



Concussion Myth Busters: Management & Evidence-Based Practices

Air Force Maj. Elvira Chiccarelli, M.D., F.A.A.P., F.A.B.O.M.

Staff Physician, Adolescent Medicine,

Jennifer Moreno Primary Care Clinic

Chief, Obesity Multi-Disciplinary Clinic,

Air Academy Liaison Officer

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Presenter

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Air Academy Liaison Officer,

Fort Sam Houston, Texas



Air Force Maj. Elvira Chiccarelli, M.D., F.A.A.P., F.A.B.O.M.



Air Force Maj. El Chiccarelli is a graduate of the Tulane University School of Medicine and the LSU Pediatrics Residency Program in New Orleans, La. She completed board certification in Obesity Medicine in 2021 and a fellowship in Adolescent Medicine at the San Antonio Uniformed Services Health Education Consortium in 2022.

Maj. Chiccarelli has been an invited speaker on the topic of concussion at multiple graduate medical education programs and Pediatrics Grand Rounds as well as within the Adolescent Medicine fellowship. She is co-chief of a school-based health center with a focus on team-oriented concussion management.



Disclosures

- Maj. Chiccarelli has no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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Learning Objectives

Following this presentation, learners should be able to:

1. Identify community supports and players in pediatric concussion and be prepared to analyze the concussion landscape related to their practice.
2. Apply the physiological mechanism of concussion injury to their clinical practice.
3. Collaborate with stakeholders across the health and education systems to evaluate and manage concussion in pediatric and adolescent patients.



Toolbox

- ACE Care Plan
 - CDC tool for concussion evaluation & management
 - Key for communicating recommendations
- PCSS: Post-Concussion Symptom Scale
 - 22 questions evaluating symptom burden in key areas
 - Not validated under age 11
 - High reliability
- SCAT 5
 - More detailed, all-in-one type sideline tool
 - Endorsed by FIFA, International Olympic Committee

(Committee on Sports-Related Concussions in Youth, 2014; McCrory et al 2017)



Case: Ruby

A ten-year-old female patient is seen in your clinic for two weeks of frontal headaches occurring at all times of day somewhat relieved by appropriately dosed NSAIDs. The parent states that her headaches began after a hard fall where she hit the back of her head at a school volleyball game. She was appropriately pulled from play when the athletic trainer (AT) found she was confused and dizzy following the event. The parents were directed to take the child to the emergency room (ER) for evaluation. There she received eight-hour observation and was discharged home and instructed she could return to sports in ten days.

What was done correctly in this situation?

What needs to be addressed in the community to better support concussion care?

What other information do you need?



Myth

“As long as a young athlete is held from play for a while, the concussion will resolve itself.”



Concussion

A traumatic brain injury induced by biomechanical forces (either direct or indirect blow to the head) that...

- Typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously.
- May result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.
- Results in a range of clinical signs and symptoms* that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged.

*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 (e.g., psychological factors or coexisting medical conditions)



Assessment: Subjective

- Mechanism of injury
- Initial symptoms
- Level of rest
- Ongoing symptoms – persistent post-concussive symptoms (PCSS)
- Level of function
- Underlying pertinent past medical history (PMH)



Pathophysiology

On a molecular level, there is a disruption of neuronal membranes, resulting in a massive efflux of potassium into the extracellular space.

This results in the calcium dependent release of excitatory amino acids, particularly glutamate, which stimulates further potassium efflux.



Pathophysiology

As the concentration of extracellular potassium increases, it triggers neuronal depolarization, which is followed by neuronal suppression.

Sodium-potassium pumps work to restore homeostasis

Given the degree of the induced ion movement, a large amount of energy is expended, which increases glycolysis. This results in local lactic acid accumulation.



Pathophysiology

To meet these increased metabolic demands and remove accumulated lactate, an increase in cerebral blood flow might be expected. However, a *decrease* in cerebral blood flow has been observed.



Myth

“Since concussion diagnosis is based on symptoms, clinicians just need to support patients until their symptoms resolve. There is no objective finding for concussion.”



Assessment: Objective

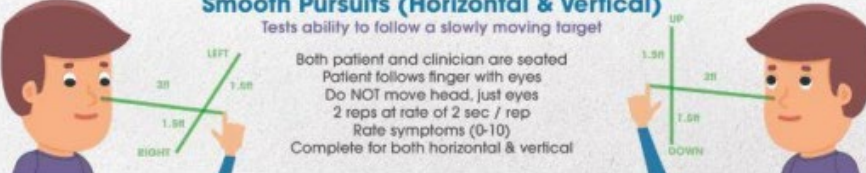
- Screening ocular examination – Vestibular ocular motor screening (VOMS)
- Static and/or dynamic balance assessment – Balance Error Scoring System (BESS)
- Mental status
- Head & Neck for tenderness/trauma, range of motion (ROM)
- Spurling's Test

Sometimes additive: coordination, orthostatic, depression/anxiety screening



Smooth Pursuits (Horizontal & Vertical)

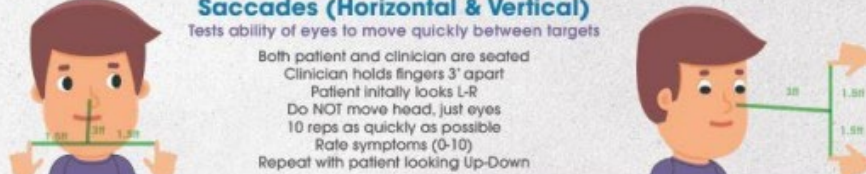
Tests ability to follow a slowly moving target



Both patient and clinician are seated
Patient follows finger with eyes
Do NOT move head, just eyes
2 reps at rate of 2 sec / rep
Rate symptoms (0-10)
Complete for both horizontal & vertical

Saccades (Horizontal & Vertical)


Tests ability of eyes to move quickly between targets



Both patient and clinician are seated
Clinician holds fingers 3' apart
Patient initially looks L-R
Do NOT move head, just eyes
10 reps as quickly as possible
Rate symptoms (0-10)
Repeat with patient looking Up-Down

Convergence


Measures ability to view a near target without double vision



Patient holds target with 14-point font "X" at arms length
Patient brings target toward eyes focusing on the "X"
Stop when they see double
Clinician measures distance from tip of nose to target (cm)
Repeat 3x; record all 3
Rate symptoms (0-10)

Visual Motion Sensitivity

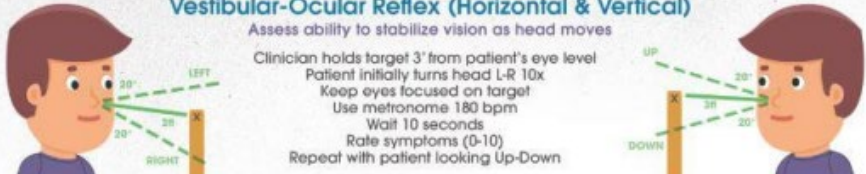
Tests visual motion sensitivity & ability to inhibit vestibular induced eye movements using vision



Patient holds arm outstretched in front with thumbs up
Turn body as a unit to L-R 80 deg from midline focusing on thumb
Use metronome 50 bpm
Repeat 5 revolutions
Rate symptoms (0-10)

Vestibular-Ocular Reflex (Horizontal & Vertical)

Assess ability to stabilize vision as head moves



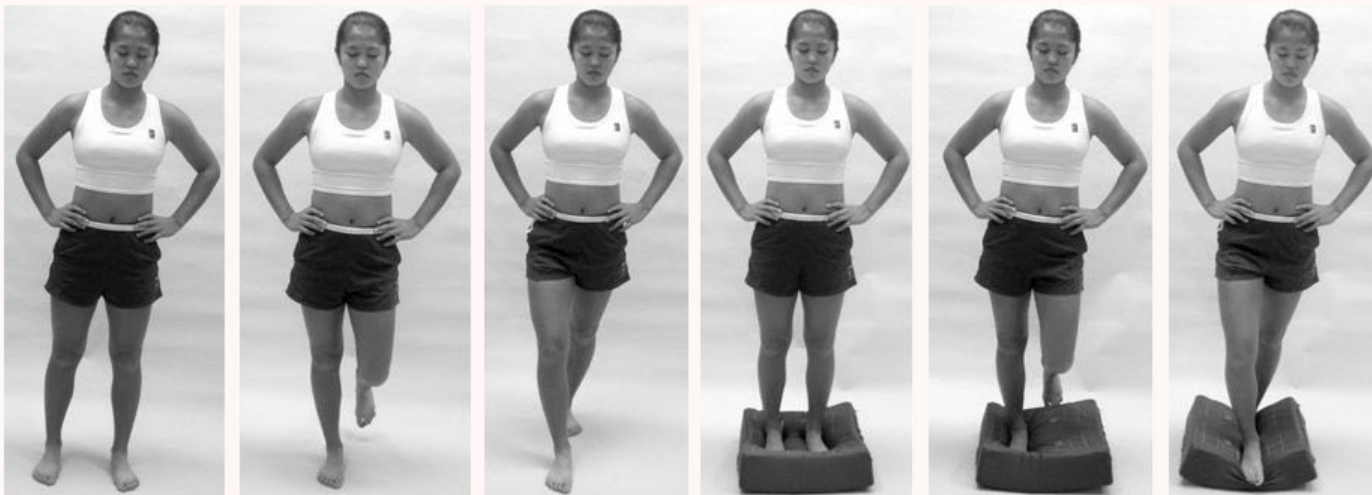
Clinician holds target 3' from patient's eye level
Patient initially turns head L-R 10x
Keep eyes focused on target
Use metronome 180 bpm
Wait 10 seconds
Rate symptoms (0-10)
Repeat with patient looking Up-Down

(NATA Foundation, n.d.)



BESS

Balance Error Scoring System (BESS)



- Quantifiable clinical battery of tests
- Eyes are closed in all positions during test
- Utilizes different stances on both firm and foam surface
- Errors are tabulated when the athlete
 - Opens their eyes
 - Takes hands off hips
 - Steps/stumbles or falls

Positions

1. On firm surface
 - a. Feet side by side
 - b. Single foot balance
 - c. One foot behind other
2. On unstable surface
 - a. Feet side by side
 - b. One foot balance
 - c. One foot behind other

(Koehle, 2013)



Myth

“Supportive care is not helpful for concussion, because it cannot help recovery.”



Clinical Course: Subcomponents

Symptomatology generally falls into several categories:

1. Physical (somatic)
2. Cognitive
3. Emotional (affective)- higher in females
4. Sleep - higher in younger athletes

Young adolescents and children generally have a longer recovery time (four weeks) than pubertal adolescents and young adults (10-14 days).

Professional recommendation for more conservative management the younger the athlete.



Myth

“To best recover from concussion, athletes should rest for several days in a completely dark and quiet room.”



Clinical Course: Treatment

1. RELATIVE physical rest
 - a. Good evidence for moderate exercise after 48-hour rest
2. RELATIVE cognitive rest
3. Symptom control (supportive care)
 - a. Ear plugs
 - b. Sunglasses
 - c. Avoidance of triggering activities
 - d. Medications for sleep, headache, and other somatic symptoms.
4. Frequent follow up with adaptation of restrictions until resolved.



Relative Cognitive Rest

Return to Learn (RTL)

STEP	PROGRESSION	DESCRIPTION
1.	HOME Light physical and mental Activity as tolerated	<ul style="list-style-type: none"> None to minimal mental exertion. Reduce computer, texting, video games or homework staying below symptom level Stay at home except for walks as tolerated No driving, no sport practices, or games
2.	HOME Light physical and mental activity as tolerated	<ul style="list-style-type: none"> Up to 30 minutes mental exertion No prolonged concentration Stay at home except for walks as tolerated No driving, no sport practices, or games
<p align="center">Progress to the next level When able to tolerate up to 30 minutes mental exertion without worsening of symptoms *NOTE: signs and symptoms of concussion often last up to 2 weeks but may last longer</p>		
3.	SCHOOL Part time (Maximum Accommodations)	<ul style="list-style-type: none"> Shortened days/schedule Built-in Breaks - provide quiet place for scheduled mental rest No significant classroom or standardized testing Modify rather than postpone academics Provide extra time, extra help, and modified assignments. No driving, no sport practices, or games

<p align="center">Progress to the next level When able to tolerate 30-40 minutes mental exertion without worsening of symptoms. *NOTE: Physical activity is part of healing; activity should be encouraged as long as it does not exacerbate symptoms. May be considered for Return to Play or Return to Physical Activity Protocol* *When returns to school full time *With appropriate healthcare professional approval and supervision</p>		
4.	SCHOOL Part Time-Full Time (Moderate Accommodations)	<ul style="list-style-type: none"> No standardized testing Modified Classroom testing Begin decrease of extra time, help, and modification of assignments PE class as tolerated. No participation in games.

STEP	PROGRESSION	DESCRIPTION
<p align="center">Progress to the next level When able to tolerate 60 minutes mental exertion without worsening of symptoms</p>		
5.	SCHOOL Full Time (Minimal Accommodations)	<ul style="list-style-type: none"> No standardized testing. Routine tests OK Continue to decrease extra time, help, and modification of assignments May require more supports in academically challenging subjects PE class as tolerated. No participation in games
6.	SCHOOL Full Time (No Accommodations)	<ul style="list-style-type: none"> Attends all classes Full course work/homework May take standardized testing

- **If persistent symptoms are interfering with academic performance, the students educational support needs should be reassessed.***
- **Students on the RTL protocol are to check in with the school nurse prior to the first class of each day.**
 - Steps are not days. Each step must take a minimum of 24 hours and the length of time

(Brain Injury Alliance of VT, n.d.)



Relative Physical Rest

Return to Play (RTP)

TABLE 5 Graduated Return-to-Sport Program

Stage	Aim	Activity	Goal of Step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work and/or school activities
2	Light aerobic exercise	Walking or stationary cycling at slow-to-medium pace; no resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills; no activities with risk of head impact	Add movement
4	Noncontact training drills	Harder drills (eg, passing drills and team drills); may begin progressive resistance training	Exercise, coordination, and increased thinking during sport
5	Full-contact practice	After medical clearance, participate in full, normal training activities	Restore confidence and allow coaching staff to assess functional skills
6	Return to sport	Normal game play	Full clearance/participation

Recommend 48 h of relative physical and cognitive rest before beginning the program. No more than 1 step should be completed per day. If any symptoms worsen during exercise, the athlete should return to the previous step. Consider prolonging and/or altering the return-to-sport program for any pediatric and/or adolescent patient with symptoms over 4 wk.

(Halstead et al, 2018)



Ruby: Subjective

- Mechanism of injury – fall with head hitting the ground
- Initial symptoms – dizziness, confusion
- Level of rest – two days of cognitive rest in a dark room, ten days physical rest, now back in full time school and sports
- Ongoing symptoms (PCSS) – 45 today
- Level of function – “Nauseated in the car, tired all the time, definitely not herself, when she went back to volleyball, she got worse.”
- Underlying pertinent PMH – “She’s been having sleep problems since her brother was born three months ago, she can hear him at night and now it’s much worse.”



Ruby: Objective

Vital Signs (VS): Blood pressure (BP) 99/64, heart rate (HR) 86, Temperature 98.1, respiratory rate (RR) 16, Pain 6/10 (headache), body mass index (BMI) 45%

General: tired appearing, shields her face from the lights, normal gait, tone and stance on entering the examination room

Mental status: appropriately alert and oriented

Special tests: Unable to tolerate VOMS, BESS attempts due to severe dizzy spell, no head/neck trauma evident, Spurling's negative. No known baseline VOMS, BESS, PCSS, or neurocognitive testing.



Ruby: Lessons Learned

Correct: Pulled from sidelines! No return to sport!

Incorrect: Non-individualized treatment, no cognitive rest, no symptom control.

- ? Role of the ER in clearance. ? Role of the AT ?

Other history:

- Activities / adherence to concussion protocol
- Symptomatology in four key areas (PCSS)

Objective findings: Physical exam



Ruby: Assessment and Plan (A/P)

Ten-year-old female on day 14 of concussive symptoms with severe symptomatology.

- Relative physical rest - pull back from volleyball and other triggering activities. Coordinate with (AT) and revisit expectations regarding concussion.
- Relative cognitive rest – school accommodations
- Symptom control – Earplugs? Sunglasses? Sleep?
- Frequent follow up



Ruby: A/P

Acute Concussion Evaluation (ACE) Care Plan

Shortened day. Recommend ____ hours per day until (date) _____.
 Shortened classes (i.e., rest breaks during classes). Maximum class length: ____ minutes.
 Allow extra time to complete coursework/assignments and tests.
 Lessen homework load by ____%. Maximum length of nightly homework: ____ minutes.
 No significant classroom or standardized testing at this time.
 Check for the return of symptoms (use symptom table on front page of this form) when doing activities that require a lot of attention or concentration.
 Take rest breaks during the day as needed.
 Request meeting of 504 or School Management Team to discuss this plan and needed supports.

Returning to Sports

1. **You should NEVER return to play if you still have ANY symptoms** – (Be sure that you do not have any symptoms at rest and while doing any physical activity and/or activities that require a lot of thinking or concentration.)
2. Be sure that the PE teacher, coach, and/or athletic trainer are aware of your injury and symptoms.
3. It is normal to feel frustrated, sad and even angry because you cannot return to sports right away. With any injury, a full recovery will reduce the chances of getting hurt again. It is better to miss one or two games than the whole season.

The following are recommended at the present time:

- Do not return to PE class at this time
 Return to PE class
 Do not return to sports practices/games at this time
 Gradual return to sports practices under the supervision of an appropriate health care provider (e.g., athletic trainer, coach, or physical education teacher).
- Return to play should occur in **gradual steps** beginning with aerobic exercise only to increase your heart rate (e.g., stationary cycle); moving to increasing your heart rate with movement (e.g., running); then adding controlled contact if appropriate; and finally return to sports competition.
 - Pay careful attention to your symptoms and your thinking and concentration skills at each stage of activity. Move to the next level of activity only if you do not experience any symptoms at the each level. If your symptoms return, let your health care provider know, return to the first level, and restart the program gradually.

Gradual Return to Play Plan

1. No physical activity
2. Low levels of physical activity (i.e., *symptoms do not come back during or after the activity*). This includes walking, light jogging, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat).
3. Moderate levels of physical activity with body/head movement. This includes moderate jogging, brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (reduced time and/or reduced weight from your typical routine).
4. Heavy non-contact physical activity. This includes sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills (in 3 planes of movement).
5. Full contact in controlled practice.
6. Full contact in game play.

*Neuropsychological testing can provide valuable information to assist physicians with treatment planning, such as return to play decisions.

This referral plan is based on today's evaluation:

Return to this office: Date/Time:

(Giola & Collins, 2006)

Improvin



Myth

“Only professional sports leagues have the resources to evaluate athletes prior to concussions.”



Case: Ryan

Ryan is a 14-year-old football player following up in the primary care clinic for concussion. He was diagnosed on the field after being tackled about 17 days ago. He did not have loss of consciousness. He was pulled from the game by the athletic trainer and has been completing relative cognitive rest (half days at school, no testing) and full athletic rest at home. He has had dizziness, motion sickness, and emotional lability as recently as 72 hours ago. Your baseline BESS from his sports physical is 0/0/1 on flat ground and 0/2/3 on the foam pillow.

What is done correctly in this situation?

What needs to be addressed in the community to better support concussion care?

What other information do you need?



Myth

“No athletes can be cleared for any increase in RTL or RTP until they have no concussion symptoms at all (PCSS = 0) for 48 hours.”



Symptomatology

Name: _____ Age/DOB: _____ Date of Injury: _____

Post Concussion Symptom Scale

No symptoms "0" ----- Moderate "3" ----- Severe "6"

<u>SYMPTOMS</u>	<u>Time after Concussion</u>		
	Days/Hrs _____	Days/Hrs _____	Days/Hrs _____
Headache	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Nausea	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Vomiting	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Balance problems	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Dizziness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Fatigue	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Trouble falling to sleep	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Excessive sleep	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Loss of sleep	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Drowsiness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Light sensitivity	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Noise sensitivity	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Irritability	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Sadness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Nervousness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
More emotional	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Numbness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Feeling "slow"	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Feeling "foggy"	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Difficulty concentrating	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Difficulty remembering	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Visual problems	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
TOTAL SCORE	_____	_____	_____

(<https://hawaii concussion.com/downloads/Post-Concussion-Symptom-Scale.pdf>, n.d.)



What's normal, anyway?

Example: PCSS baseline scores in girls with attention deficit hyperactivity disorder (ADHD).

Also consider:

- HA disorder
- Depression/anxiety
- ASD
- High somatic burden

Reference group	Classification		
	Broadly normal	Above normal	Unusually high
All girls with ADHD	0-20	21-35	36+
No other pre-existing condition	0-10	11-21	22+
Learning disability	0-27	28-37	38+
Academic problems	0-25	26-39	40+
Migraine	0-31	32-46	47+
Psych Tx Hx	0-32	33-47	48+
Substance Tx Hx	0-34	35-47	48+
No prior concussion	0-19	20-33	34+
1 prior concussion	0-20	21-35	36+
2 prior concussions	0-25	26-44	45+
3 or more prior concussions	0-34	35-49	50+

(Cook et al, 2020)



Role of the Primary Care Manager (PCM)

-Patient

- Pre-concussion education, evaluation
- Post-concussion care: individualized; RTP, RTL, symptom control

-Community... make sure the patient gets to you!

- ER
- Athletic trainers
- School nurses
- Educators



Concussion Law

All 50 states and Washington, DC have concussion laws in their educational code involving the following:

1. Concussion education annually for coaches, athletes, and parents
2. Removal from play at the time of suspected injury WITHOUT eligibility for same-day return to play
3. Clearance by a health care provider (HCP) trained in concussion management for an athlete to be eligible for return to play



Ryan: Subjective & Objective

Mom and Ryan report that his dizzy spells seem to have improved as of the last two days, he has not had any symptoms in the last 24 hours. She asks if you can refill his ADHD medication today.

VS: BP 105/73, HR 76, T 98.1, RR 12, Pain 0, BMI 85%ile

General: healthy-appearing, pleasant, conversant

Mental status: appropriately alert and oriented

Special tests: VOMS normal and without triggered symptoms, BESS 0/1/0 flat and 0/2/2 on pillow, no head/neck trauma evident, Spurling's negative.

PCSS: 4



Case: Ryan

Correct: Pulled from sidelines! No return to sport!

- Relative cognitive rest! Baseline neurological knowledge! Role of the PCM!

Other history:

- Activities / adherence to concussion protocol

Symptomatology in four key areas (PCSS)

Supports available for symptom control.



Ryan: A/P

Fourteen-year-old male with recovered concussion and VOMS/BESS at baseline with no symptoms above baseline.

- RTL: Progress to full time, begin removing school supports
- RTP: begin RTP 2 in coordination with athletic trainer
- Symptom control: none needed
- Follow up: virtual check in before full RTP in 2-3 weeks; change to face to face (F2F) sooner if symptoms recur



- Shortened day. Recommend ___ hours per day until (date) _____
- Shortened classes (i.e., rest breaks during classes). Maximum class length: ___ minutes.
- Allow extra time to complete coursework/assignments and tests.
- Lessen homework load by ____%. Maximum length of nightly homework: ___ minutes.
- No significant classroom or standardized testing at this time.
- Check for the return of symptoms (use symptom table on front page of this form) when doing activities that require a lot of attention or concentration.
- Take rest breaks during the day as needed.
- Request meeting of 504 or School Management Team to discuss this plan and needed supports.

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*Neuropsychological testing can provide valuable information to assist physicians with treatment planning, such as return to play decisions.

This referral plan is based on today's evaluation:

Return to this office: Date/Time _____



Myth

“Concussion is a sports medicine problem.”



Case: Rihanna

Rihanna is a nineteen-year-old female presenting for ongoing concussion follow up after a work-related fall approximately eight weeks ago. She made sure to rest in a quiet dark room for one week after the incident. She has had ongoing symptoms affecting her in all four areas of concussion effects despite adherence to relative cognitive and physical rest including using some Family and Medical Leave Act (FMLA) from her job. She does have a PMH of depression on fluoxetine, migraine headaches on topiramate, and is in therapy for binge eating disorder.

What is done correctly in this situation?

What needs to be addressed in the community to better support concussion care?

What other information do you need?



Case: Rihanna

Correct: Cognitive and physical rest! Use of time off work! Role of the PCM!

Incorrect: Full cognitive rest.

Other history:

- Patient's baseline neurological status and symptom burden
- Activities / adherence to concussion protocol

Symptomatology in four key areas (PCSS) *and their triggers (or lack of)*

Concussion? Something else?



Re-evaluating the plan

Today Rihanna reports adherence to previous recommendations for time off work, physical rest. She reports her sleep quality continues to be especially poor, and her mood symptoms are severe lately (PHQ9 = 19 today). She ran out of her fluoxetine and topiramate since her last visit three weeks ago as well. Therapy for her eating habits is progressing well in the outpatient setting. Her migraines are increased from her baseline of 1-2 a week to three headache days weekly. She can read books, watch TV, text and chat online without triggering any physical or emotional symptoms, and she helped her younger sister with a science project last night. She does not have nausea or dizziness in the last two weeks.

What do you make of this history and her symptoms?



Myth

“Kids are great healers; they always bounce back quicker than adults after concussion.”



Post-Concussive Syndrome?

Patient has persistent post concussive symptoms lasting beyond expected time frame with appropriate treatment (Children ~4 weeks, Adults ~2 weeks) *which are not attributable to other causes.*

Revisit the plan

Mitigating neurological factors?

Further evaluation

- Targeted therapy: vestibular rehab?

- Neuropsychology testing

- Supports



Other Options

Vestibular Rehabilitation

@Occupational therapy HOPE

An exercise based program designed to reduce vertigo, dizziness, gaze instability, imbalance & falls

1. Balance Training

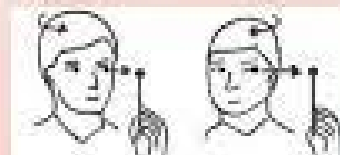
- Overhead peg activities
- Stability trainer
- Tandem walking
- Obstacle course



2. Habituation

3. Gaze Stabilization exs

- Head and Eye tracking exs.



(<https://www.facebook.com/13ishaan/photos/a.103789578101770/106167731197288/?type=3>, n.d.)

Case: Tua Tagovailoa

Video: <https://www.youtube.com/watch?v=t3b-l32oDRM>

Week 3 (not pulled), Week 4, Week 16 (pulled day after)

Concussions are often worse when they involve a ground hit; an individual body has more 'give' than the field/court, so floor hits tend to involve greater acceleration forces

Force = mass x acceleration-- Tua (217 lbs.) vs Josh Tupou (340 lbs.)

Torque and shearing forces also tend to worsen outcomes

(Fierce Prods, n.d.)



What do the big leagues do?

Emergency Action Plan

Baseline NFL Locker Room Comprehensive Concussion Assessment (2y)-modified SCAT 5

Baseline neurocognitive testing (3y)

Repeat baselines at beginning of next season if concussion occurs

Sideline Unaffiliated Neurotrauma Consultants & Spotters



What do the big leagues do?

No Go Signs: level of consciousness (LOC), Impact seizure, fencing posture, Ataxia, Confusion/Amnesia

Sideline Exam: Maddocks questions, concussion signs/symptoms, video review, focused neurological exam (spine, speech, gait/coordination/balance, eye movements)

If needed, Locker Room Comprehensive Concussion Assessment



What do the big leagues do?

Table 1. An Example of a Graduated Exertion Protocol* #

Phases	Activity	Objective
1. Symptom Limited Activity	Routine daily activities as tolerated, with the introduction of light aerobic activity (e.g., 10 minutes on a stationary bike or treadmill with light to resistance supervised by the team's athletic trainer.)	Recovery and light cardiovascular challenge to determine if concussion signs or symptoms are provoked.
2. Aerobic Exercise	≥20 minutes on a stationary bike or treadmill with moderate to strenuous resistance supervised by the team's athletic trainer. Duration and intensity of the aerobic exercise can be gradually increased over time if no aggravation of symptoms or signs return during or after the exercise.	Strenuous cardiovascular challenge to determine if there are any recurrent concussion signs or symptoms.
3. Football Specific Exercise	With continued supervision by the athletic trainer, introduction of non-contact sport specific conditioning drills (e.g., changing direction drills, cone drills). Introduction of strength training supervised by the athletic trainer.	Add strength training and more complex movements to determine if there are any aggravation of concussion signs or symptoms.
4. Club-based Non-contact Training Drills	Participation in all non-contact activities for the typical duration of a full practice.	Increasing football specific demands to determine if there is any aggravation concussion signs or symptoms. Add the cognitive engaging in football drills.
5. Full Football Activity / Clearance	Full participation in practice and contact without restriction.	Tolerance of all football activities without any recurrent concussion signs or symptoms.

(McCroory et al, 2013)



Emerging Therapies

- Diagnostic testing: biomarkers (S100B, tau, IL-6)
- Hyperbaric
- Pro2Cool: sideline immediate head/neck cooling improved recovery time by 30%
- Magnesium: randomized cohort 12-18 with significant PCSS decrease
- Amantadine for post concussion syndrome associated headaches: 80% response rate for symptom reduction
- Apolipoprotein E (APO E) gene - more severe concussion symptoms, tau deposition
- Evidence of harm: fluoxetine, Vitamin C



Centers for Disease Control & Prevention (CDC) HEADS UP

Resources for all players in concussion

CDC.GOV/HEADSUP

The screenshot shows the CDC HEADS UP website. At the top, the CDC logo and name are displayed, along with the tagline "CDC 24/7: Saving Lives. Protecting People™". A search bar and a "CDC A-Z INDEX" dropdown menu are also visible. The main navigation menu on the left includes links for "HEADS UP", "Brain Injury Basics", "Helmet Safety", "HEADS UP to Parents", "HEADS UP to Youth Sports", "HEADS UP to School Sports", "HEADS UP to Schools", "HEADS UP to Health Care Providers", "Sports Concussion Policies and Laws", "HEADS UP Resource Center", "Get Involved", "HEADS UP Partners", and "About HEADS UP". A "Get Email Updates" section is located below the navigation menu. The main content area features a social media sharing bar, a safety infographic titled "To help keep children safe:" with four key points: "Use playground equipment that is right for your child's age.", "Make sure there are guardrails to help prevent falls.", "Check that playgrounds have soft material under them such as wood chips, sand, or mulch.", and "Look out for things in the play area that can trip your child, like tree stumps or rocks." Below the infographic are six featured content tiles: "HEADS UP to Parents CONCUSSION", "HEADS UP to Youth Sports CONCUSSION IN YOUTH SPORTS", "HEADS UP to School Sports CONCUSSION in High School Sports", "HEADS UP to Schools KNOW YOUR", "HEADS UP to Providers", and "HEADS UP on Facebook".

Improving Health and Building Readiness. Anytime, Anywhere — Always



Key Takeaways

1. Concussions occur and are often primarily managed outside of the primary care office. To optimize concussion care, physicians must collaborate with each other and the community (educators, athletic trainers, parents, emergency room, athletic federations).
2. Concussion symptomatology represents a complex pathophysiological brain response to trauma and requires individualized treatment.
3. Evidence based approaches to concussion management are based on an understanding of physiology as well as an individual patient's health and lifestyle.



References

- Al-Husseini, A. et al. (2022). Shorter Recovery Time in Concussed Elite Ice Hockey Players by Early Head-and-Neck Cooling: A Clinical Trial. *Journal of Neurotrauma*. <https://doi.org/10.1089/neu.2022.0248>
- Carabenciov, I.D., Bureau, B.L., Cutrer, M., Savica, R. (2019). Amantadine Use for Post-concussion Syndrome. *Mayo Clin. Proc*, 94, 275–277,
- Casson, I. (2015). Legal and ethical implications in the evaluation and management of sports-related concussion. *Neurology*, 84, 861.
- <https://doi.org/10.1212/WNL.0000000000001355>
- Centers for Disease Control & Prevention. (n.d.). CEC Heads Up. <https://www.cdc.gov/HEADSUP/>
- Cook, N., Sapigao, R., Silverberg, N., Maxwell, B., Zafonte, R., Berkner, P. & Iverson, G. (2020). Attention-Deficit/Hyperactivity Disorders Mimics the Post-concussion Syndrome in Adolescents. *Frontiers in Pediatrics*, 8. <http://doi.org/10.3389/fped.2020.00002>
- Fierce Prods. (n.d.). Tua Tagovailoa 3 Concussions IN ONE SEASON Compilation: Tua Head Injuries Full Sequences [Video]. YouTube.
- <https://www.youtube.com/watch?v=t3b-l32oDRM>



References

Koehle, M.S. (2013). Normative data for the balance error scoring system in adults. *Rehabilitation Research & Practice*.

<https://doi.org/10.1155/2013/846418>.

Giola, G. & Collins, M. (2006). Acute Concussion Evaluation (ACE) Care Plan. Centers for Disease Control & Prevention.

https://www.cdc.gov/headsup/pdfs/providers/ace_care_plan_school_version_a.pdf

Halstead, M.E., McAvoy, K., Devore, C.D., Carl, R., Lee, M., Logan, K., Council on Sports Medicine and Fitness, et al. (2013). Returning to Learning

Following a Concussion. *Pediatrics*, 132 (5), 948–957. <https://doi.org/10.1542/peds.2013-2867>

Halstead, M.E., Walter, K.D., Moffatt, K., Council on Sports Medicine and Fitness, LaBella, C.R., et al. (2018). Sport Related Concussion in Children and

Adolescents. *Pediatrics*, 142 (6): e20183074. <https://doi.org/10.1542/peds.2018-3074>

Harmon, K.G., Clugston, J.R., Dec, K., Hainline, B., Herring, S.A., Kane, S., Kontos, A.P., Leddy, J.J., McCrea, M.A., Poddar, S.K., Putukian, M., Wilson, J.C.,

Roberts, W.O. (2019). *American Medical Society for Sports Medicine position statement on concussion in sport*, *British Journal of Sports*

Medicine, 53, 213–225.



References

McCrory, P., Meeuwisse, W. H., Aubry, M., Cantu, B., Dvorák, J., Echemendia, R. J., Engebretsen, L., Johnston, K., Kutcher, J. S., Raftery, M., Sills, A., Benson, B. W.,

Davis, G. A., Ellenbogen, R. G., Guskiewicz, K., Herring, S. A., Iverson, G. L., Jordan, B. D., Kissick, J., McCrea, M., Turner, M., et al. (2013). Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012. *British journal of sports medicine*, 47(5), 250–258. <https://doi.org/10.1136/bjsports-2013-092313>

McCrory, P., Meeuwisse, W., Dvorak, J., et al. (2017). Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016 *British Journal of Sports Medicine*, 51, 838-847.

NATA Research & Education Foundation. (n.d.). Vestibular/Ocular-Motor Screening (VOMS). <https://www.natafoundation.org/wp-content/uploads/VOMS-Infographic.pdf>

NFL Head, Neck and Spine Committee. (2022) NFL Concussion Diagnosis and Management Protocol. <https://www.nfl.com/playerhealthandsafety/resources/factsheets/nfl-head-neck-and-spine-committee-s-concussion-diagnosis-and-management-protocol>



References

Post Concussion Symptom Scale. (n.d.). <https://hawaiiiconcussion.com/downloads/Post-Concussion-Symptom-Scale.pdf>

Randolph, C., McCrea, M., Barr, W.B. (2005). Is neuropsychological testing useful in the management of sport-related concussion? *Journal of Athletic Training*, Jul-Sep; 40(3), 139-52.

Standiford, L., O'Daniel M., Hysell, M., & Trigger, C. (2021). A randomized cohort study of the efficacy of PO magnesium in the treatment of acute concussions in adolescents. *Am J Emerg Med*, 44, 419-422. <https://doi.org/10.1016/j.ajem.2020.05.010>

Tal, S., Hadanny, A., Sasson, E., Suzin, G., & Efrati, S. (2017). Hyperbaric oxygen therapy can induce angiogenesis and regeneration of nerve fibers in traumatic brain injury patients, *Frontiers Hum. Neurosci.* 11 (508).

VT Concussion Task Force. (n.d.). All Schools – All Concussions Toolkit. Brain Injury Association of Vermont. <https://biavt.org/wp-content/uploads/2020/09/ConcussionToolkit09.26.2019.pdf>

Wang, K.K., Yang, Z., Zhu, T., & et al. (2018). *An update on diagnostic and prognostic biomarkers for traumatic brain injury*. *Expert Rev Mol Diagnostics*, 18(2), 165-180.



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