

*February 10, 2017
2017 TBI Conference
Toronto, ON, Canada*

Concussions and Long-Term Brain Health in Athletes



Jeffrey Kutcher, MD, FAAN

National Director, The Sports Neurology Clinic
Team Neurologist, USSA

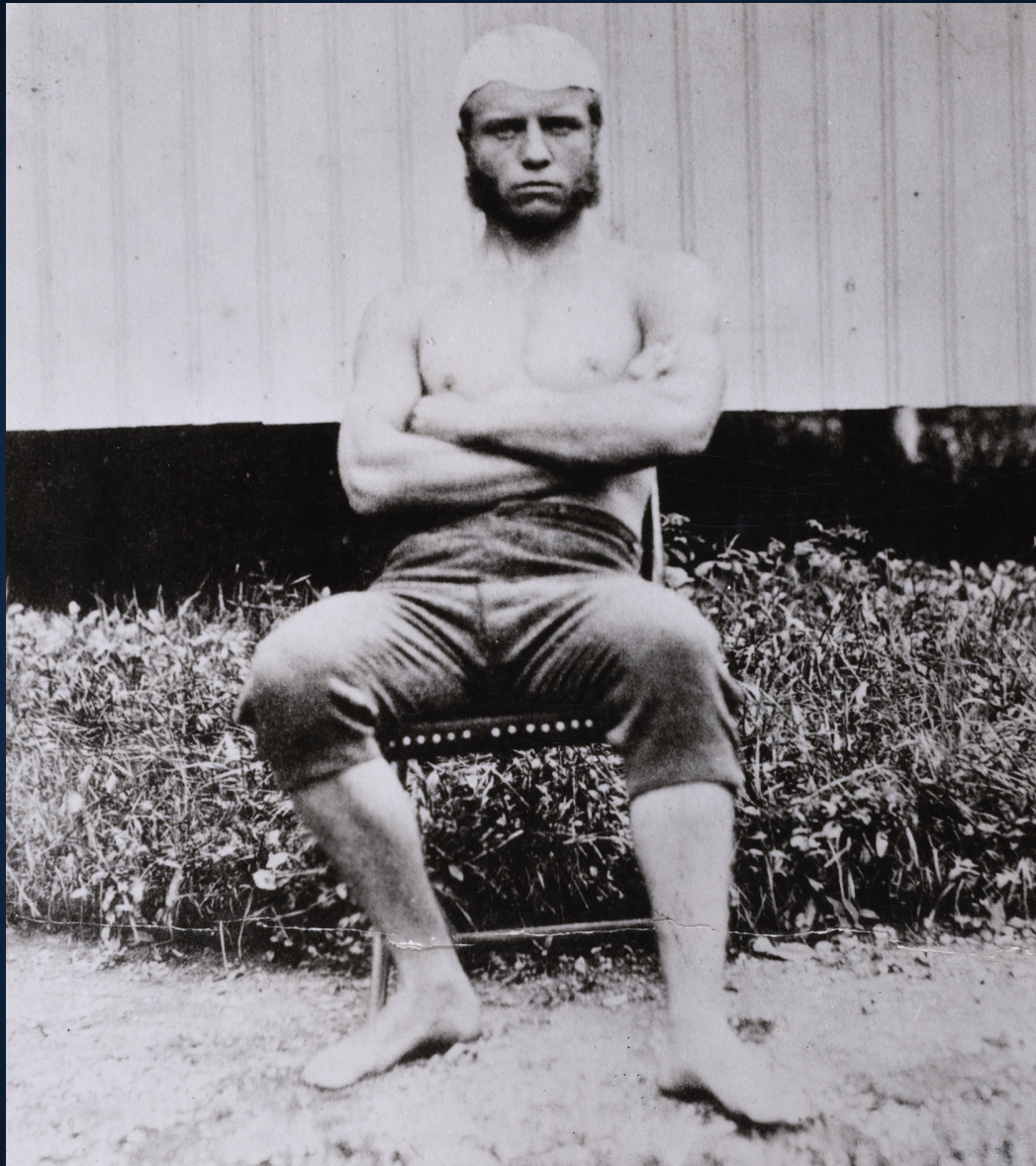
@JeffKutcherMD

@SptsNeuroClinic

Disclosures

- National Director, The Sports Neurology Clinic™
- Team Neurologist, US Ski & Snowboard Team
- Director, NBA Concussion Program
- Consultant, NHLPA
- Consultant, NFLPA
- Consultant, ELMindA, Ltd.
- Book royalties: Oxford University Press







GETTY IMAGES

The Punch Drunk Syndrome

Martland H. Punch Drunk. JAMA. 1928

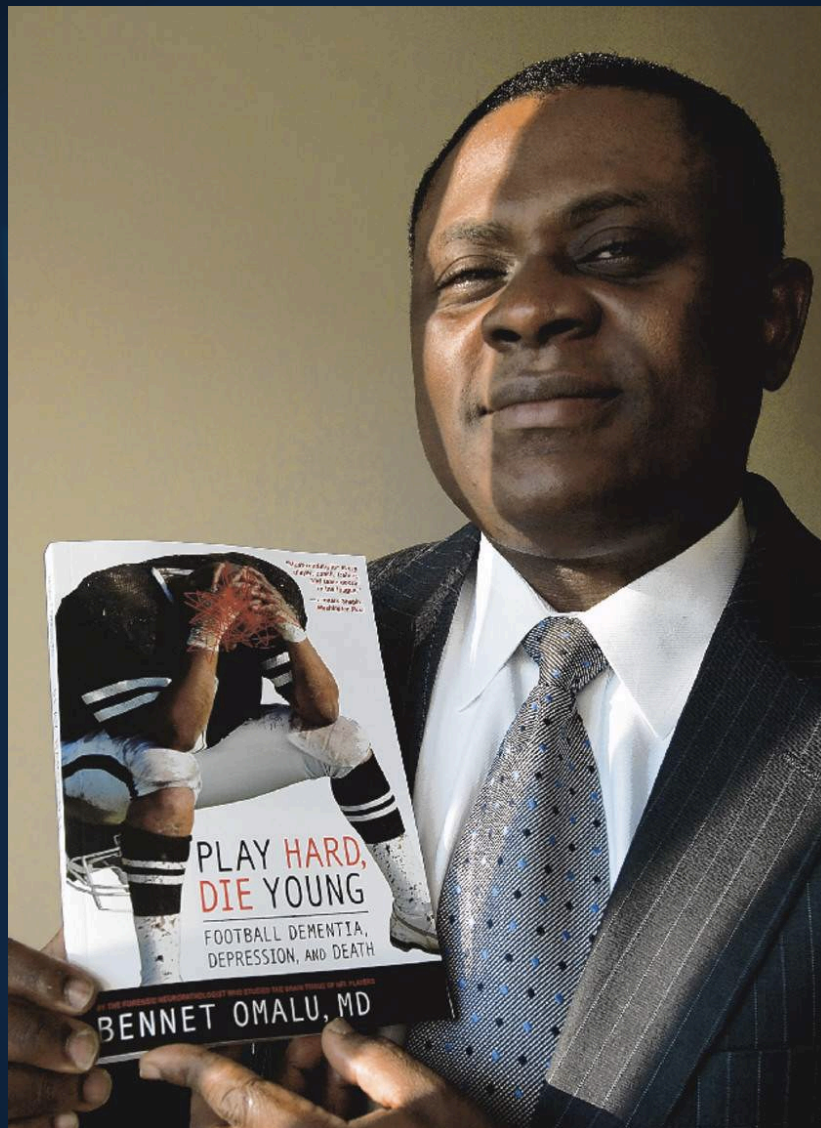
Described 23 cases of professional boxers who had:

- behavioral changes
- cognitive decrement
- slurred speech
- and/or clumsiness

...labeled them "punch drunk"
or "slug nutty."

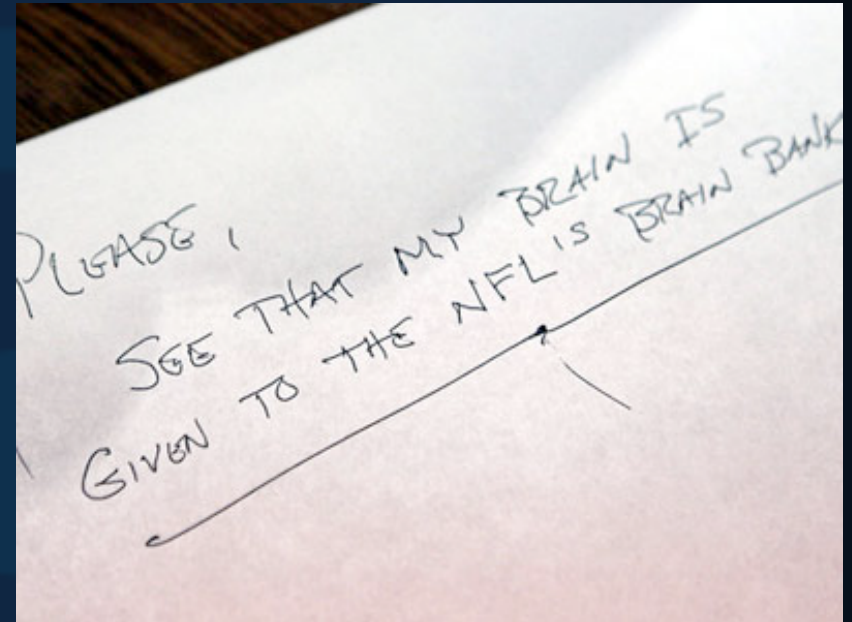
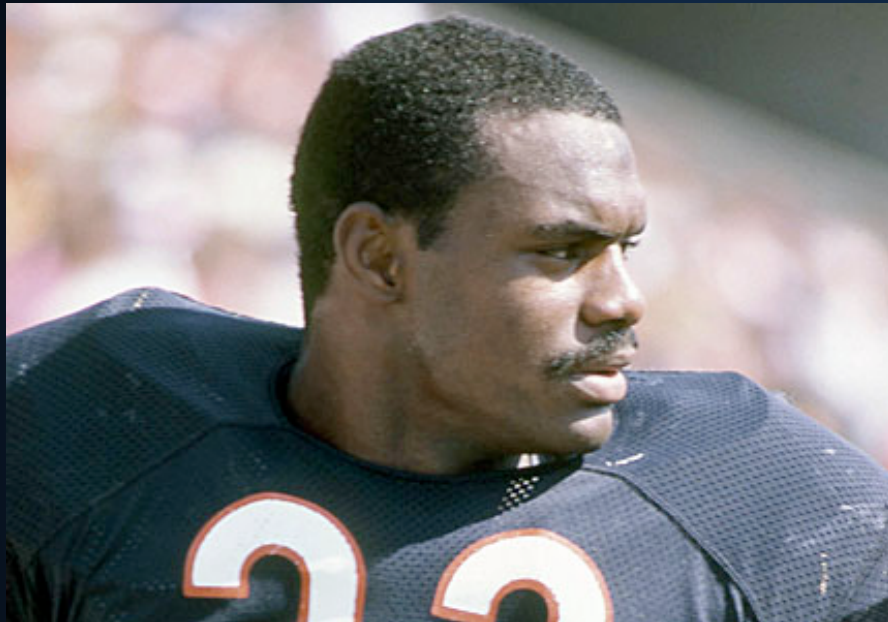




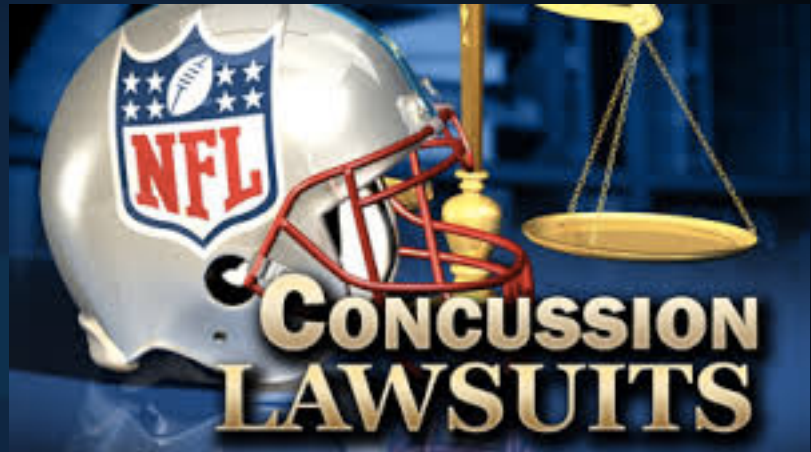
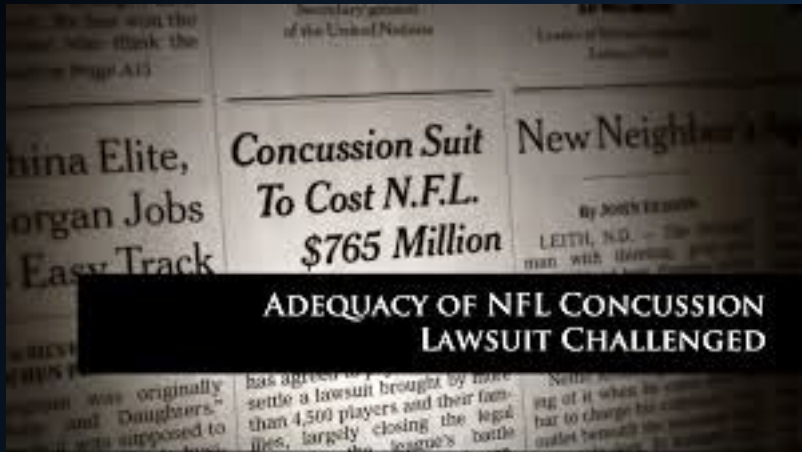








Dave Duerson
1960-2011



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Kyros Law Group



Wade Belak
1976-2011



Rick Rypien
1984-2011



Todd Ewen
1966-2015

HOCKEY

Autopsy Shows the N.H.L.'s Todd Ewen Did Not Have C.T.E.

By JOHN BRANCH FEB. 10, 2016



When the former N.H.L. enforcer Todd Ewen died in September, reportedly of a self-inflicted gunshot, his brain was sent to researchers. Years of memory loss and undiagnosed depression led to speculation that Ewen, 49, had chronic traumatic encephalopathy, a degenerative brain disease caused by repeated blows to the head.

On Wednesday, researchers in Toronto announced that Ewen did not have C.T.E., upending presumptions about the disease

BASED ON A TRUE STORY

CONCUSSION
CHRISTMAS

The Patient's Perspective

1. Concussion: days to weeks
2. Post Concussion Syndrome: months to years
3. Long-term brain health: lifetime



TSNC Approach to Athlete Brain Health



“Baseline Testing”

- Great concept to measure brain function prior to an injury...easy to do?
- Results should be useful to the provider managing the concussion
- Testing should augment the neurologic history and exam

The Neuro PPE

Neurologic history:

- Recurrent symptoms
- Relevant comorbidities
- Brain trauma history
- Family history

Neurologic physical exam:

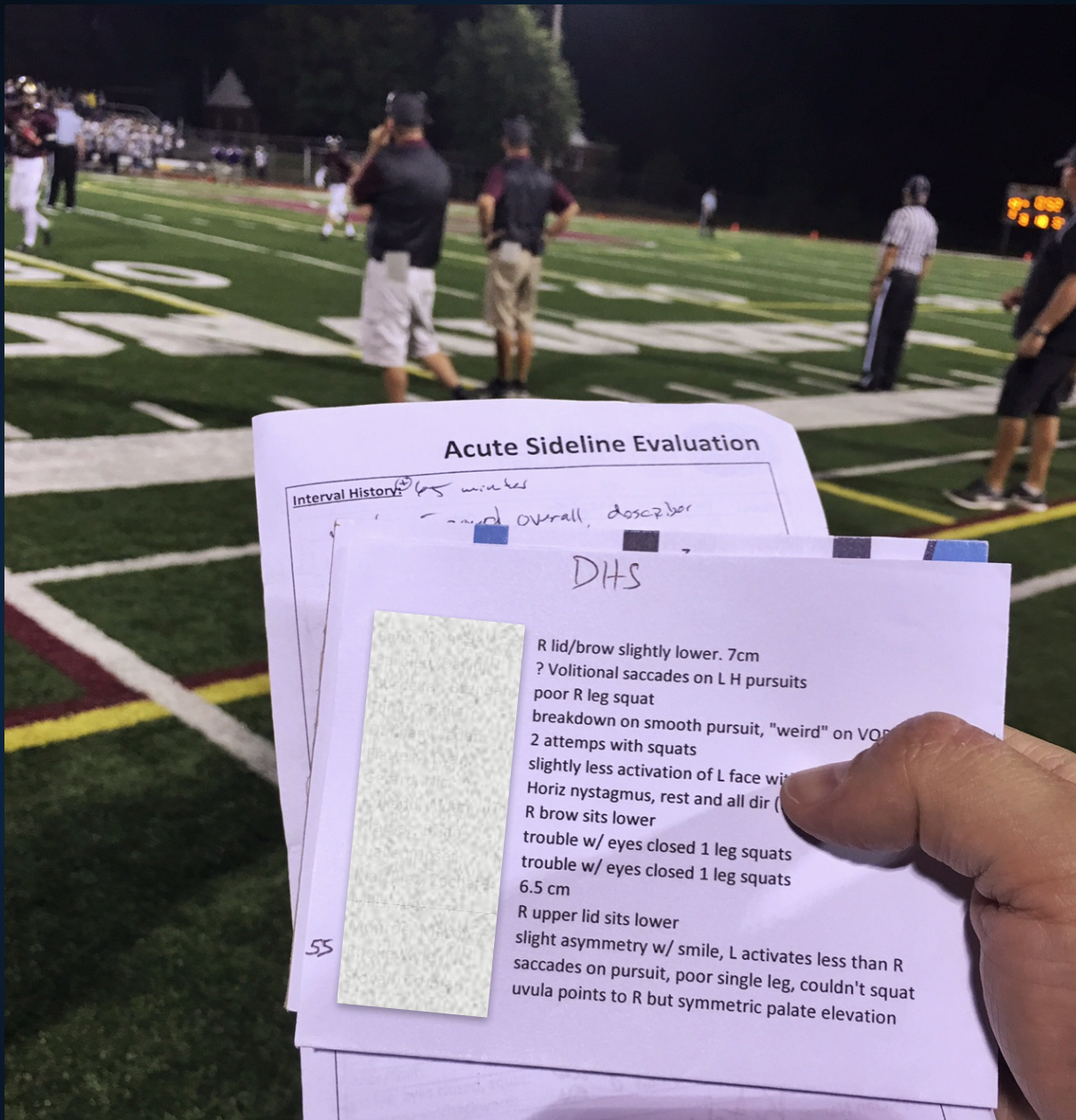
- Screening neurologic exam
- Focused concussion exam
- Supplementary tests



Neurological Physical Examination

Cranial Nerves			
<input type="checkbox"/> face symmetric <input type="checkbox"/> sensation intact <input type="checkbox"/> hearing intact (finger rub) <input type="checkbox"/> palate symmetric <input type="checkbox"/> tongue symmetric <input type="checkbox"/> shoulder shrug normal			
Abnormalities:			
Eyes/Vision			
Pupils: <input type="checkbox"/> equal, round, reactive to light		Abnormalities:	
Visual Fields: <input type="checkbox"/> finger counting normal		Abnormalities:	
Eye Movements			Abnormalities
Smooth pursuit	H pattern	<input type="checkbox"/> Normal movements <input type="checkbox"/> No symptoms	
Saccades	horizontal and vertical	<input type="checkbox"/> Normal movements <input type="checkbox"/> No symptoms	
Convergence (to nearest point in cm)	Trial 1 _____ Trial 2 _____ Trial 3 _____	<input type="checkbox"/> Normal movements <input type="checkbox"/> No symptoms	
Vestibular Ocular Reflex (VOR)	horizontal and vertical	<input type="checkbox"/> Normal movements <input type="checkbox"/> No symptoms	
Visual Motion Sensitivity	(VOR suppression)	<input type="checkbox"/> Normal movements <input type="checkbox"/> No symptoms	
Motor and Coordination			
Proximal and Distal Strength (4 extremities): <input type="checkbox"/> 5/5 strength		Abnormalities:	
Finger-to-Nose: <input type="checkbox"/> no <u>dysmetria</u> or <u>dyscoordination</u>		Abnormalities:	
Proprioception and Vestibular			
Romberg: <input type="checkbox"/> no step or excessive sway		Abnormalities:	
Fakuda: <input type="checkbox"/> less than 30° turn, no missteps		Abnormalities:	
Balance and Gait (optional, use if SCAT-3 balance testing is abnormal or unclear)			
Single Leg Stance (eyes closed +/- partial squat): <input type="checkbox"/> normal		Abnormalities:	
Tandem Walk (forwards and backwards): <input type="checkbox"/> normal		Abnormalities:	





Acute Sideline Evaluation

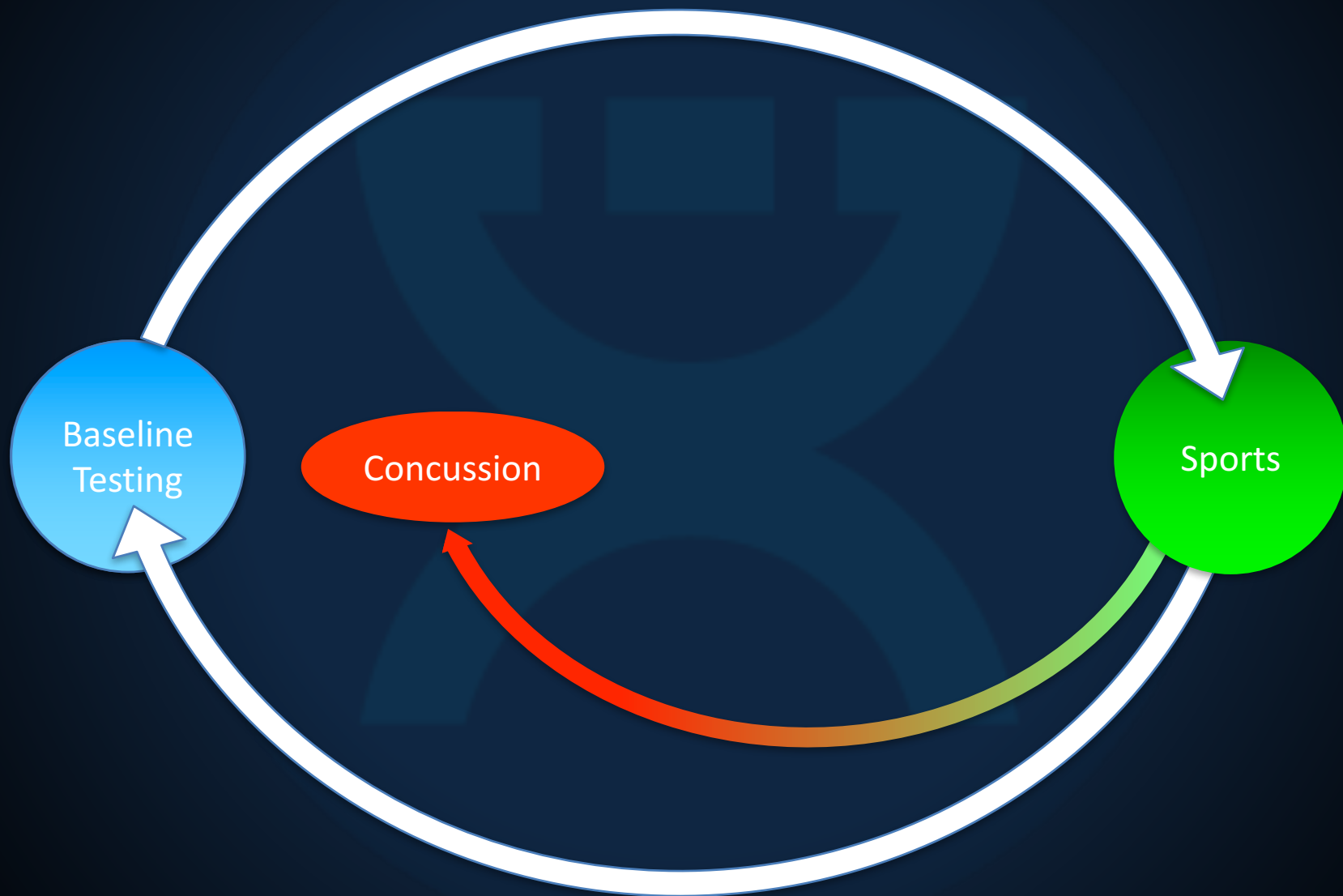
Interval History: 105 minutes
normal overall, describe

DHS

55

R lid/brow slightly lower. 7cm
? Volitional saccades on L H pursuits
poor R leg squat
breakdown on smooth pursuit, "weird" on VOF
2 attempts with squats
slightly less activation of L face with
Horiz nystagmus, rest and all dir ()
R brow sits lower
trouble w/ eyes closed 1 leg squats
trouble w/ eyes closed 1 leg squats
6.5 cm
R upper lid sits lower
slight asymmetry w/ smile, L activates less than R
saccades on pursuit, poor single leg, couldn't squat
uvula points to R but symmetric palate elevation

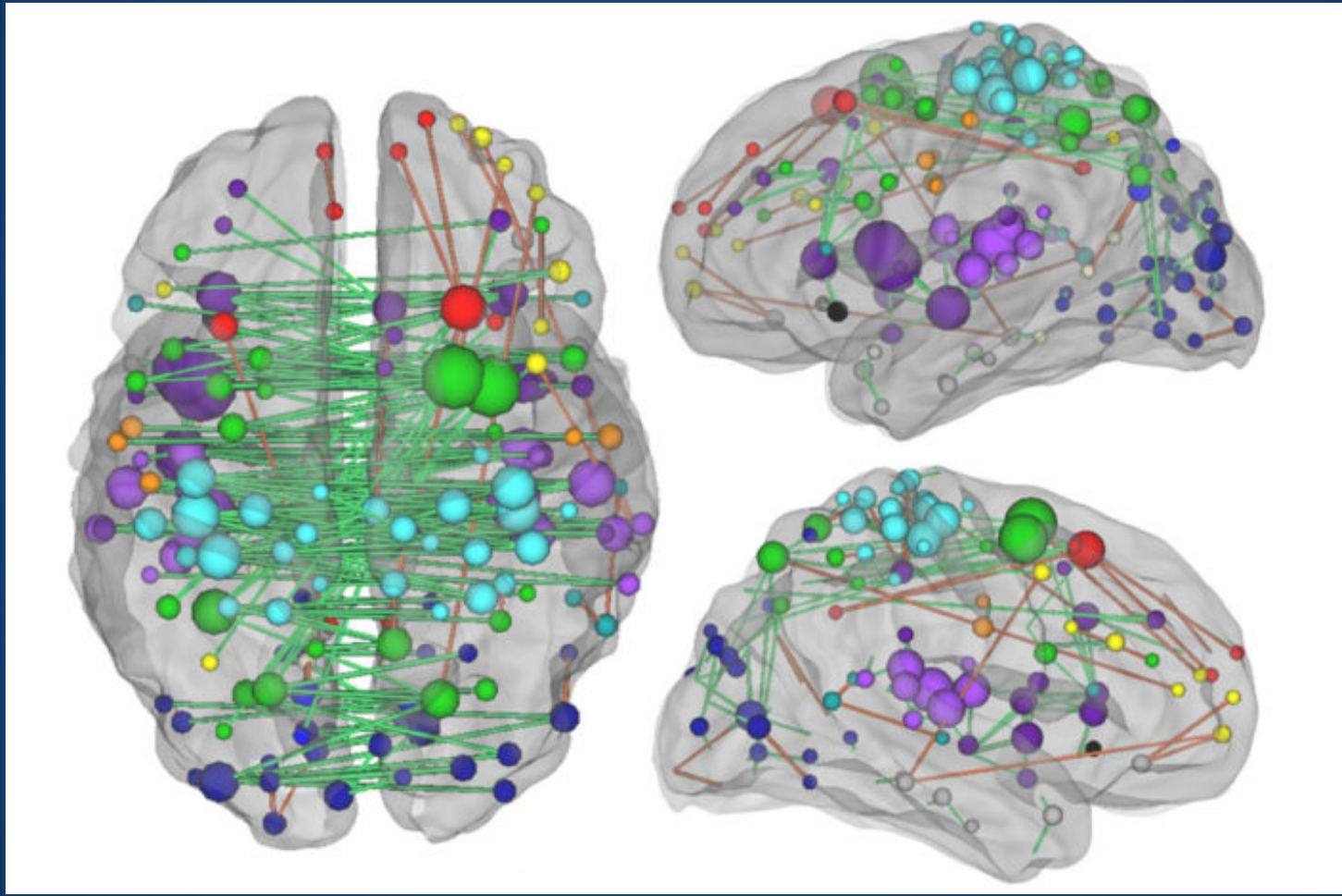
TSNC Approach to Athlete Brain Health



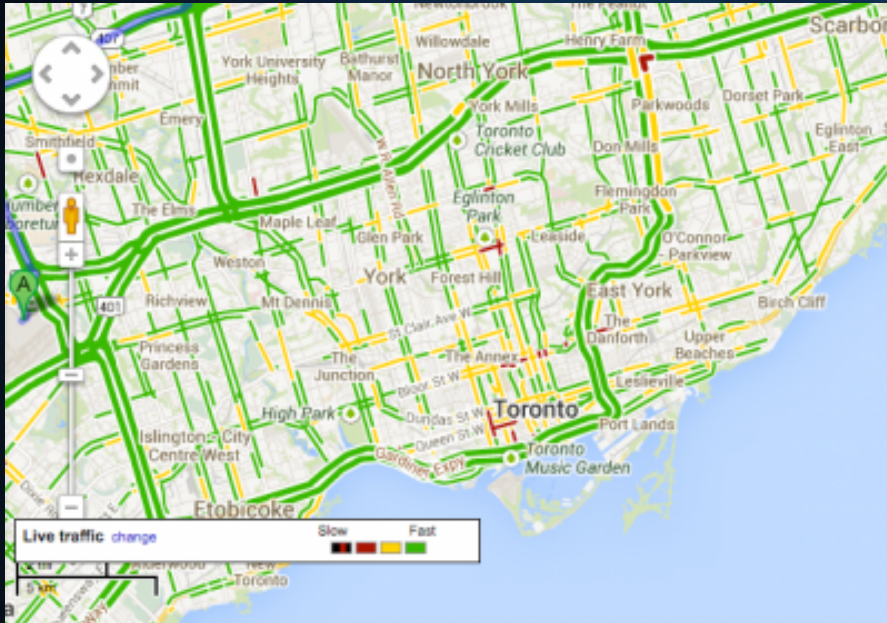
Concussion: Three tricky bits

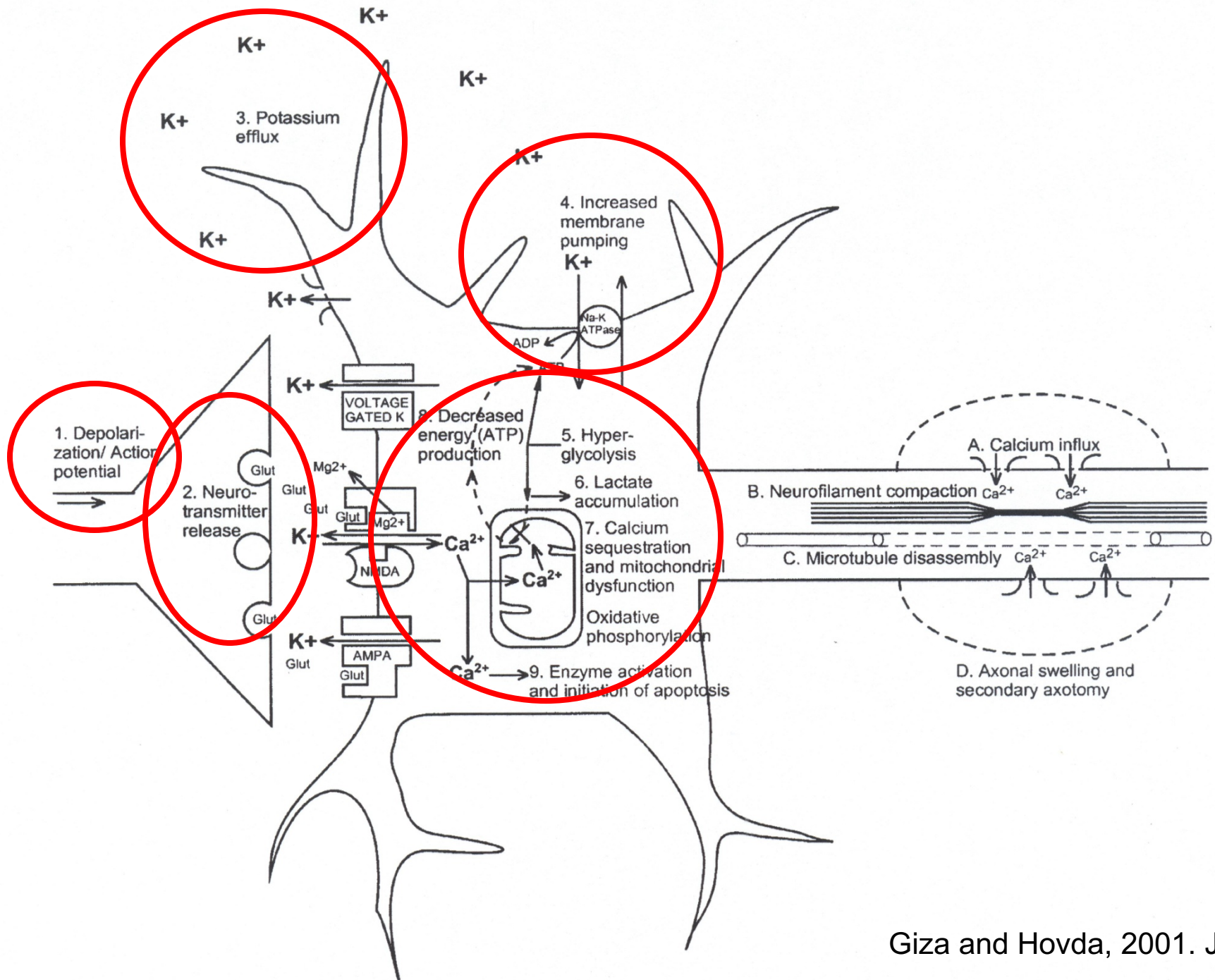
- ⊗ Not all brain pathology causes a clinical syndrome
- ⊗ Not every clinical effect seen after a hit is due to concussion
- ⊗ If concussed, some symptoms may still be from something else

Concussion is a Network Injury



Cross Town Traffic





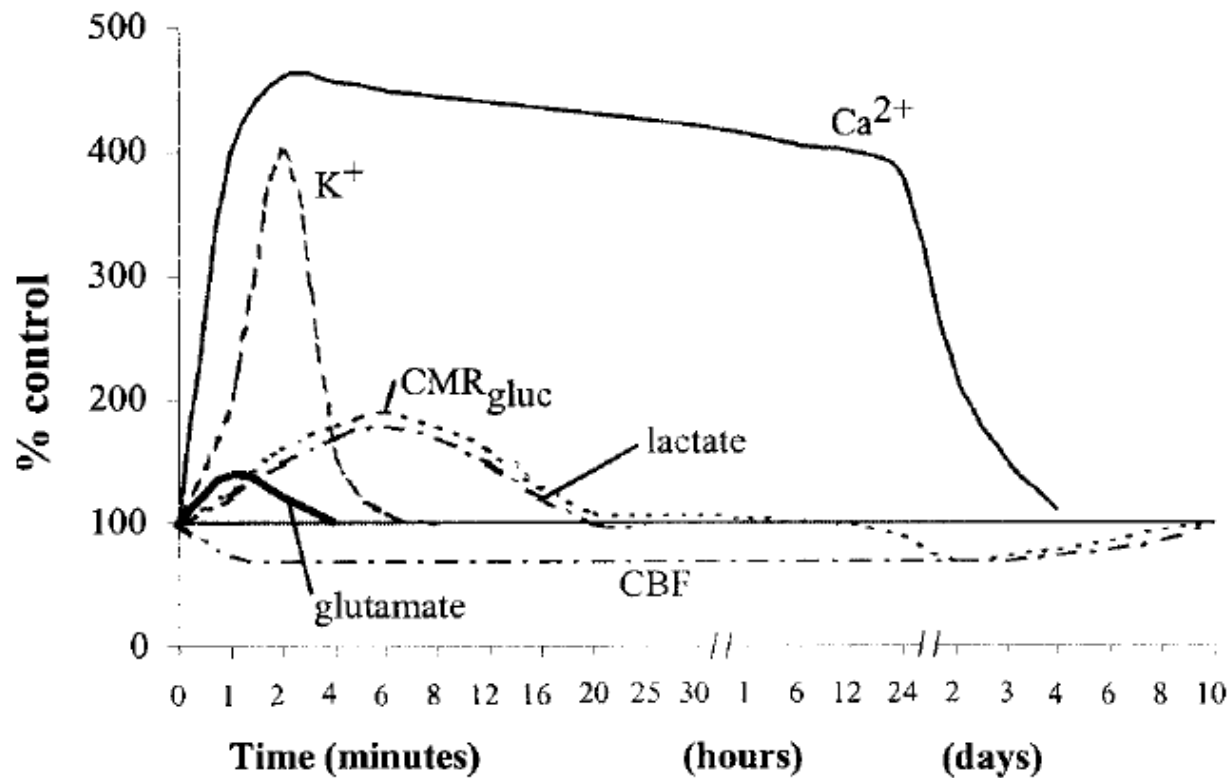


Figure 1. Neurometabolic cascade following experimental concussion. K⁺, potassium; Ca²⁺, calcium; CMR_{gluc}, oxidative glucose metabolism; CBF, cerebral blood flow. (Reprinted with permission. Giza CC, Hovda DA. Ionic and metabolic consequences of concussion. In: Cantu RC, Cantu RI. *Neurologic Athletic and Spine Injuries*. St Louis, MO: WB Saunders Co; 2000:80–100.).

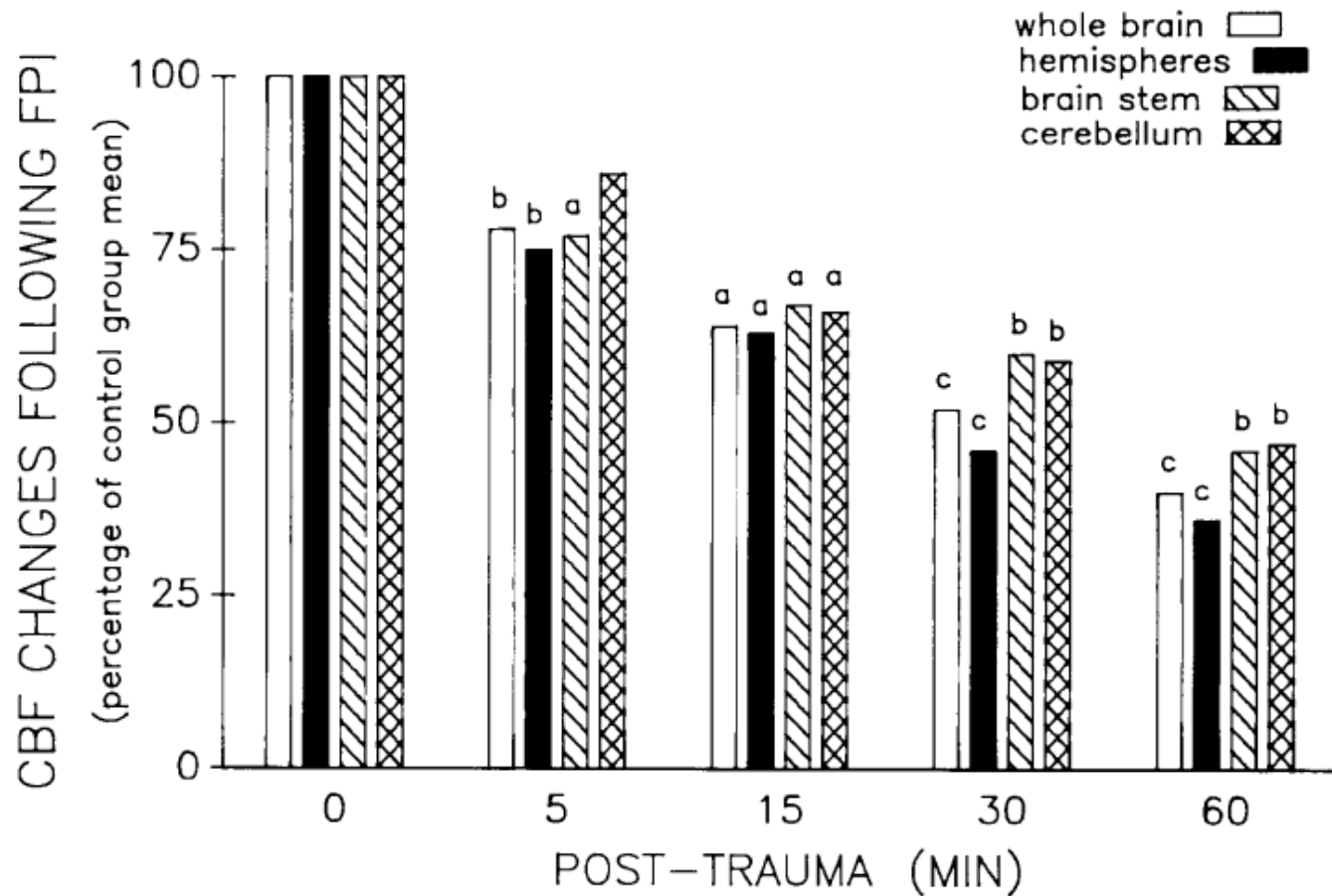
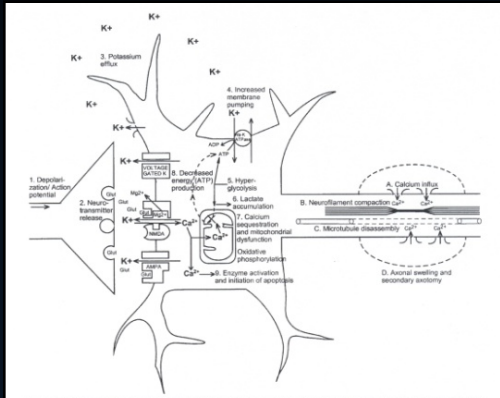


FIG. 3. Cerebral blood flow changes over time after fluid percussion injury (FPI, 2.47 ± 0.08 atm). Values are expressed as percentage of CBF values in uninjured group for each brain region and time. Statistical comparisons were made between mean values for control and injured groups. a, $p < 0.05$; b, $p < 0.01$; c, $p < 0.001$.



Increased energy demand



Decreased energy supply

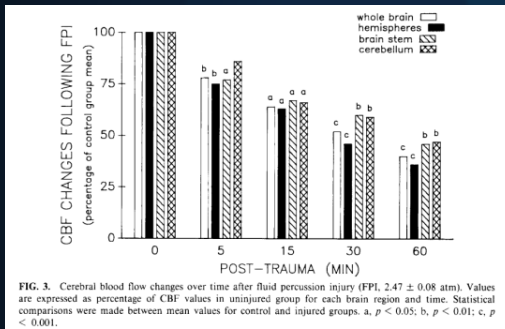
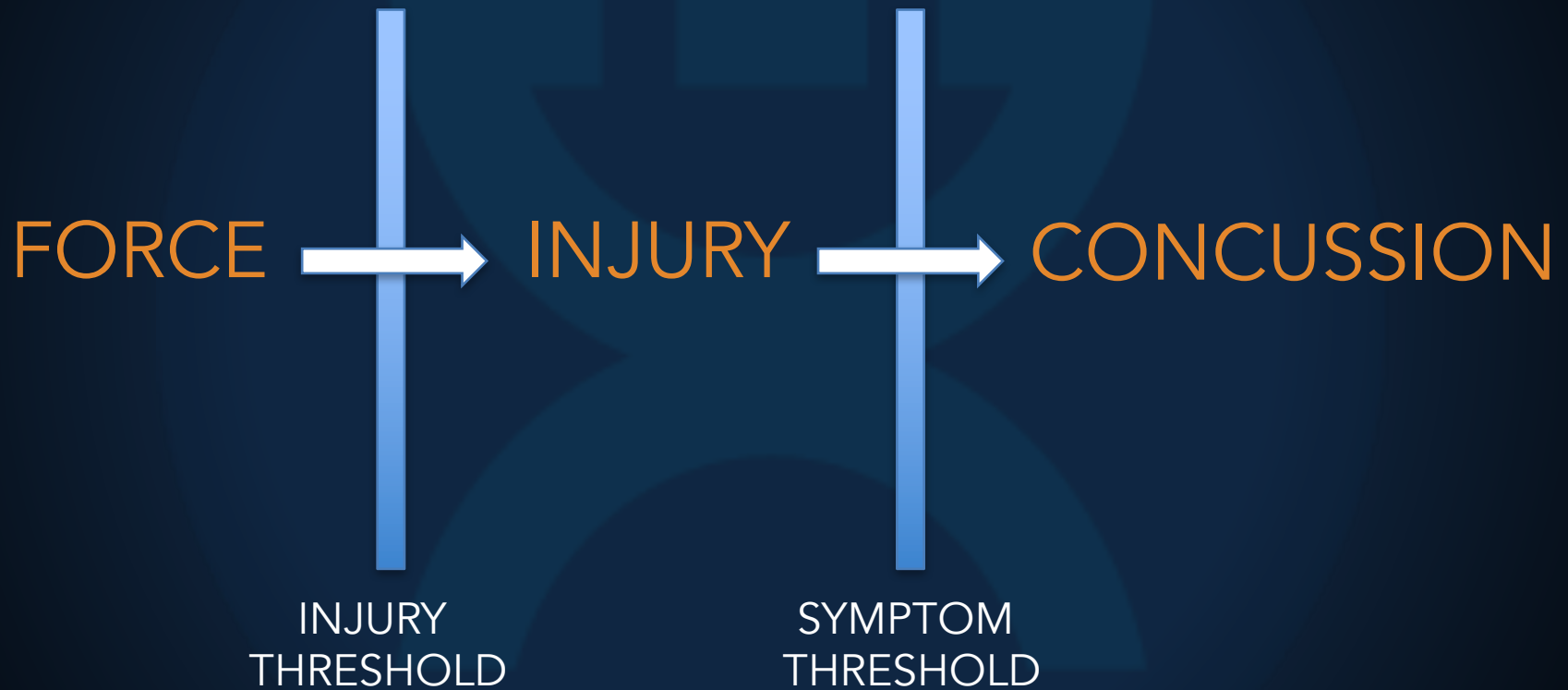


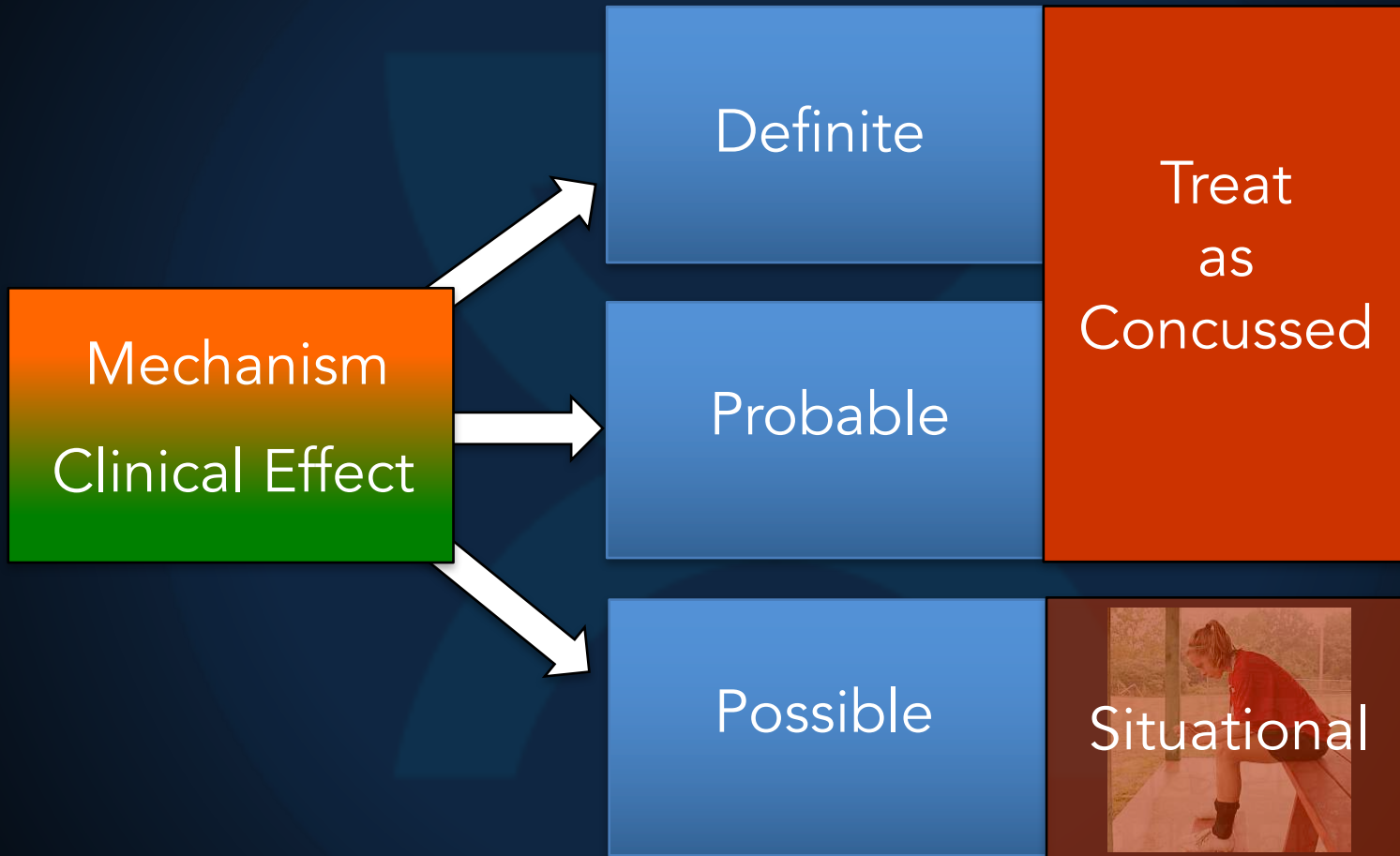
FIG. 3. Cerebral blood flow changes over time after fluid percussion injury (FPI, 2.47 ± 0.08 atm). Values are expressed as percentage of CBF values in uninjured group for each brain region and time. Statistical comparisons were made between mean values for control and injured groups. a, $p < 0.05$; b, $p < 0.01$; c, $p < 0.001$.

ENERGY CRISIS: *Neuronal Dysfunction*

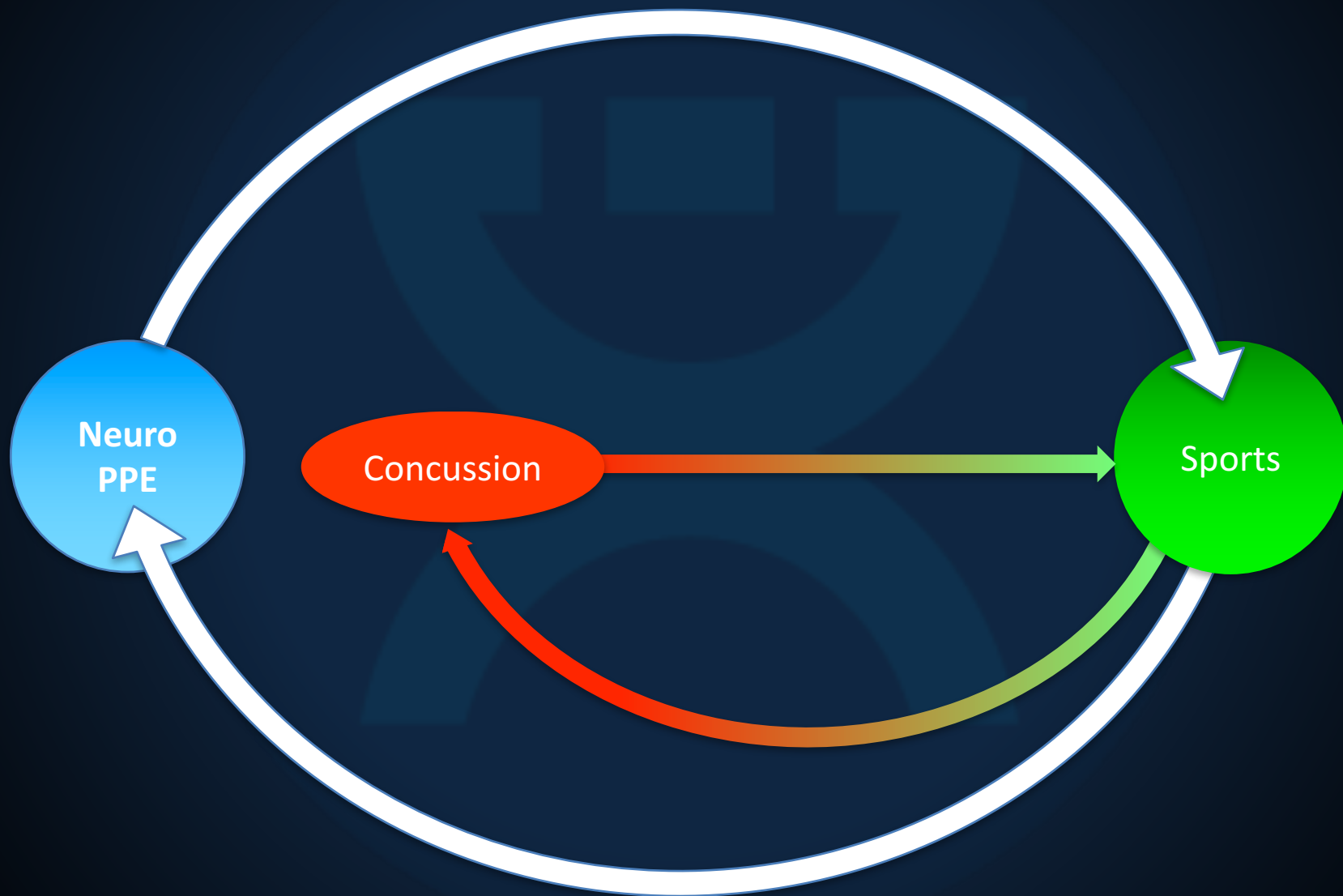
A Tale of Two Thresholds



Concussion Diagnosis

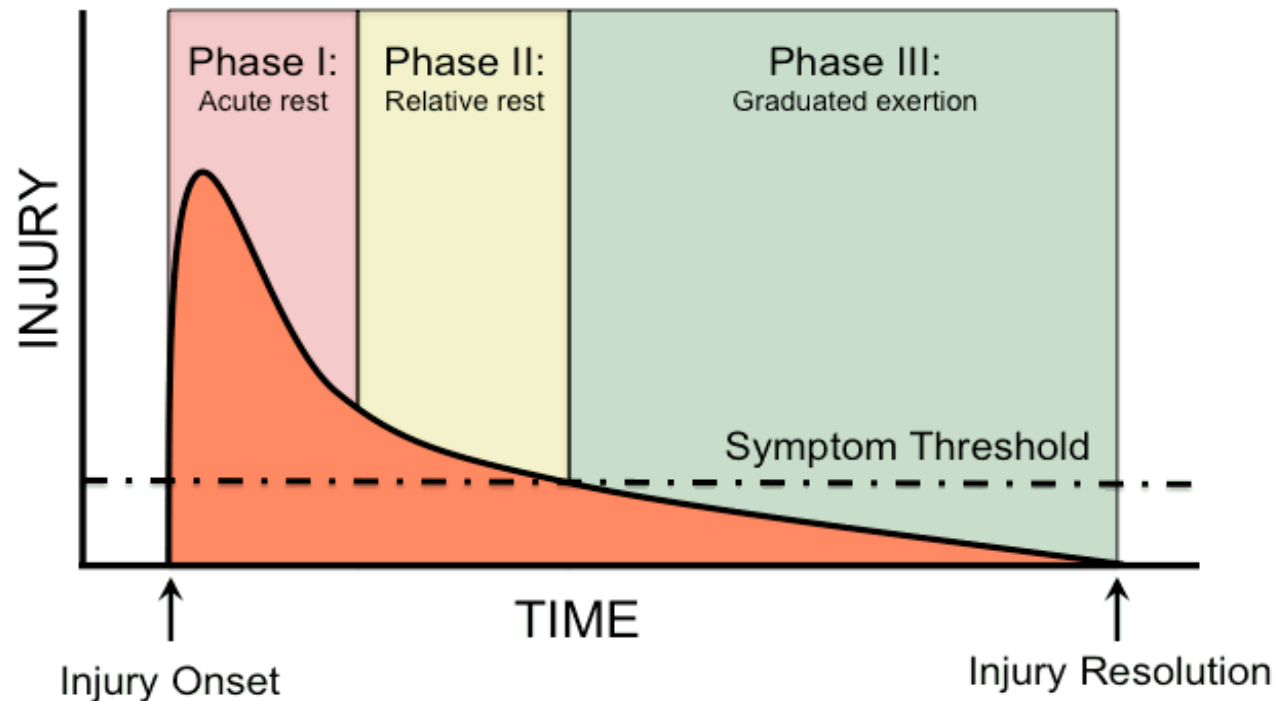


TSNC Approach to Athlete Brain Health



Concussion Management

Figure 2: Three phases of concussion management



The Symptom Checklist

SYMPTOM EVALUATION

3 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
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

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? Y N

Do the symptoms get worse with mental activity? Y N

self rated self rated and clinician monitored

clinician interview self rated with parent input

Overall rating: If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?

Please circle one response:

no different very different unsure N/A

VS.

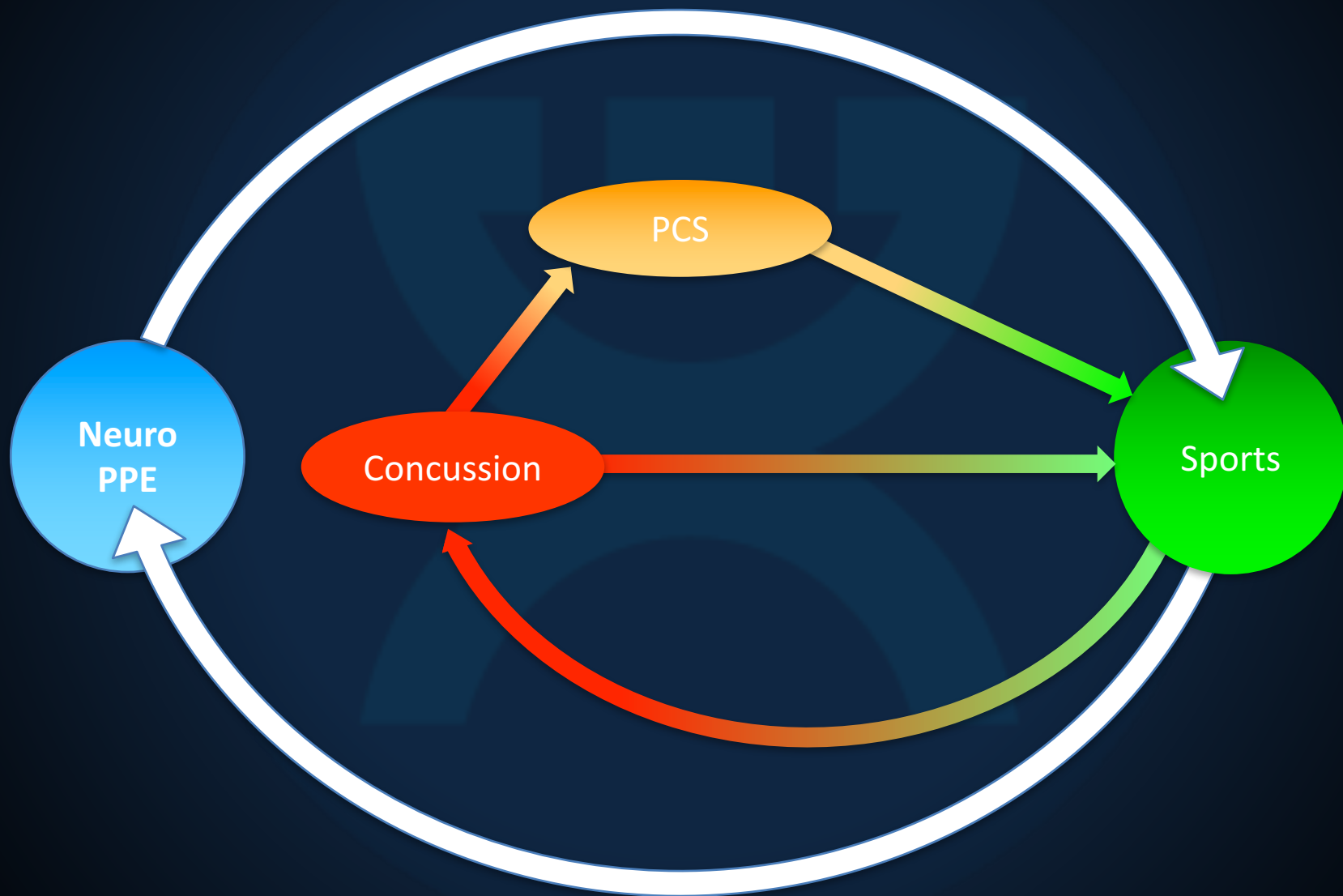
TSNC Clinical Symptom Scale

Level I: Have to stop and think about it

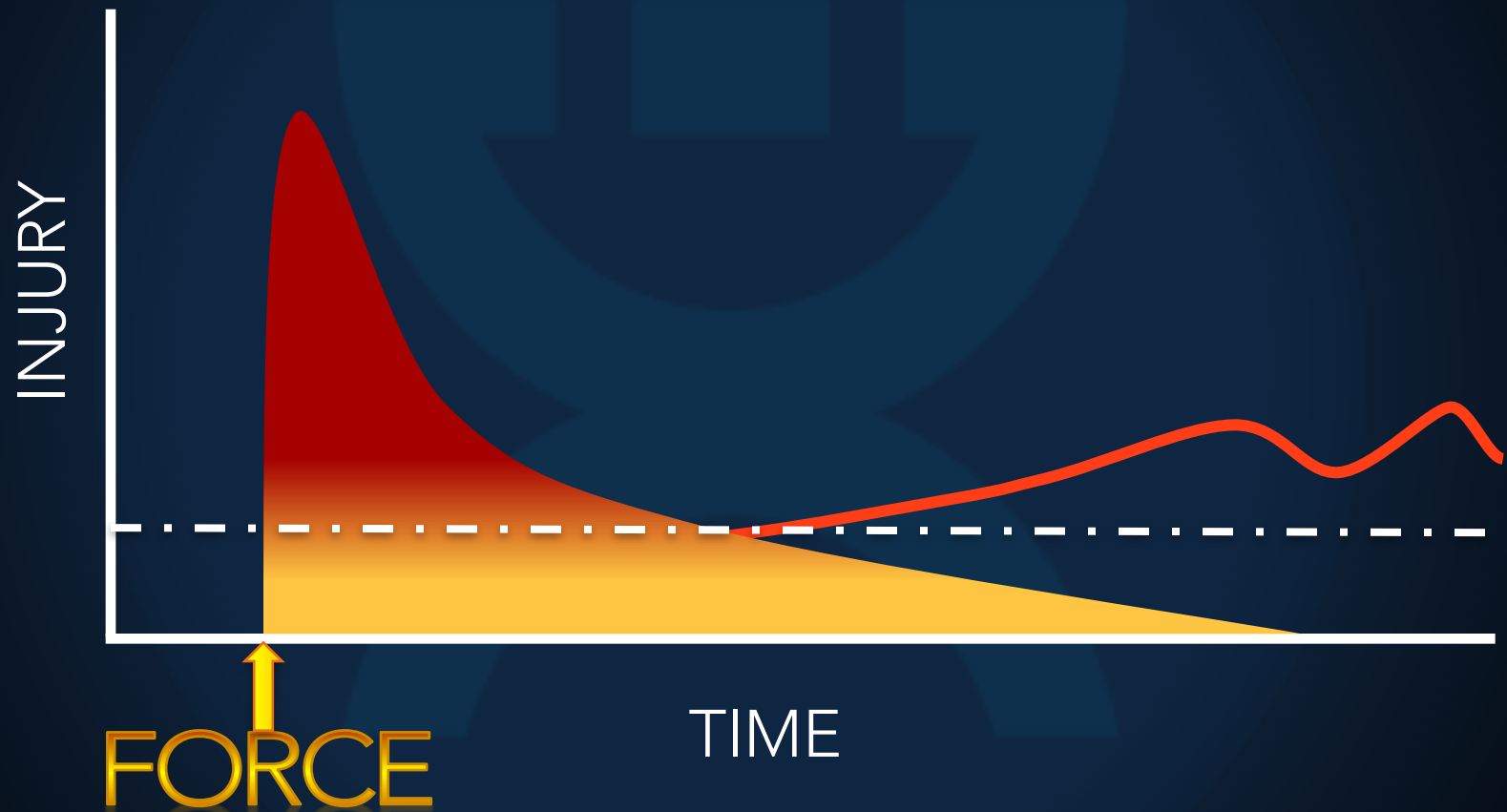
Level II: Always there, does not interfere with function

Level III: Interferes with function

TSNC Approach to Athlete Brain Health



Concussion vs. PCS



Post Concussion Syndrome

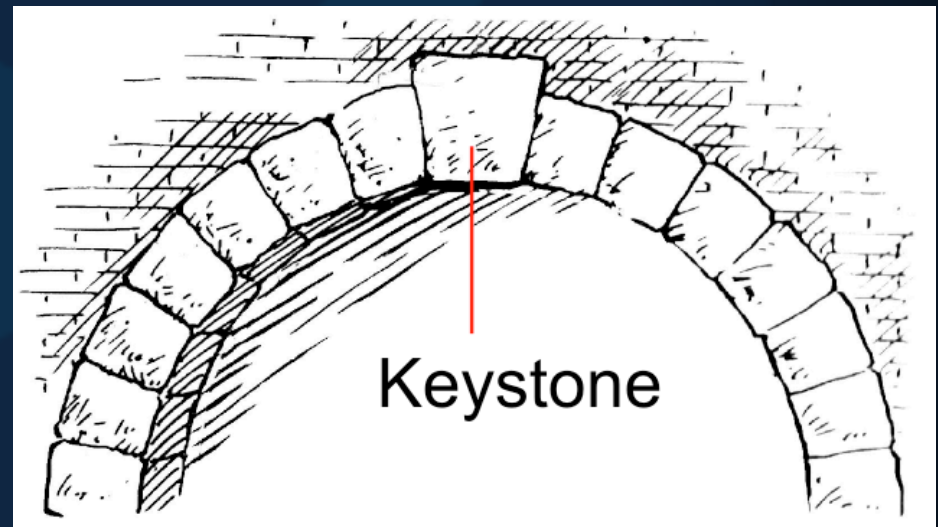
Take a history, make a list...

- Unplugged Syndrome
- Migraine
- Mood
- Sleep
- Neck
- ADHD
- etc...

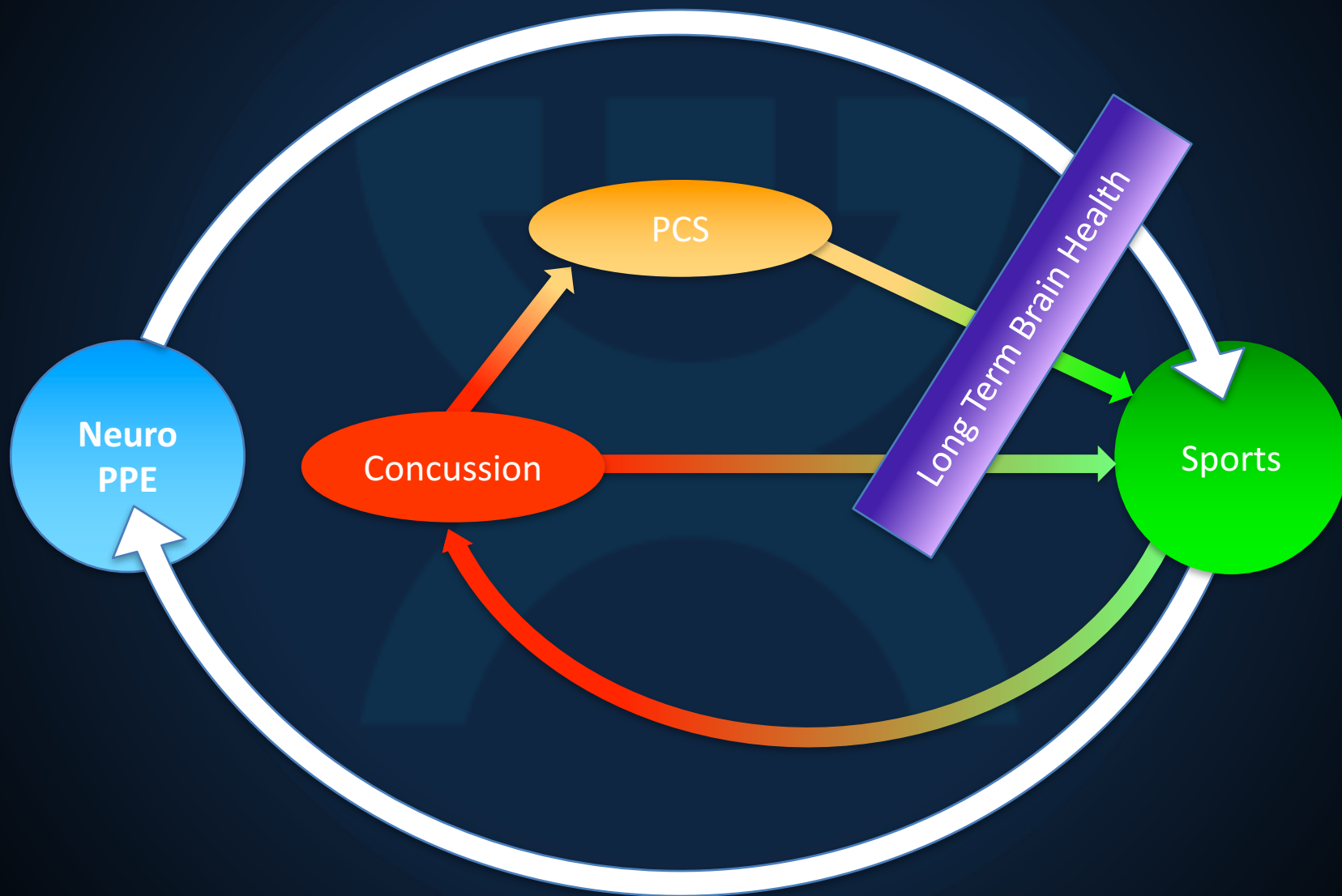


Post Concussion Syndrome

Identify *lodestone* vs. *keystone* problems...



TSNC Approach to Athlete Brain Health

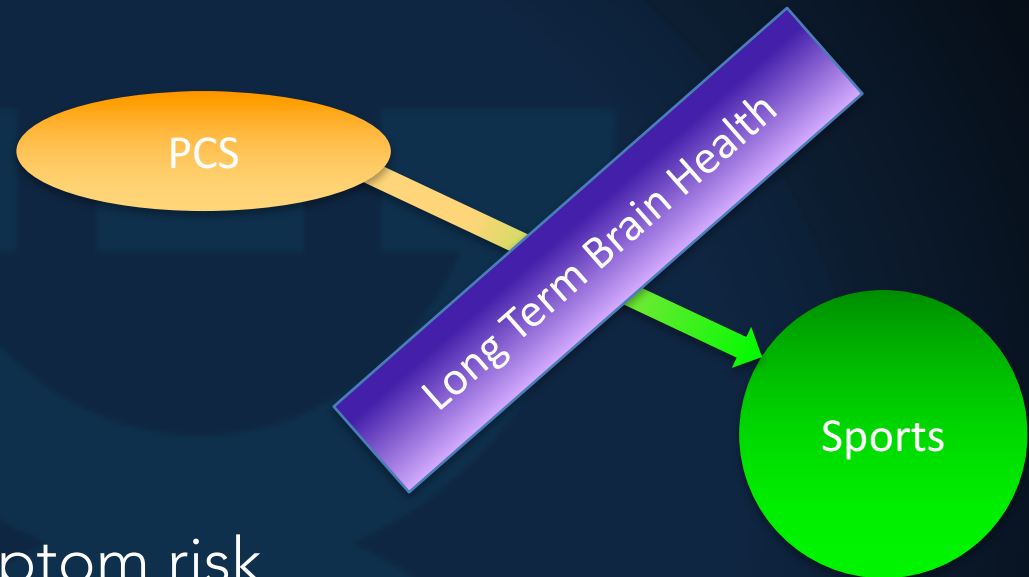


Concussion RTP and Long-Term Brain Health



- Review entire history of brain trauma
- Identify potential modifiers of RTP process
- Assess “background” brain health
- Re-educate

Return from PCS and Long-Term Brain Health



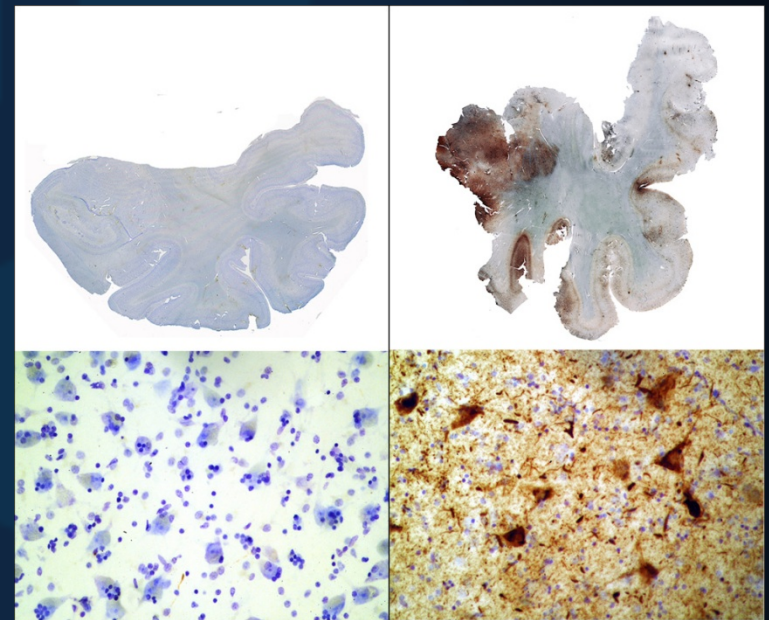
- Assess chronic symptom risk
- Discuss quality of life
- Revisit sports' "health quotient"
- Identify behavior modifications that may help

Annual Neuro PPE and Long-Term Brain Health



Chronic Traumatic Encephalopathy

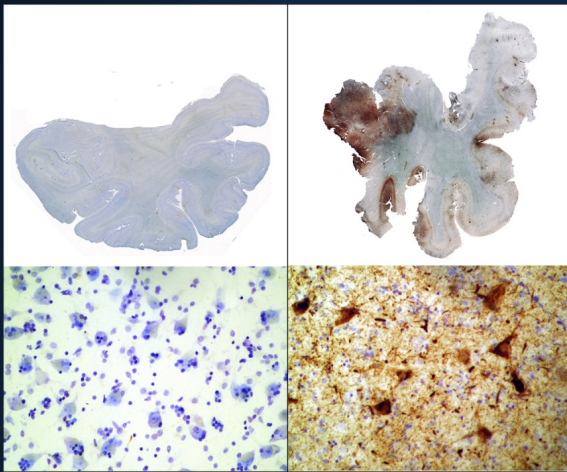
- Tau protein deposition, like Alzheimer's Disease, but in different locations
- Presumed to be from repeated contact
- Unclear clinical effects



NORMAL

CTE

CTE vs. TES



VS.



CTE:
Pathological finding
Tissue diagnosis

Traumatic
Encephalopathy
Syndrome

Evaluation/Management of TES

- Identify all contributing symptom generators
- Treat them!
- Look for clear neurodegenerative diagnoses
- Treat them too!

Review

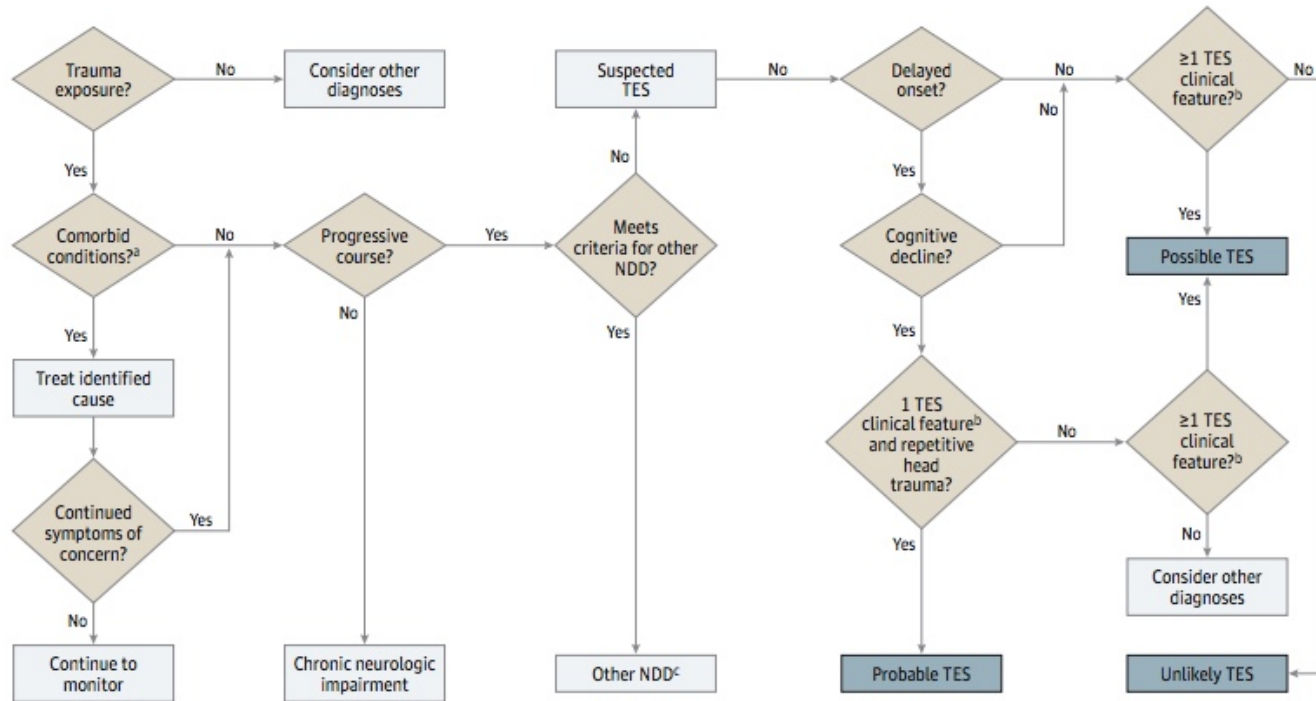
A Clinical Approach to the Diagnosis of Traumatic Encephalopathy Syndrome A Review

Nicole Reams, MD; James T. Eckner, MD, MS; Andrea A. Almeida, MD; Andrea L. Agesen, DO;
Bruno Giordani, PhD; Hank Paulson, MD; Matthew T. Lorincz, MD, PhD; Jeffrey S. Kutcher, MD

JAMA Neurol. 2016;73(6):743-749. doi:10.1001/jamaneurol.2015.5015

Evaluation/Management of TES

Figure. Initial Clinical Approach to the Patient With Neurocognitive Problems and Possible Traumatic Encephalopathy Syndrome (TES)



This model includes patients with a duration of neurocognitive problems for longer than 2 years. For a patient to be considered for a diagnosis of TES, the neurocognitive complaints or decline must be beyond the expected course given the individual's age and other medical issues. This flowchart is intended to provide a framework for the practicing physician; clinical judgment and assessment remain a necessary aspect of the diagnostic pathway. NDD indicates neurodegenerative disease.

^a Includes obstructive sleep apnea, migraine, mood disorder, substance abuse, medication effect, and "worried well" (ie, individuals who do not have a medical disorder but may visit a physician owing to psychological distress or need for reassurance).

^b Include emotional dysregulation, behavioral change, or motor disturbance.

^c Consider trauma-accelerated NDD vs typical NDD.

Sport Concussion and Suicide

HOME PAGE TODAY'S PAPER VIDEO MOST POPULAR TIMES TOPICS Su

The New York Times

Sports

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION AS

BASEBALL N.F.L. COLLEGE FOOTBALL N.B.A. COLLEGE BASKETBALL HOCKEY SOCCER GO

Suicide Reveals Signs of a Disease Seen in N.F.L.

By ALAN SCHWARZ
Published: September 13, 2010

ALLENTOWN, Pa. — A brain autopsy of a [University of Pennsylvania](#) football player who killed himself in April has revealed the same trauma-induced disease found in more than 20 deceased [National Football League](#) players, raising questions of how young football players may be at risk for the disease.

[Enlarge This Image](#)



Owen Thomas, a popular 6-foot-2, 240-pound junior lineman for Penn with no previous history of depression, [hanged himself](#) in his off-campus apartment after what friends and family have described as a sudden and uncharacteristic emotional collapse. Doctors at [Boston University](#) subsequently received permission from the family to examine Thomas's brain tissue and discovered early stages of chronic traumatic encephalopathy, [a disease linked to depression and impulse control](#) primarily among N.F.L. players, two of whom also committed suicide in the last 10 years.

Doctors in the Boston University group and outside it cautioned that Thomas's suicide should not be attributed solely or even primarily to the damage in his brain, given

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Descendants

Parents seek answers for son's concussion, suicide

PUBLISHED Tuesday, Aug 30, 2011 at 5:21 pm EDT

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Associated Press

Text size [A](#) [A](#) [A](#)

NOKESVILLE, Va. — Austin Trenum's bed remains half-made, the way a typical teenager would leave it. On a shelf is his scarred black helmet, the one he was wearing when he tackled the quarterback near the sidelines during Brentsville High's game against Handley some 11 months ago. Austin's mouthpiece remains tucked neatly in the face mask, ready to be taken out for the next play.

For Austin, there was no next play.

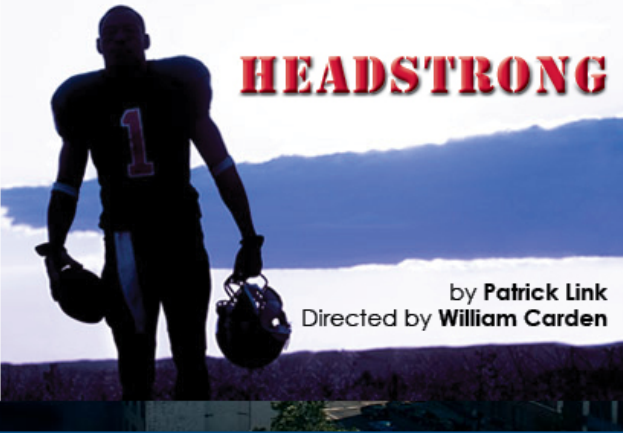


Sport Concussion and Suicide

The Ensemble Studio Theatre

Now Playing / Current Productions /
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- Current Productions
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 - Memberfest
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HEADSTRONG

by Patrick Link
Directed by William Carden

EST/Sloan presents HEADSTRONG

Dates: April 18 - May 13
Wednesday - Monday @ 7pm, Saturdays @ 2pm & 7pm, Sundays @ 5pm
Sunday, May 6 @ 7pm

Sport Concussion and Suicide

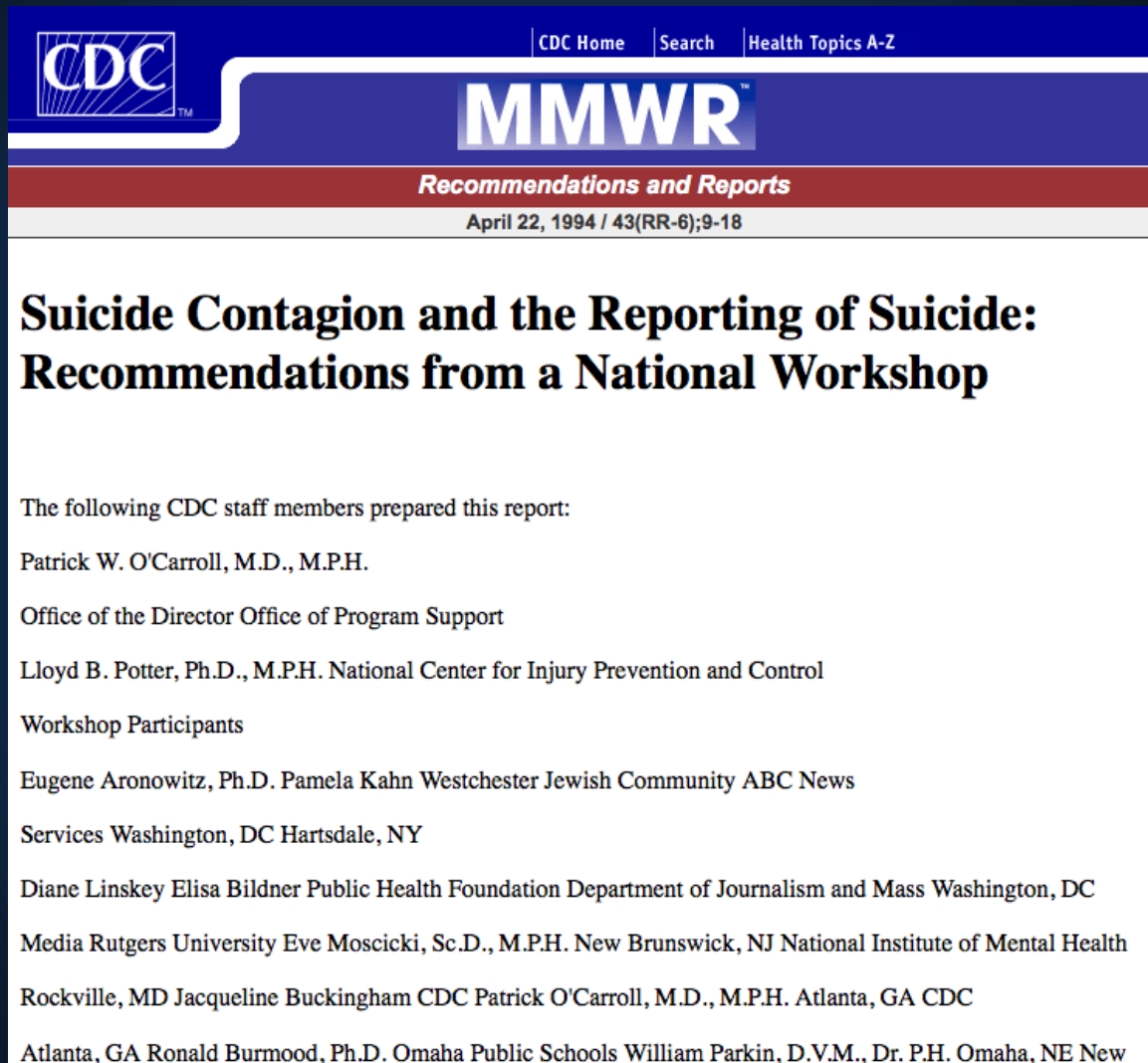


Jeremy Shockey (Getty Images)

"The no it all Rog goodell [sic] lied to every player and told us concussions will not effect us in life that a LIE!"

"Science tells me I'll be dead time in 54yrs old!! What would U do?"

Sport Concussion and Suicide



The screenshot shows the top portion of a CDC MMWR report. The header includes the CDC logo, navigation links for 'CDC Home', 'Search', and 'Health Topics A-Z', and the 'MMWR' logo. Below this is a red banner with the text 'Recommendations and Reports' and the date 'April 22, 1994 / 43(RR-6);9-18'. The main title of the report is 'Suicide Contagion and the Reporting of Suicide: Recommendations from a National Workshop'. The text below the title lists the CDC staff members who prepared the report, followed by workshop participants from various organizations and locations.

CDC Home | Search | Health Topics A-Z

MMWR

Recommendations and Reports

April 22, 1994 / 43(RR-6);9-18

Suicide Contagion and the Reporting of Suicide: Recommendations from a National Workshop

The following CDC staff members prepared this report:

Patrick W. O'Carroll, M.D., M.P.H.

Office of the Director Office of Program Support

Lloyd B. Potter, Ph.D., M.P.H. National Center for Injury Prevention and Control

Workshop Participants

Eugene Aronowitz, Ph.D. Pamela Kahn Westchester Jewish Community ABC News
Services Washington, DC Hartsdale, NY

Diane Linskey Elisa Bildner Public Health Foundation Department of Journalism and Mass Washington, DC

Media Rutgers University Eve Moscicki, Sc.D., M.P.H. New Brunswick, NJ National Institute of Mental Health
Rockville, MD Jacqueline Buckingham CDC Patrick O'Carroll, M.D., M.P.H. Atlanta, GA CDC

Atlanta, GA Ronald Burmood, Ph.D. Omaha Public Schools William Parkin, D.V.M., Dr. P.H. Omaha, NE New

Sport Concussion and Suicide

“All parties should understand that a scientific basis exists for concern that news coverage of suicide may contribute to the causation of suicide.”

Things that promote suicide:

- Presenting simplistic explanations for suicide
- Engaging in repetitive, ongoing or excessive reporting
- Providing sensational coverage of suicide
- Glorifying persons who commit suicide
- Focusing on the suicide completer's positive characteristics

Sport Concussion and Suicide

The
American Journal
of
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[< Previous Article](#) **March 15, 2012** Volume 109, Issue 6, Pages 889–896 [Next Article >](#)

Body Mass Index, Playing Position, Race, and the Cardiovascular Mortality of Retired Professional Football Players

[Sherry L. Baron, MD](#)  , [Misty J. Hein, PhD](#), [Everett Lehman, MS](#), [Christine M. Gersic](#)

Received: September 1, 2011; Received in revised form: October 28, 2011; Accepted: October 28, 2011; Published Online: January 27, 2012

DOI: <http://dx.doi.org/10.1016/j.amjcard.2011.10.050>

Sport Concussion and Suicide

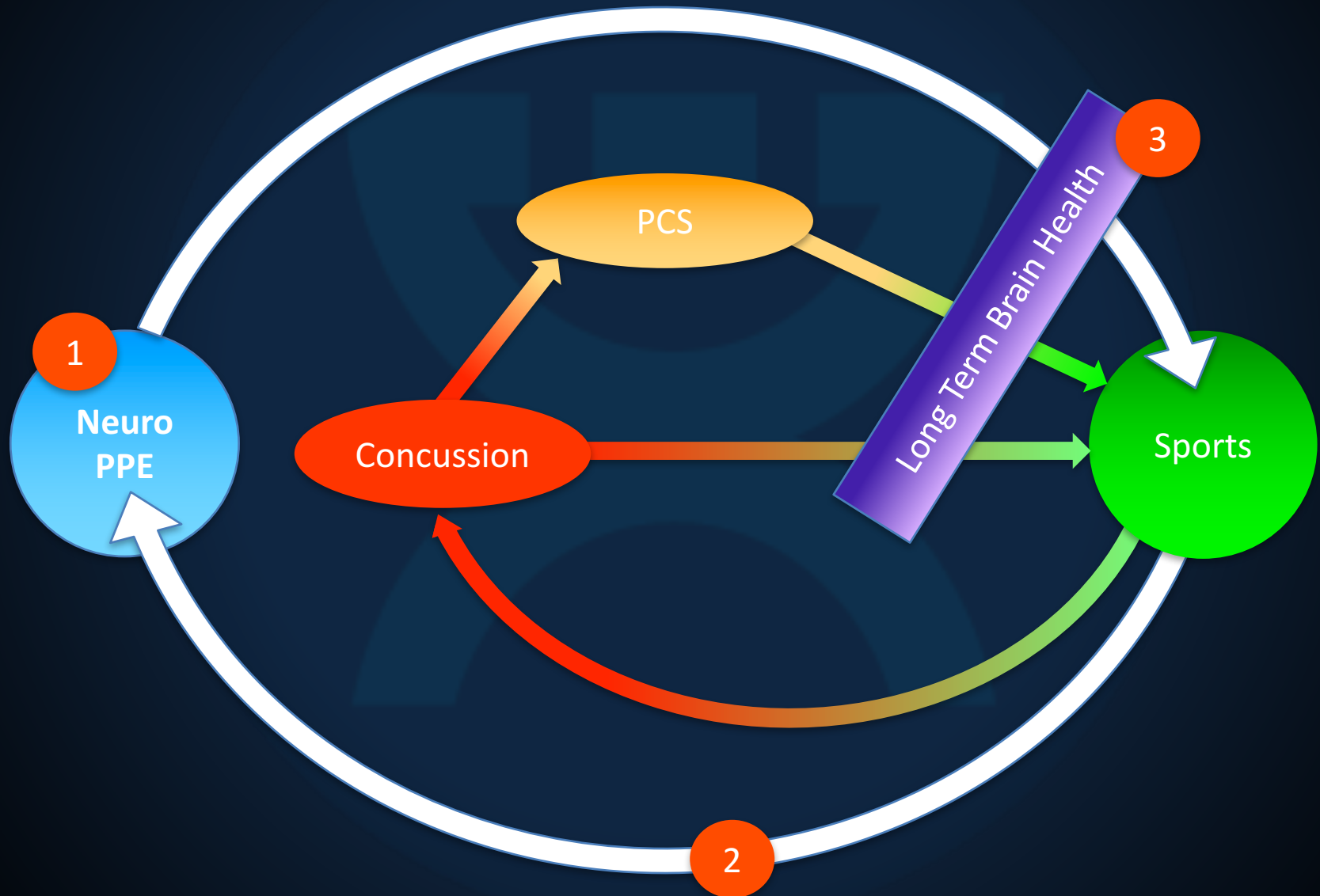
Transportation injuries	19	32.3	0.59	0.35–0.92
Falls	3	4.4	0.68	0.14–2.00
Other injury	19	28.2	0.67	0.41–1.05
Violence	13	48.3	0.27	0.14–0.46
Intentional self-harm	9	21.8	0.41	0.19–0.78
Assault and homicide	4	26.4	0.15	0.04–0.39
Other causes	9	21.1	0.43	0.19–0.81
Unknown cause of death	4	—	—	—

* International Classification of Diseases codes were mapped to cause-of-death categories as tabulated on the National Institute for Occupational Safety and Health Web site (<http://www.cdc.gov/niosh/ltras/rates.html>). Categories omitted because no deaths occurred include cancers of the buccal cavity and pharynx, cancers of the breast, benign and unspecified nature neoplasms, and diseases of the skin and subcutaneous tissue.

† United States referent rates.

<u>Observed</u>	<u>Expected</u>	<u>SMR</u>
9	21.8	0.41

Take Away Points:



Thank you for your time!



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@JeffKutcherMD