limited

# Management

## Exercise as Medicine

Prescribe subsymptomatic threshold exercise

- Patricios et al 2022
- Reduces Kinesophobia
- Improved cardiovascular and cerebrovascular bloodflow
- Reconnect patients with their bodies



### CDC Heads Up

[https://www.cdc.gov/heads-up/media/images/2024/07/HU\\_RTP-Graphic\\_V2\\_1643.png?\\_=31024](https://www.cdc.gov/heads-up/media/images/2024/07/HU_RTP-Graphic_V2_1643.png?_=31024)

# Progressive Return to Physical Activity

Depends on pre-injury activity level of exercise

As tolerated

Partner with PT/OT for exercise goals

3. Increase Heart Rate
- Light (55% max HR)
  - Moderate (70% max HR)

4. Agility and Movement
- Individual Sports Specific
  - Noncontact

Next steps should begin after symptoms resolve, and should not start if symptoms are provoked by exercise



# Return to Competition

Coordinate with state  
mandated HCPs

LA – physician, PA, NP

VA – Allied HCP (ATCs)

State to state variability

4. Sports specific training  
- Team drills  
- Noncontact  
- Increase cognitive load,  
coordination

5. Confidence and Function  
- **Full contact** Team Practice  
- Assess Sports Specific skills

6. Return to  
Competition  
- Normal Sports  
Participation

# Complications

## Litigation?

### Lystedt Law Protects HCPs

- Removal from Play
- But what if it's more complex than concussion or no concussion?
- <https://bloximages.newyork1.vip.townnews.com/theadvocate.com/content/tncms/assets/v3/editorial/a/1b/a1baadaf-da46-5a6c-833b-701fa2635866/6709796a3d52a.pdf.pdf>
- Lawsuit filed in 2024, for 2023 season
- Captain of team, Safety Position
- Passed out, nausea and vomiting on return to consciousness, not seen by Neurology
- Assessed and reassessed for concussion by team athletic staff, Primary Care Sports Medicine Physicians, no exam done
- Computerized testing came back “normal”
- Continued to complain of dizziness, headaches
- Eventually seen by Neurology who found localizing exam findings, ordering an MRI Brain
- Neurosurgery consulted, did emergent surgery

yahoo/sports

## Former LSU player Greg Brooks Jr. files lawsuit against school, medical center for negligence that led to emergency brain surgery

Brooks was a captain for LSU in 2023 and played in two games before an MRI scan discovered a brain tumor



**Ross Dellenger**

Senior College Football Reporter

Fri, Oct 11, 2024 · 7 min read



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# Clinical Vignette

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Denies history of migraine, denies family history of migraine

Started Escitalopram over the summer, Bupropion started within one month

New prescription of Amitriptyline one week prior to office visit

Accompanied by Athletic Trainer – Certified (ATC)

Medication list simplified and removed interacting agents

Asked if there was a positive family history, other factors over the course of weeks and visits

Physical exam showed recreation of headache with cervical facet compression

"Oh, I forgot that last season I tweaked my neck, and had to have my nerves burned"

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# Questions

