Recognition, Evaluation and Treatment of Concussion in Athletes

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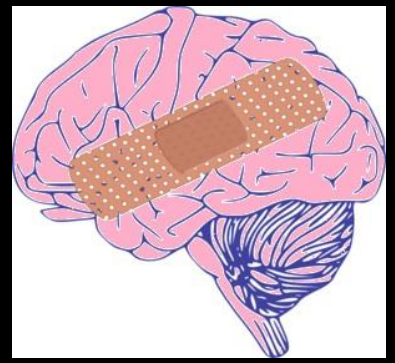

Objectives

- Review updates to concussion management
- Identify signs and symptoms necessitating advanced imaging
- Recognize factors that contribute to an increased symptom burden and prolong concussion recovery and incorporate screening of them in your clinical practice.
- Prescribe a return to play and return to learn/work plan for all patients in your clinical practice

Outline

- Concussion Statistics
- Pathophysiology of Concussion
- Incidence of concussion and associated risk factors
- Diagnosing concussions
- Managing concussions
- Common Pitfalls

Concussion Rate Per Sport

per 10,000 athlete exposures

Males 9.41

Females 9.10/ Males 3.03

Males 4.00

Females 4.23/ Males 0.95

Females 2.88

Females 1.83/ Males 1.35

10,500 concussions

college athletes in past 5 years

3.8 million

recreation-related concussions annually

1.6%

MSHAA athletes in 2016-17

28%

RTP after 6 to 10 days

20%

RTP after 11 to 15 days

Concussion

- Mild traumatic brain injury
- Complex pathophysiological process induced by biomechanical forces

Concussion

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- Complex pathophysiological process induced by biomechanical forces
- Physical forces acting on the brain
- Disrupts brain function usually without structural injury
- Causes one or more signs & symptoms, typically resolves spontaneously within days-weeks
- May or may not involve loss of consciousness

~~Function~~

Signs/Symptoms

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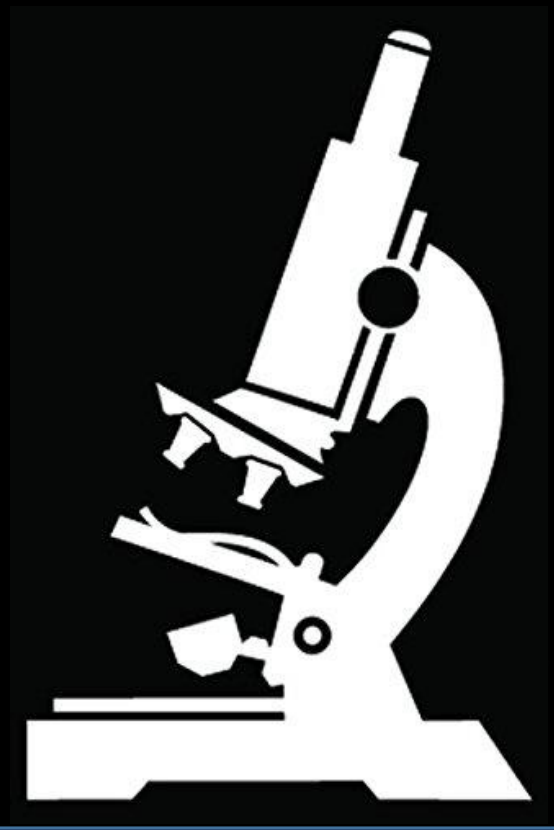
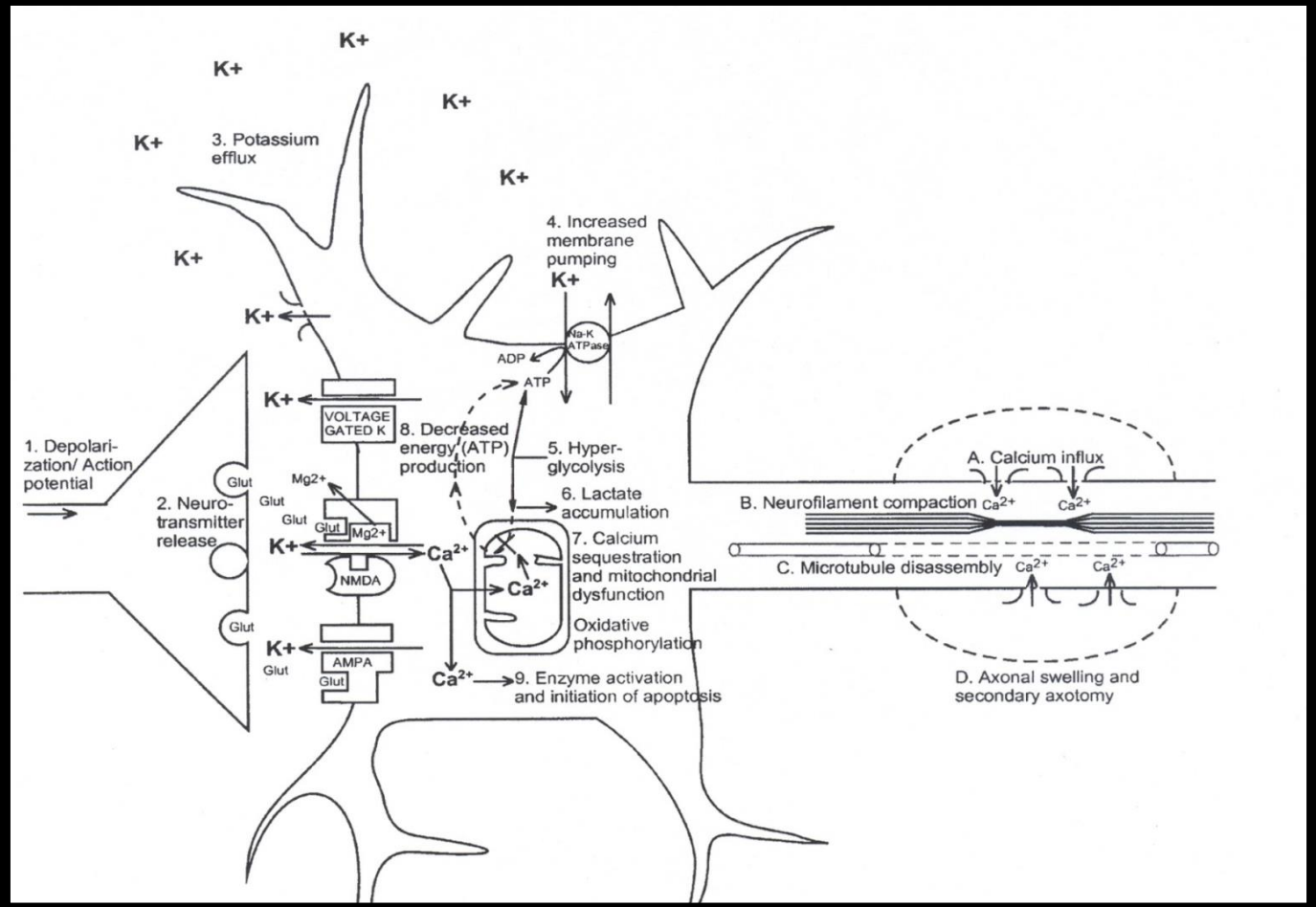


Concussion Pathophysiology

- Physical forces disrupts brain function
- Cascade for ionic, metabolic, and pathophysiological events
- Microscopic axonal injury
- Mitochondrial dysfunction

Axon Stretch → K+ Efflux, Ca++ Influx → Metabolic Changes (7-10 days) → Symptom Production → ATP to repair homeostasis



Concussion Pathophysiology

- Physical forces disrupts brain function
- Cascade for ionic, metabolic, and pathophysiological events
- Microscopic axonal injury

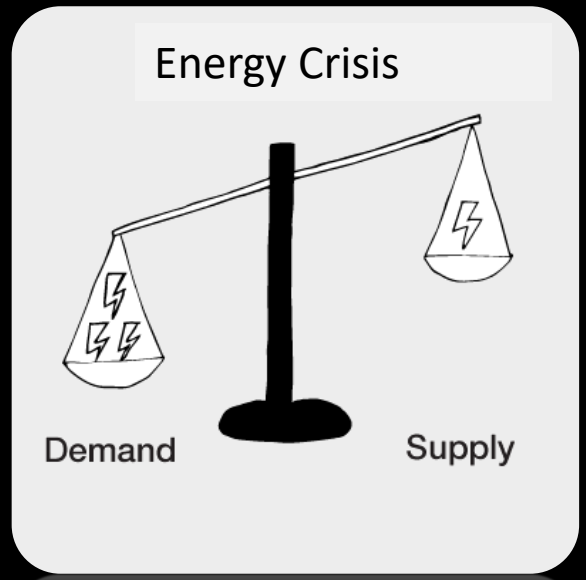
  →Increased energy demand

- Decreased cerebral blood flow

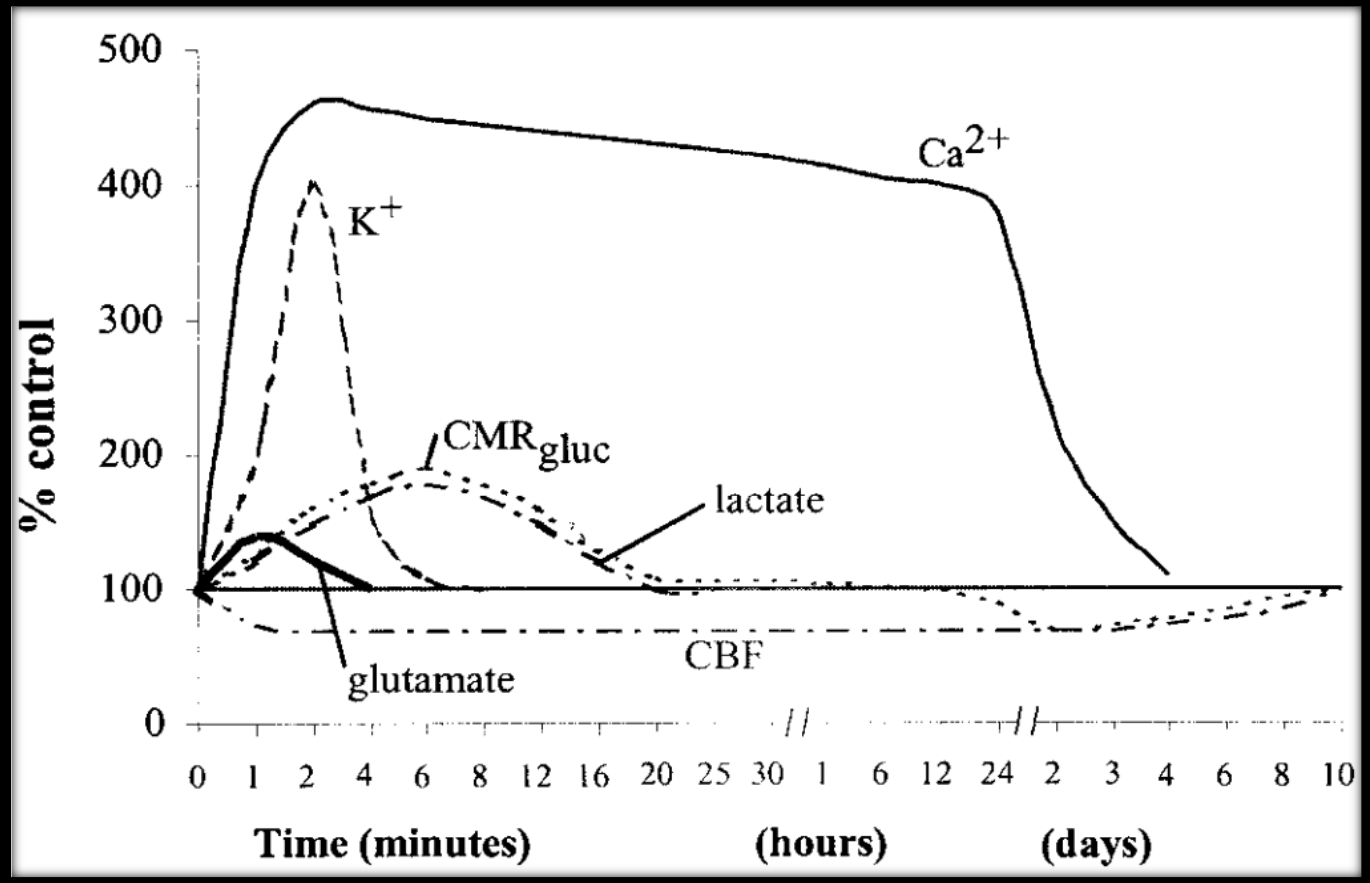
  +

- Mitochondrial dysfunction

  →decreased energy supply

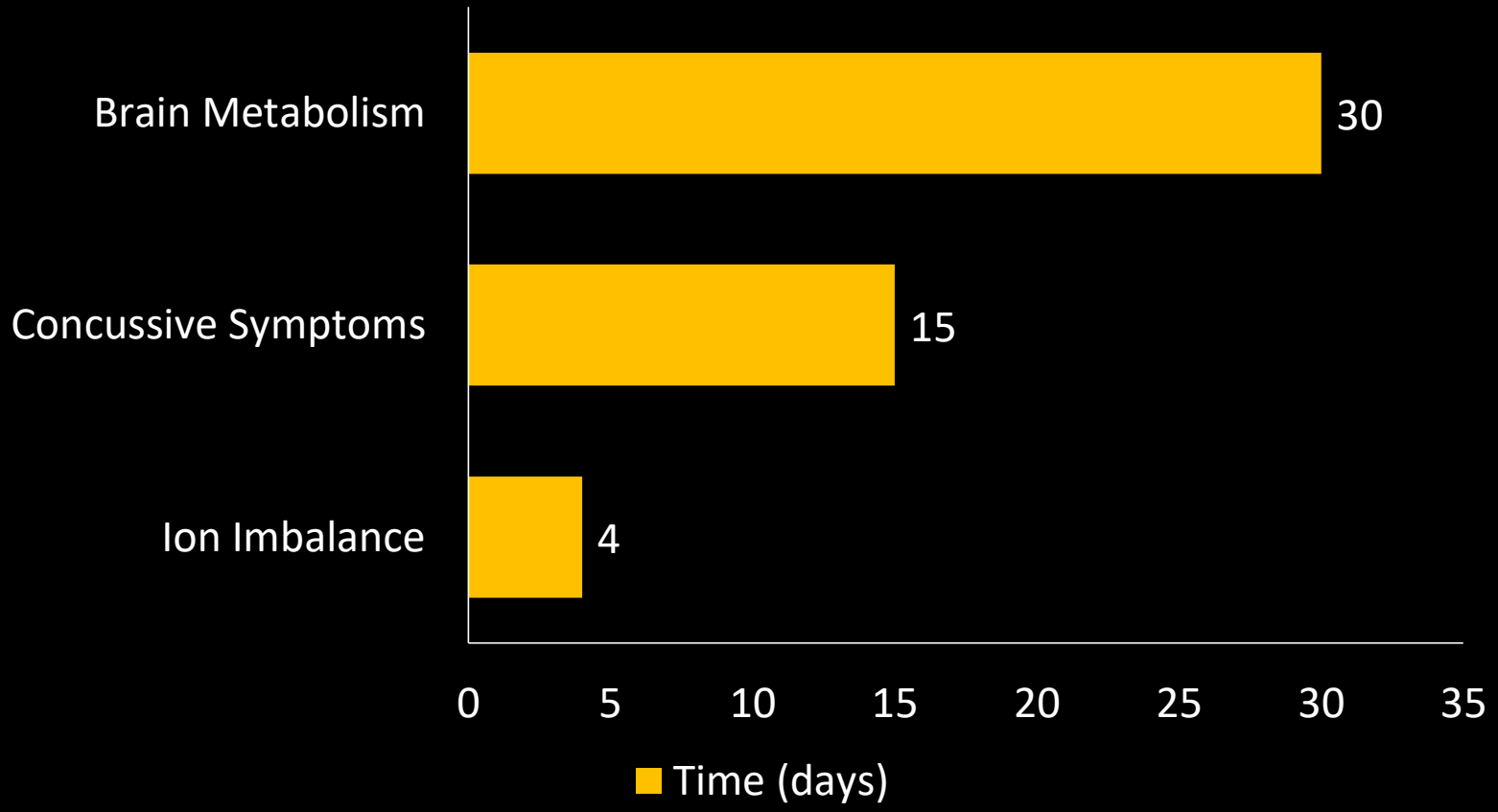


Ionic Imbalance from Neurometabolic Cascade



J Athvl Train. 2001 Jul-Sep; 36(3): 228–235.

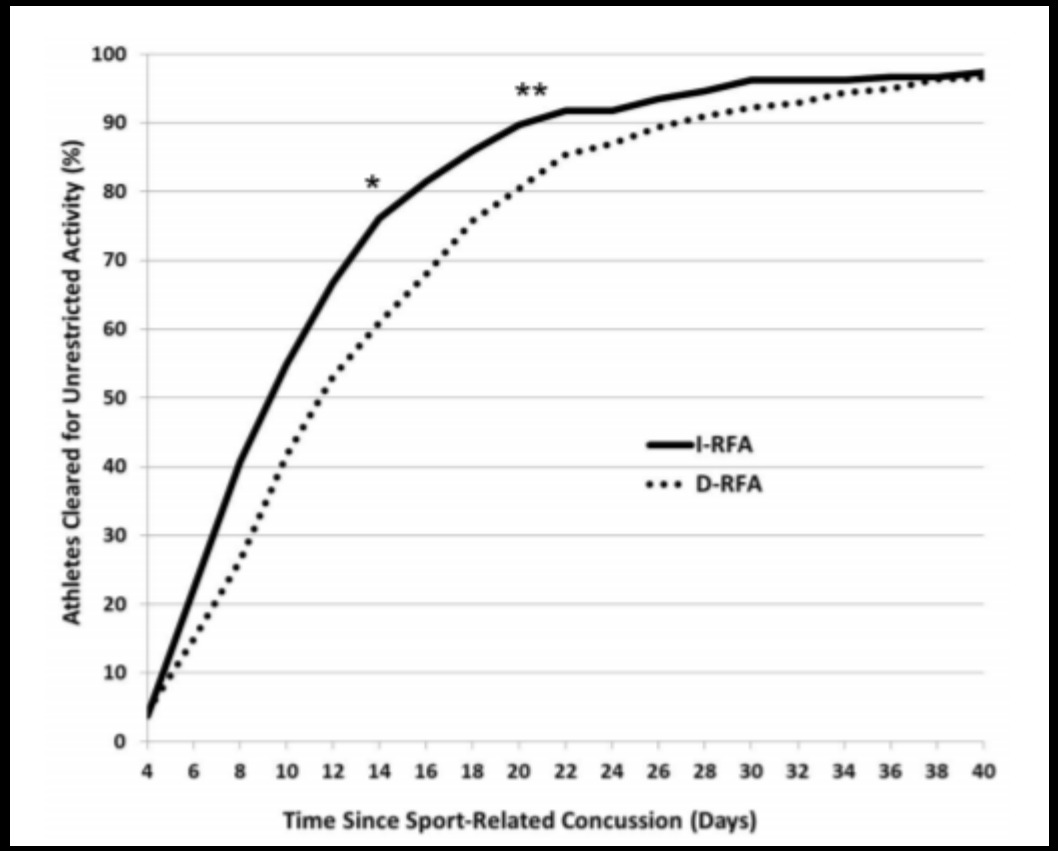
Concussion Recovery



Case: 16 y/o M soccer player

- Head to head impact when heading soccer ball.
- Immediately felt “stunned” and a little unsteady that quickly resolved.
- Continued to play for remainder of quarter.
- Developed headache and mild nausea at sideline between periods.
- ATC and coach removed player from game

Delayed Removal from Sport



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*IRFA group at 39% lower likelihood of missing ≥14 days

**I-RFA at 47% lower likelihood of missing ≥ 21 days

Immediate removal from Sport → 3 fewer days until return to sport

Immediate Removal from Activity Decreases Injury Duration

- Asken et al: 506 collegiate athletes (18 sports at 22 institutions)
  - Immediately removed→ 3 fewer days to return to sport than those with delayed removal
- Asken et al: 97 collegiate athletes
  - immediately removed→ 5 fewer days to return to sport (6.8 vs 12.3 days).
- Elbin et al: Prospective study of 64 adolescents
  - immediately removed→recovered 22 days sooner than those with delayed removal

Sideline Assessment and Management

- Remove from play and assessed by a licensed healthcare provider trained in the evaluation and management of concussions. (Michigan Law)
- No same day return to play.

- Monitored for deteriorating physical or mental status

- Symptoms checklist
- Cognitive evaluation
- Balance tests
- Neurological physical examination

Case: Sideline Assessment

Symptom Evaluation

- SCAT Symptoms= 12
- SCAT Severity Score= 21

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Case: Sideline Assessment

- ATC evaluated at sideline with SCAT 3

Scoring Summary:

Test Domain	Score		
	Date: _____	Date: _____	Date: _____
Number of Symptoms of 22	12		
Symptom Severity Score of 132	21		
Orientation of 5	5		
Immediate Memory of 15	13		
Concentration of 5	2		
Delayed Recall of 5	2		
SAC Total			
BESS (total errors)	9		
Tandem Gait (seconds)	8		
Coordination of 1	1		

Symptom burden and duration of Concussion

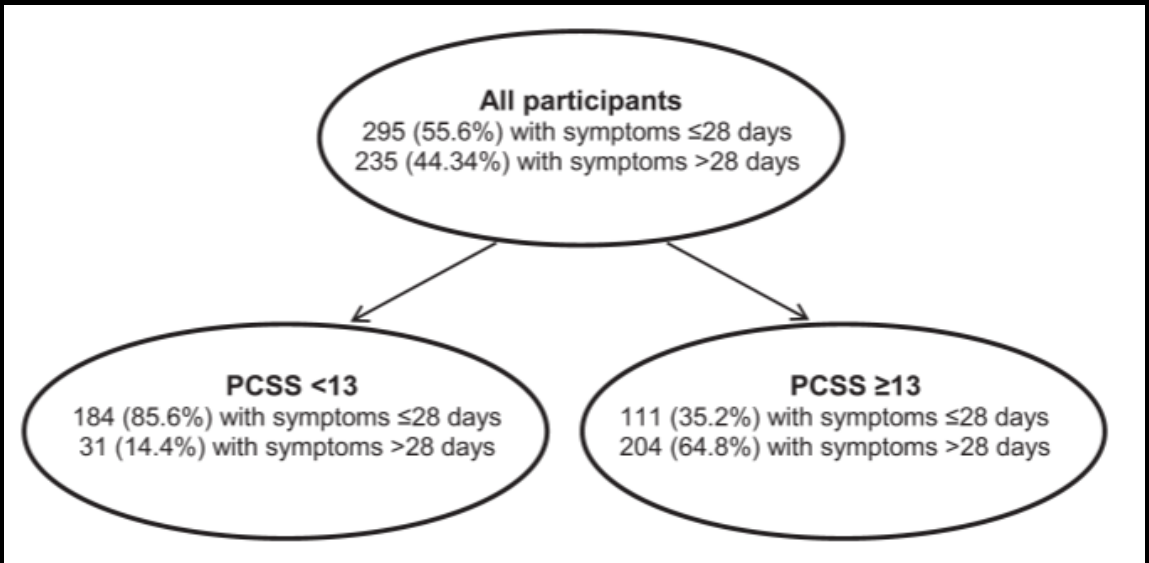
Potential predictor variable	Participants with symptoms ≤28 days (n = 296)	Participants with symptoms >28 days (n = 235)	p Value
Continuous variables			
Mean age, y	14.5	14.6	0.671
Mean initial PCSS score	16	40	<0.01
Mean number of prior concussions	0.79	0.82	0.837
Participants with computerized neurocognitive testing at initial visit	No. = 86	No. = 43	
Mean verbal memory	84.05	75.47	0.004
Mean visual memory	71.16	61.40	0.002
Mean visual motor speed	35.53	30.58	0.005
Mean reaction time	0.60	0.68	0.003
Mean symptom score[a]	8.78	27.50	<0.01
Categorical variables, n/N (%)[b]			
Male sex	194/296 (65.5)	135/235 (57.5)	0.059
Loss of consciousness at time of injury	60/268 (22.4)	52/220 (23.6)	0.747
Amnesia at time of injury	85/278 (30.6)	95/221 (43.0)	0.005
History of prior concussion	131/295 (44.4)	87/235 (37.0)	0.092
Prior treatment for headaches	30/291 (10.3)	43/230 (18.7)	0.007
History of migraines	20/291 (6.9)	22/227 (9.7)	0.259
Family history of concussion	97/286 (33.9)	90/226 (39.8)	0.196

Abbreviation: PCSS = Post-Concussion Symptom Scale.
[a] Symptom scale from computerized neurocognitive assessment.
[b] The denominator for comparisons varies, as not all participants answered every question.

Neurology 83 Dec 9, 2014

PCSS score ≥ 13 are more likely to have symptoms beyond 28 days

Symptom burden and duration of Concussion



PCSS score ≥ 13 are more likely to have symptoms beyond 28 days

Neurology 83 Dec 9, 2014

Diagnosis of Concussion

- Clinical Diagnosis
- Graded Symptom checklists
  - Objective tool for assessing a variety of concussive symptom
  - Track the severity of symptoms over serial evaluations.
- Standardized assessment tools / Neurologic and vestibular examination
  - Provides a helpful structure for the evaluation
  - Limited validation of tools

- No tools/tests have 100% sensitivity or specificity

2018 CDC Pediatric Guidelines

Should

- combination of tools to assess recovery
- age-appropriate, validated, symptom rating scale as a component of the diagnostic evaluation and to assess recovery

May

- validated cognitive testing (including measures of reaction time) to assess recovery.
- balance testing to assess recovery
- validated, age-appropriate computerized cognitive testing in the acute period of injury as a component of the diagnosis

- Standardized Assessment of Concussion (SAC) *should not* be exclusively used to diagnose mTBI in children 6-18 years .

Clinical History

Recall / memory of injury

Symptom Inventory

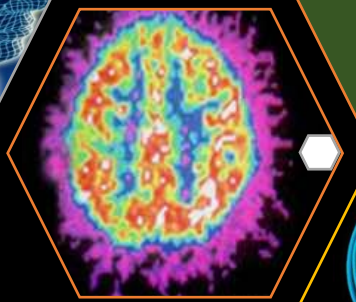
Prior concussion

Sport. Position, playing style

Injury Details

Mood/ learning disorders, migraines

Premorbid Symptoms



Family/ social stressors

Back to the Case: Symptoms

- 16 year old with headache, mild nausea following head to head impact in soccer.
- Symptoms worsened that evening and the next day

- Nausea ↑
- Photophobia
- Headache ↑
- Blurry vision
- Drowsy
- Slowed thinking

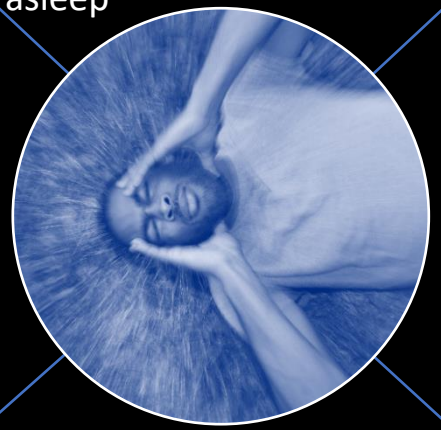
Signs and Symptoms of Concussion

Sleep

- Drowsiness
- Sleeping more than usual
- Sleeping less than usual
- Difficulty falling asleep

Cognitive

- Feeling "foggy"
- Feeling slowed down
- Difficulty concentrating
- Difficulty remembering
- Confused about recent events
- Answers questions slowly
- Repeats Questions



Emotional

- Irritability
- Sadness
- More emotional
- Nervousness

Physical

- Headache
- Nausea
- Vomiting
- Dazed
- Stunned
- Fatigue
- Light Sensitivity
- Sound Sensitivity
- Balance problems
- Vision Problems

PEDIATRICS Vol. 126 No. 3 September 1, 2010

Case: Clinical History

- Injury Mechanism: *head to head impact*
- Detailed Symptom Inventory (number, severity and duration of symptoms)
- Recall/memory of injury: *full memory*
- Past concussions or head injuries*: 1 prior concussion, recovered in 2 weeks, no residual symptoms, 1 year ago*.
- Sports, positions and individual playing style: *forward*
- Pre-injury mood disorders, learning disorders, attention deficit disorders (ADD/ADHD) and migraines: *ADHD*

How do you feel?

"You should score yourself on the following symptoms, based on how you feel now".

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
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Blurred vision	0	1	2	3	4	5	6
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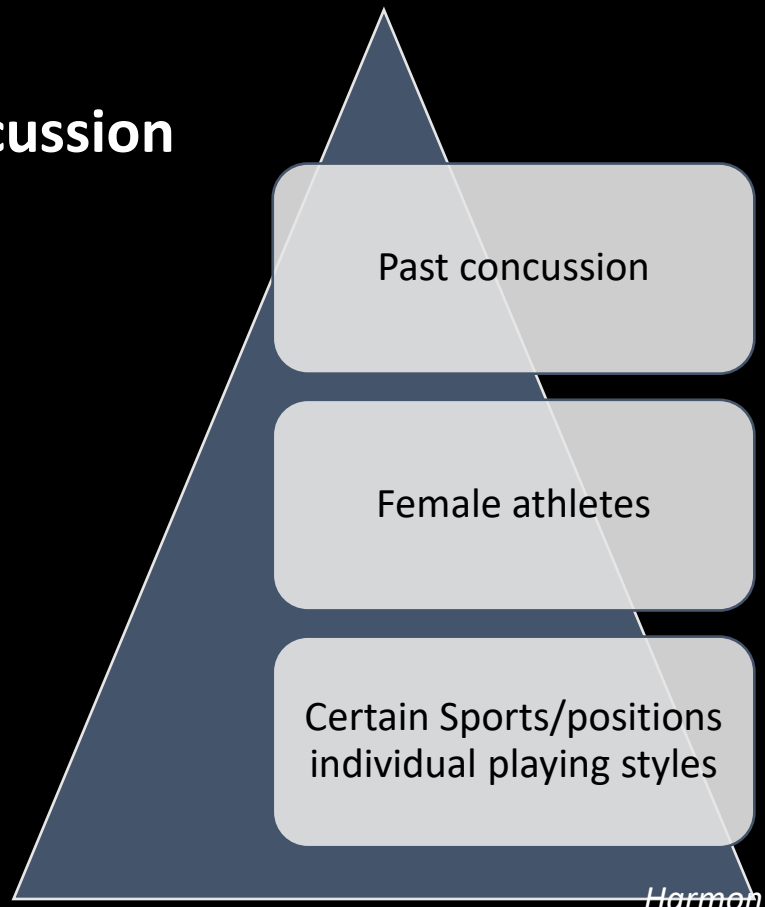
Total number of symptoms (Maximum possible 22) 14

Symptom severity score (Maximum possible 132) 32

Risk Factor for Sports Concussions

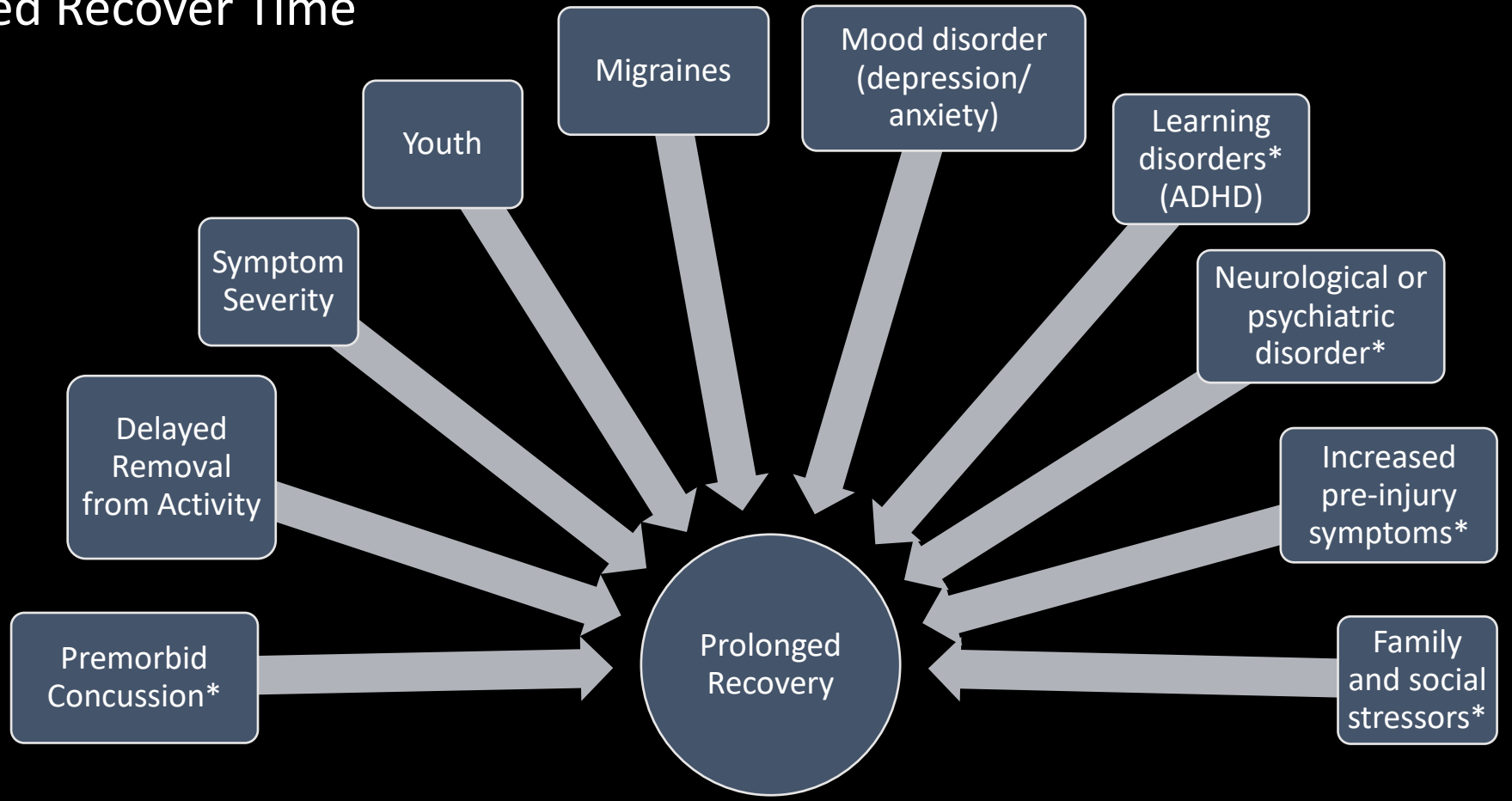
Increased Risk of Concussion



Harmon KG, et al. Br J Sports Med 2013;47:15–26

Risk Factors for Sports Concussion

Prolonged Recover Time



Goals of Physical Examination

- Establish current mental status and degrees of impaired coordination/balance
- Rule out more serious neurologic injury
- Evaluate spine for associated injury
- Identify impairments for individualized treatment

Head and Neck Examination

Head Examination

- Facial tenderness
- Skull bony tenderness
- Inspect detention
- Lacerations/swelling
- TM rupture

Neck Examination

- Palpate for bony tenderness
- Neck ROM
- Suboccipital/ paraspinal muscles
- Isometric Neck Strength
- Spurling’s maneuver
- UE/LE Strength, Pronator Drift

Neurologic Examination

Concentration/Mental Status

- Orientation (day, date, time, month, year)
- Immediate memory (5 items, 3 trials)
- Delayed recall (5 items after 5 minutes)
- Concentration (digits backwards, months/WORLD backwards, serial sevens)

Cranial Nerve Testing

- EOM evaluation (nystagmus, convergence insufficiency)
- VOMS (Vestibular/Ocular-Motor Screening)
- Speech
- Visual Fields
- Pupils

Neurologic Examination

Coordination

- Finger-nose-finger/ finger-to-nose
- Heel-to-shin
- Rapid finger movements
- Reaction Time Testing

Balance

- Modified BESS/ single leg stance
- Tandem gait
- Rhomberg test

Vestibular/Oculo-motor Screen

Smooth Pursuit	• Follow a moving target while seated (3 ft from pt)
Saccades	• Quickly follow a target between two points (3ft away, 1.5 ft to right/left OR above/below eye level)
Convergence	• View a near target without double vision (target at arms length moving toward nose, >5cm is abnormal)
Vestibulo-ocular reflex	• Ability to stabilize vision as the head moves (focus on object 3 ft away while moving head)
Visual Motion Sensitivity	• Ability to inhibit vestibular –induced eye movements using vision (rotate head and arm focus on thumb)

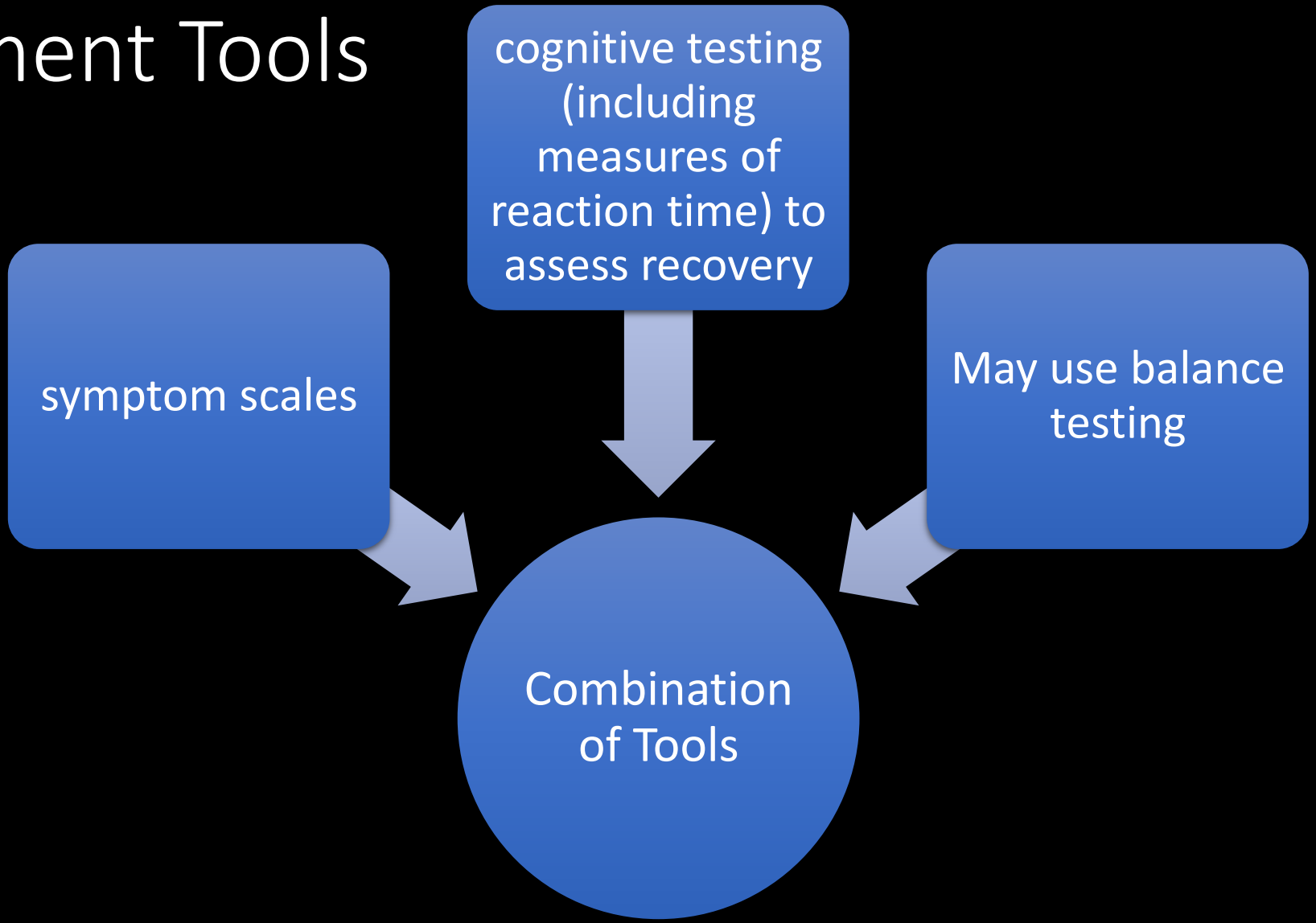
(Mucha, Collins et al. 2014)

Balance Evaluation

BESS Balance testing errors:

- Hands lifted off iliac crest
- Opening eyes
- Step, stumble, or fall
- Moving hip into > 30 degrees abduction
- Lifting forefoot or heel
- Remaining out of test position > 5 s

Assessment Tools



Common Concussion Signs

- Mental Status: +/- impairments
- Balance: *Impaired tandem gait or single leg balance, abnormal BESS*
- CN: *nystagmus, saccades*
- Strength: Normal, symmetric
- DTR: normal
- FTN: *may be slightly abnormal*
- GAIT: +/- ataxia

Signs that may indicate more serious injury

- Mental Status: significantly impaired
- Balance: Rhomberg, postural instability
- CN: unequal or fixed pupils, visual field deficit, abnormal EOM
- Strength: asymmetric, focal weakness
- DTR: hyper-reflexia, Babinski, clonus, Hoffman's reflex
- FTN: discoordination
- GAIT: ataxic

Red Flags for ED referral / Urgent work up

Glascow Coma Score < 14
Concern for intracranial process
Evidence of a skull fracture (bruising under eyes, behind ears, or swelling of the head)
Concern symptoms are not related to recent minor head trauma

CLIN PEDIATR October 2015 vol. 54no. 11 1031-1037

Indications for Neuroimaging

Rule Out Intracranial Process

- Glasgow Coma Score < 15
- Signs of basilar skull fracture
- Altered mental status/ Focal neurologic findings on examination
- Combination of the following factors:
  - Loss of consciousness (>30 s)
  - Vomiting
  - Severe mechanism of injury
  - Severe/worsening headache/symptoms
  - Amnesia
  - Non-frontal scalp hematoma
  - Significant drowsiness/difficulty waking

Neuroimaging

Computed Tomography (CT)	Magnetic Resonance Imaging (MRI)
Not for routine concussions	Not for routine concussions
Sensitive for skull fracture, intracranial hemorrhage	Sensitive for cerebral contusion, petechial hemorrhage, white matter injury, posterior fossa abnormalities
Best for first 24-48 hours after injury	Gradient Echo and perfusion and diffusion tensor imaging may detect white matter injury**
Will NOT r/o rule out chronic subdural or neurobehavioral dysfunction	

Neurocognitive Testing

- Objective measure for subtle cognitive impairments
- More sensitive than office examination
- Not required for most concussions
- Should NOT be used in isolation
- Helpful in the post concussion management of patients with persistent symptoms and/or a more complicated course.
- *may* be used in acute period of injury as a component of the diagnosis (typically computerized)

Neurocognitive Testing

Computerized testing compares to individual's pre-season baseline

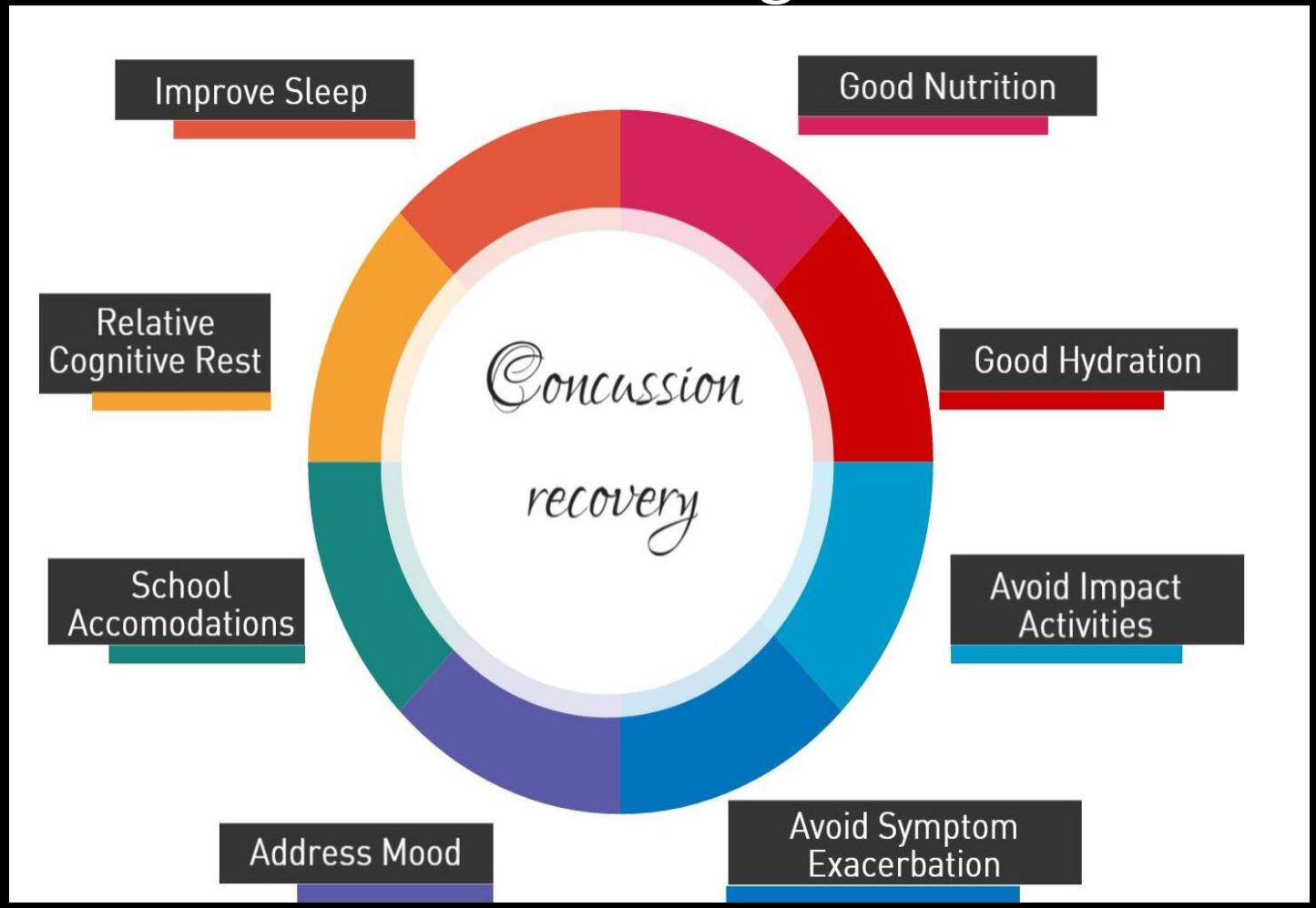
Paper and pencil NP testing is more comprehensive (assess for other conditions such as ADHD, Depression)

Acute Concussion Management

- Remove from Play/sports
- Rest → ***Relative* Rest** first several days post injury
- Decrease symptom burden
- Treat impairments found on examination
- Return to activity that does not increase symptoms
- Return to non-contact aerobic activity that does not exacerbate symptoms, with close monitoring of symptom expression (number, severity).
- Gradual return to learn /school

- Return to full activity when returns to premorbid performance and symptom-free at rest and with increasing levels of physical exertion

Concussion Management



Case: Decrease the symptom burden

- Nausea→ avoid reading or looking at phone in the car
- Photophobia→ sun glasses, adjust seating away from windows in class, turn out lights when possible
- Blurry vision→ limit reading to small amounts. Listen in class. Limit computer/ gaming
- Vestibular Ocular Motor Impairment, nystagmus→ Vestibular PT, Limit reading homework until improves, provide class notes to avoid looking up/down in class
- Drowsy→ allow naps as needed if not affecting sleep overnight.
- Neck spasms→ Physical Therapy, neck stretching
- Impaired Concentration/Memory→ No testing/exams in school, May need accommodations to repeat assignments/instructions, may need repetition/assistance
- Impaired Balance→ Balance training, avoid bike riding, elevated surfaces

Patient/Family Eduction

- Warning signs of more serious injury
- Description of injury and expected course of symptoms and recovery
- Instructions on how to monitor post-concussive symptoms
- Prevention of further injury
- Management of cognitive and physical activity/rest
- Instructions regarding return to play/recreation and school
- Clear clinician follow-up instructions.

Return to Learn:

- Medical and school-based teams should counsel the student and family*
- Gradually increase the duration and intensity of academic activities as tolerated, with the goal of increasing participation without significantly exacerbating symptoms.*
- Return-to-school protocols should be customized based on the severity of postconcussion symptoms and determined jointly by medical and school-based teams.*
- Quite home environment for short periods of time (15-20 minutes)
- Start with core subjects if able, but may tolerate some subjects better than others
- When tolerating 30-45 minutes of studying without symptom escalation, may begin returning to school

Return to Learn: Back to School

- Shortened days with rest breaks, core classes. Avoid symptom exacerbation
- Alternative or shortened assignments/homework or forgive assignments
- Provide student with written instructions, class notes, recordings, additional instruction when needed.
- Avoid noisy environments such as hallways, cafeteria, recess, gym, band, movies
- Encourage rest breaks whenever symptoms increase. Put head down, leave class, lay down, return home if needed
- Avoid testing until recovered

Return to Learn: Prolonged Symptoms CDC Pediatric Concussion Guidelines

- Prolonged symptoms that interfere with academic performance, school-based teams should assess the educational needs of that student and determine the student's need for additional educational supports (504 Plan)
- Postconcussion symptoms and academic progress in school should be monitored collaboratively by the student, family, health care, provider(s), and school teams, who jointly determine what modifications or accommodations are needed to maintain an academic workload without significantly exacerbating symptoms
- The provision of educational supports should be monitored and adjusted on an ongoing basis by the school-based team until the student's academic performance has returned to preinjury levels.
- For students who demonstrate prolonged symptoms and academic difficulties despite an active treatment approach, health care providers should refer the child for a formal evaluation by a specialist in pediatric mTBI.

Support for Transition to Classroom

Initial transitional support
School personnel alerted to injury and potential consequences
Reintegration into school occurs gradually
Student not expected to do all work completed in absence
Extra assistance provided to facilitate completion of makeup work
General school-based support
Monitor student carefully for a period of 2–3 mo
Ensure rest time and breaks available as needed
Reduce overall homework and class workload
Reduce cognitively demanding in-school tasks (eg, no more than 1 test each day)
Specific classroom-based support
Delay standardized and classroom tests
Waive time constraints for tests
Increase flexibility for assignment due dates
Provide preferential seating to allow for closer monitoring and decreased distractions
Allow access to a model peer's or teacher's notes

PEDIATRICS April 2006

Sample School Accommodations Note

To whom it may concern:

This patient is currently under my medical care for treatment of a concussion. Please make school accommodations to assist with his/her recovery process. These may include, but are not limited to, rest breaks during class, homework, and examination as dictated by symptoms exacerbation; repetition and written instructions for assignments/instructions; extended time for assignments and examinations and/or forgiveness of projects or assignments; providing class notes; allow to wear sunglasses and provide seating away from bring lights and noisy environments; lighter workload; and/or shortened school day as necessary. Please forgive any non-essential homework/assignments. He/She should not return to gym class or sports at this time and should not have additional coursework to make up for missed gym class.

Returning to Play

Requirements to begin RTP Progression:

- Normal neurologic examination
- Full resolution of all symptoms and off of all analgesic medications for at least 24 hours.
- Back to full school without symptoms exacerbation or cognitive difficulties
- Back to academic baseline (pass computerized NP testing if performed)

RTP Considerations

- Evaluate prior to beginning return to play protocol and re-evaluate athlete prior to return to full contact competition.
- Must complete each stage without symptoms returning during activity or for the following 24 hours.
- May perform one stage for multiple days for younger athletes or more complex cases.
- If symptoms return the progression should be stopped until symptom free again and then return to the previous phase

Graduated RTP Protocol (Zurich 2012)

Rehabilitation Stage	Functional Exercise at each stage	Objective of Each Stage
No Activity	Physical and Cognitive Rest	Recovery
Light Aerobic Exercise	Walking, swimming, stationary bike, <70% maximum MR. No resistance training.	Increase HR
Sports Specific Exercise	Skating drills in ice hockey, running drills, No head impact activities	Add Movement
Non-contact training drills	Progression to more complex training drills. May start progressive resistance training	Exercise, coordination and cognitive load
Full-contact practice	Full practice (following medical clearance)	Restore confidence and assess functional skills by coaching staff
Return to Play	Normal game play	

Legislature

Michigan Legislature (June 30, 2013):

- Immediately remove from activity if suspected of sustaining a concussion
- He/she shall not return to physical activity until he or she has been evaluated by an “appropriate health professional” and receives written clearance authorizing the youth athlete’s return to physical

MHSAA Concussion Protocol:

- Only an M.D., D.O., Physician’s Assistant or Nurse Practitioner
- Must be in writing and must be unconditional
- Clearance may not be on the same date on which the athlete was removed from play.

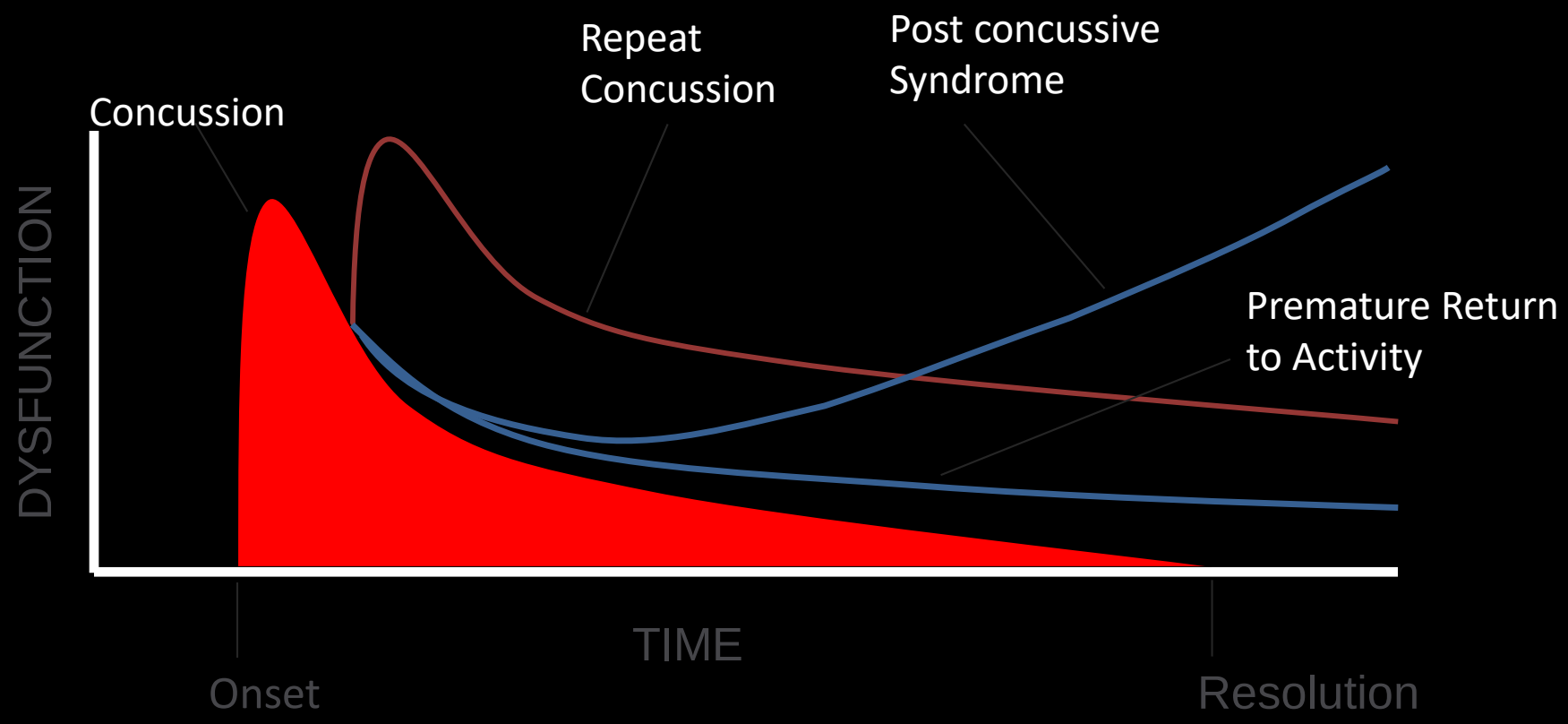
Approach to Prolonged Recovery

- Forced exercise in *acute* stages is detrimental in animal studies (animal studies)
- Voluntary exercise shortens recovery (animal studies)
- Early exercise (with in 1 week) may decreases PCS
- Sub symptom threshold is treatment for exercise intolerant patients with PCS (4-6 weeks post injury)

When to start exercise?

- Symptom free patients (acute concussion)—graduated return to play protocol
- Patients with symptoms at 4-6 weeks (PCS)—sub symptom threshold exercise
- POSSIBLY after ~48 hrs in all patients?--LIGHT exercise (no collision risk). Preliminary research at this time.

Concussion Recovery Timeline



Post Concussive Syndrome

Diagnosis

- Cognitive deficits in attention or memory
- Three of the following:
  - Fatigue
  - Sleep disturbances
  - Headache
  - Dizziness
  - Irritability
  - Affective disturbance
  - Apathy
  - Personality changes

- Treadmill testing
  - Should have reproduction or exacerbation of symptoms
  - If no symptoms occur with exercising to exhaustion, other causes are likely
- Repeated neurocognitive testing is widely used

Treatment:

- Multidisciplinary treatment

Summary

- Sport-related concussions are common.
- Immediate removal from play following concussion decreases duration of symptoms and time from sport
- Some athletes may take weeks to months to recover and may benefit from a concussion specialist
- Concussion has many signs and symptoms. Some overlap with other medical conditions.
- Results of CT or MRI are generally are normal with a concussion.

Summary

- Neuropsychological testing can provide objective data and is one tool in the complete management of a sport-related concussion.
- Athletes with concussion should follow relative rest, both physically and cognitively, until their symptoms have resolved.
- Follow a return to play progression once symptom free.
- Early exercise may be considered after acute period.
- Teachers and school administrators should work with students to modify workloads to avoid exacerbation of symptoms.

References

- Giza CC, Hovda DA (2001). The Neurometabolic Cascade of Concussion. Journal of Athletic Training. 2001;36(3):228-235.
- Halstead, ME; Walter, KD (2010). Clinical Report—Sport-Related Concussion in Children and Adolescents. Pediatrics. Vol. 126 No. 3 September 1, 2010. pp. 597 -615
- Grool AM et al. Association Between Early Participation in Physical Activity Following Acute Concussion and Persistent Postconcussive Symptoms in Children and Adolescents. *JAMA.*2016;316(23):2504–2514.
- Harmon KG, et al (2013). American Medical Society for Sports Medicine position statement: concussion in sport. Br J Sports Med 47:15–26.
- Kirkwood, MW; Yeates, KO; Wilson, PE (2006). Review Article: Pediatric Sport-Related Concussion: A Review of the Clinical Management of an Oft-Neglected Population. Pediatrics April 2006; 117:4 1359-1371
- Leddy, J., et al. (2016). "The Role of Controlled Exercise in Concussion Management." Pm r 8(3 Suppl): S91-s100.
- McCrory, P; Meeuwisse MH; et al (2012). Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012 Br J Sports Med 2013;47:5 250-258

Reference

- Mucha, A., et al. (2014). "A Brief Vestibular/Ocular Motor Screening (VOMS) assessment to evaluate concussions: preliminary findings." Am J Sports Med 42(10): 2479-2486.
- Reisener, A; et al (2015). The Central Role of Community-Practicing Pediatricians in Contemporary Concussion Care: A Case Study of Children's Healthcare of Atlanta's Concussion Program. CLIN PEDIATR October 2015 vol. 54 no. 11 1031-1037.
- Vagnozzi, R., et al. (2010). Assessment of metabolic brain damage and recovery following mild traumatic brain injury: a multicentre, proton magnetic resonance spectroscopic study in concussed patients. Brain 133(11): 3232-3242
- Asken BM et al. Immediate Removal From Activity After Sport-Related Concussion Is Associated With Shorter Clinical Recovery and Less Severe Symptoms in Collegiate Student-Athletes. Am J Sports Med. 2018 May;46(6):1465-1474. PMID: 29558195.
- Asken BM, McCrea MA, Clugston JR, Snyder AR, Houck ZM, Bauer RM. ‘‘Playing through it’’: delayed reporting and removal from athletic activity after concussion predicts prolonged recovery. J Athl Train. 2016;51(4):329-335
- Meehan WP 3rd, Mannix R, Monuteaux MC, Stein CJ, Bachur RG. Early symptom burden predicts recovery after sport-related concussion. Neurology. 2014 Dec 9;83(24):2204-10. doi: 10.1212/WNL.0000000000001073. Epub 2014 Nov 7. PubMed PMID: 25381296;

Questions?

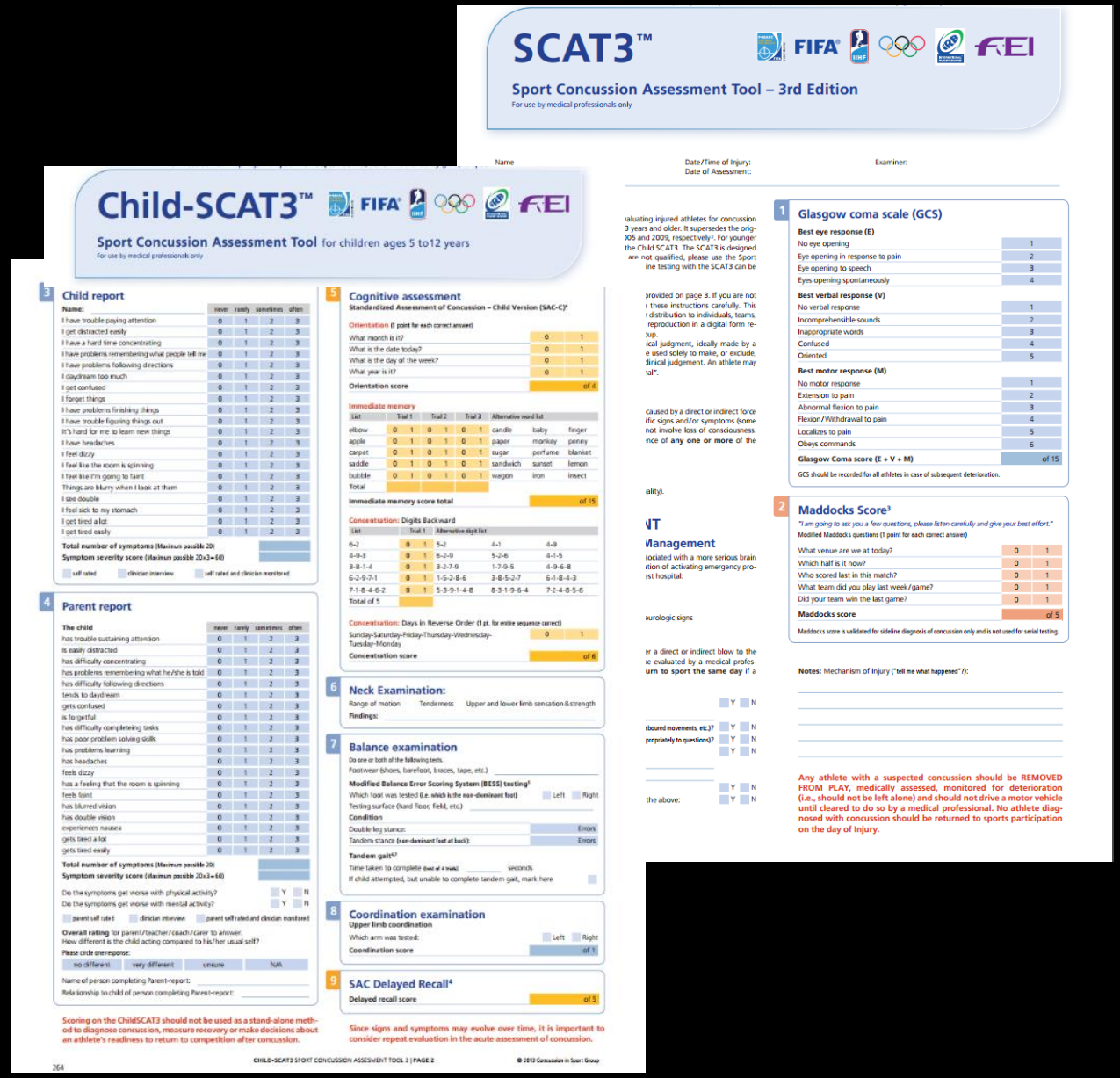
Resources

- SCAT3

  http://bjsm.bmj.com/content/47/5/259.full.pdf

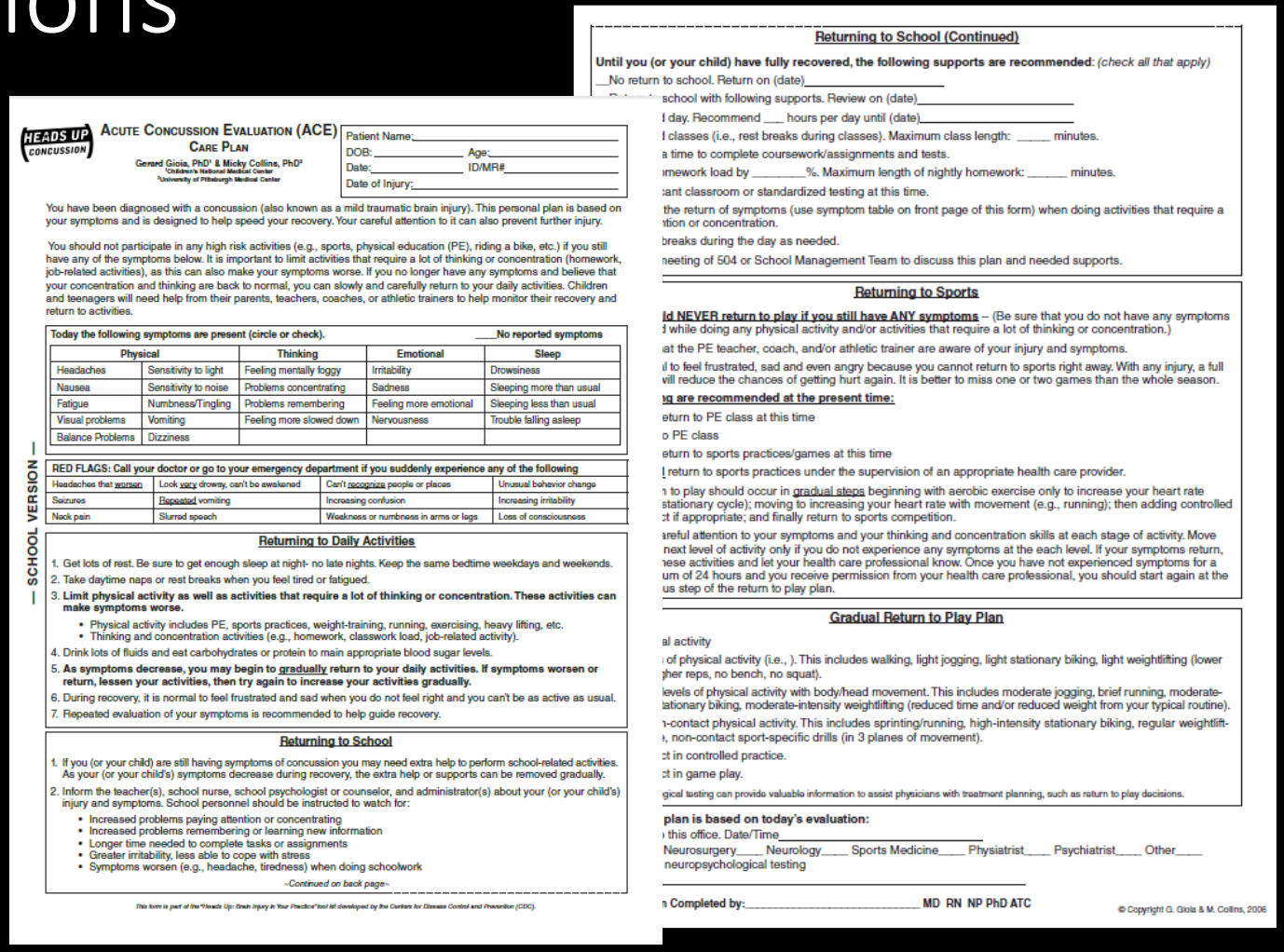
- Child SCAT3

  http://bjsm.bmj.com/content/47/5/263.full.pdf



Patient Instructions

- ACE Care Plan



HEADS UP CONCUSSION

ACUTE CONCUSSION EVALUATION (ACE) CARE PLAN

Gerard Gioia, PhD[1] & Micky Collins, PhD[2]
[1]Children's National Medical Center
[2]University of Pittsburgh Medical Center

Patient Name:_____
DOB: _____ Age:_____
Date:_____ ID/MR#_____
Date of Injury:_____

You have been diagnosed with a concussion (also known as a mild traumatic brain injury). This personal plan is based on your symptoms and is designed to help speed your recovery. Your careful attention to it can also prevent further injury.

You should not participate in any high risk activities (e.g., sports, physical education (PE), riding a bike, etc.) if you still have any of the symptoms below. It is important to limit activities that require a lot of thinking or concentration (homework, job-related activities), as this can also make your symptoms worse. If you no longer have any symptoms and believe that your concentration and thinking are back to normal, you can slowly and carefully return to your daily activities. Children and teenagers will need help from their parents, teachers, coaches, or athletic trainers to help monitor their recovery and return to activities.

Today the following symptoms are present (circle or check). ____No reported symptoms

Physical		Thinking	Emotional	Sleep
Headaches	Sensitivity to light	Feeling mentally foggy	Irritability	Drowsiness
Nausea	Sensitivity to noise	Problems concentrating	Sadness	Sleeping more than usual
Fatigue	Numbness/Tingling	Problems remembering	Feeling more emotional	Sleeping less than usual
Visual problems	Vomiting	Feeling more slowed down	Nervousness	Trouble falling asleep
Balance Problems	Dizziness			

RED FLAGS: Call your doctor or go to your emergency department if you suddenly experience any of the following

Headaches that worsen	Look very drowsy, can't be awakened	Can't recognize people or places	Unusual behavior change
Seizures	Repeated vomiting	Increasing confusion	Increasing irritability
Neck pain	Slurred speech	Weakness or numbness in arms or legs	Loss of consciousness

— SCHOOL VERSION —

Returning to Daily Activities

1. Get lots of rest. Be sure to get enough sleep at night- no late nights. Keep the same bedtime weekdays and weekends.
2. Take daytime naps or rest breaks when you feel tired or fatigued.
3. **Limit physical activity as well as activities that require a lot of thinking or concentration. These activities can make symptoms worse.**
   - Physical activity includes PE, sports practices, weight-training, running, exercising, heavy lifting, etc.
   - Thinking and concentration activities (e.g., homework, classwork load, job-related activity).
4. Drink lots of fluids and eat carbohydrates or protein to main appropriate blood sugar levels.
5. **As symptoms decrease, you may begin to gradually return to your daily activities. If symptoms worsen or return, lessen your activities, then try again to increase your activities gradually.**
6. During recovery, it is normal to feel frustrated and sad when you do not feel right and you can't be as active as usual.
7. Repeated evaluation of your symptoms is recommended to help guide recovery.

Returning to School

1. If you (or your child) are still having symptoms of concussion you may need extra help to perform school-related activities. As your (or your child's) symptoms decrease during recovery, the extra help or supports can be removed gradually.
2. Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your (or your child's) injury and symptoms. School personnel should be instructed to watch for:
   - Increased problems paying attention or concentrating
   - Increased problems remembering or learning new information
   - Longer time needed to complete tasks or assignments
   - Greater irritability, less able to cope with stress
   - Symptoms worsen (e.g., headache, tiredness) when doing schoolwork

~Continued on back page~

This form is part of the "Heads Up: Brain Injury in Your Practice" tool kit developed by the Centers for Disease Control and Prevention (CDC).

Returning to School (Continued)

Until you (or your child) have fully recovered, the following supports are recommended: *(check all that apply)*

__No return to school. Return on (date)_____
school with following supports. Review on (date)_____
l day. Recommend ___ hours per day until (date)_____
l classes (i.e., rest breaks during classes). Maximum class length: _____ minutes.
a time to complete coursework/assignments and tests.
omework load by _____%. Maximum length of nightly homework: _____ minutes.
ant classroom or standardized testing at this time.
the return of symptoms (use symptom table on front page of this form) when doing activities that require a tion or concentration.
breaks during the day as needed.
neeting of 504 or School Management Team to discuss this plan and needed supports.

Returning to Sports

ld NEVER return to play if you still have ANY symptoms – (Be sure that you do not have any symptoms l while doing any physical activity and/or activities that require a lot of thinking or concentration.)
at the PE teacher, coach, and/or athletic trainer are aware of your injury and symptoms.
l to feel frustrated, sad and even angry because you cannot return to sports right away. With any injury, a full vill reduce the chances of getting hurt again. It is better to miss one or two games than the whole season.
ng are recommended at the present time:
eturn to PE class at this time
o PE class
eturn to sports practices/games at this time
l return to sports practices under the supervision of an appropriate health care provider.
n to play should occur in gradual steps beginning with aerobic exercise only to increase your heart rate stationary cycle); moving to increasing your heart rate with movement (e.g., running); then adding controlled ct if appropriate; and finally return to sports competition.
areful attention to your symptoms and your thinking and concentration skills at each stage of activity. Move next level of activity only if you do not experience any symptoms at the each level. If your symptoms return, hese activities and let your health care professional know. Once you have not experienced symptoms for a um of 24 hours and you receive permission from your health care professional, you should start again at the us step of the return to play plan.

Gradual Return to Play Plan

al activity
of physical activity (i.e.,). This includes walking, light jogging, light stationary biking, light weightlifting (lower gher reps, no bench, no squat).
levels of physical activity with body/head movement. This includes moderate jogging, brief running, moderate- tionary biking, moderate-intensity weightlifting (reduced time and/or reduced weight from your typical routine).
n-contact physical activity. This includes sprinting/running, high-intensity stationary biking, regular weightlift- , non-contact sport-specific drills (in 3 planes of movement).
ct in controlled practice.
ct in game play.
gical testing can provide valuable information to assist physicians with treatment planning, such as return to play decisions.

plan is based on today's evaluation:
this office. Date/Time_____
Neurosurgery____ Neurology____ Sports Medicine____ Physiatrist____ Psychiatrist____ Other____
neuropsychological testing

n Completed by:_____ MD RN NP PhD ATC

https://www.cdc.gov/headsup/providers/discharge-materials.html