NOT ALWAYS A BUMP ON THE HEAD: CONCUSSIONS & TRAUMATIC BRAIN INJURIES

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Northeast **Rehab**

Spine • Sports • Neuro • Pain

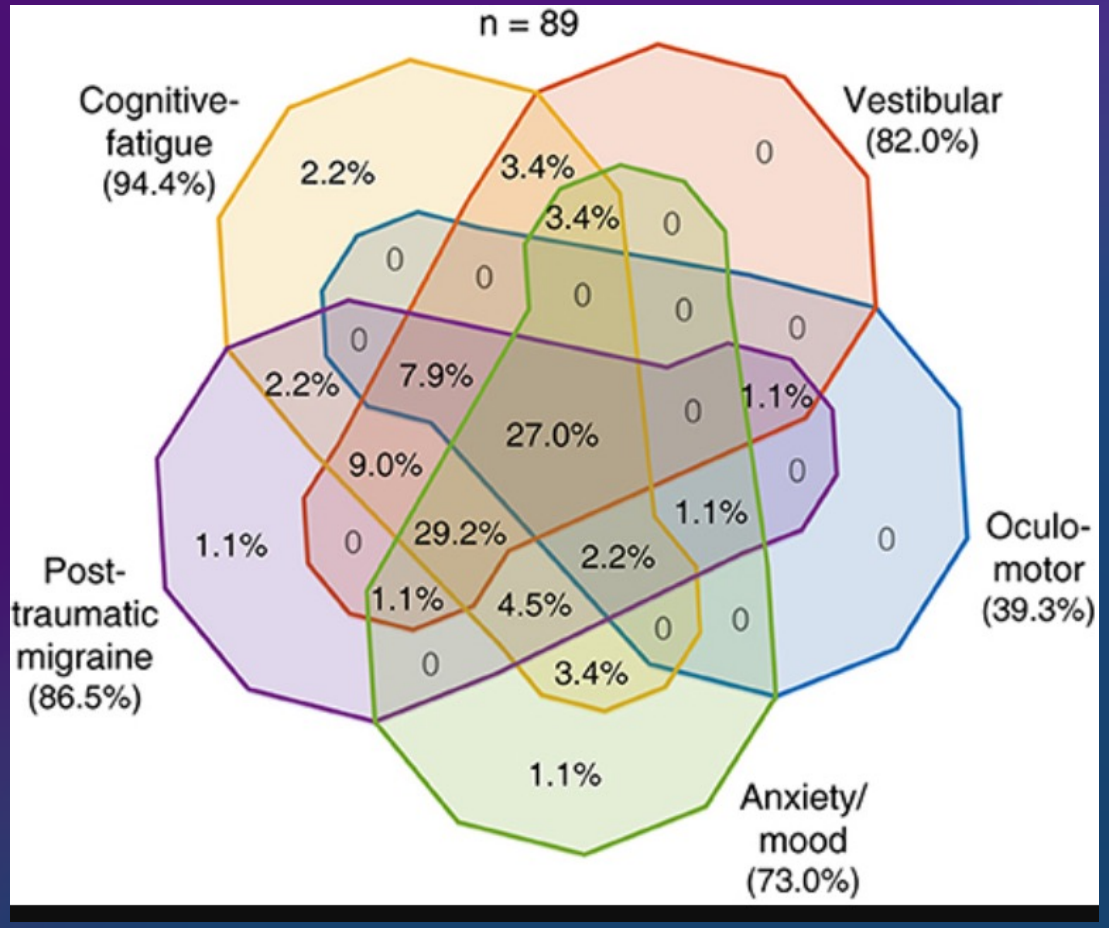
CDC DEFINITION

A concussion is a type of traumatic brain injury—or TBI—caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth.

UNIQUE… WITH CERTAIN NECESSARY ELEMENTS

CONCUSSION VS. CONTUSION

HAVE I HAD A CONCUSSION ?



Compared with **before** the accident, do you **now** (i.e., over the last 24 hours) suffer from:

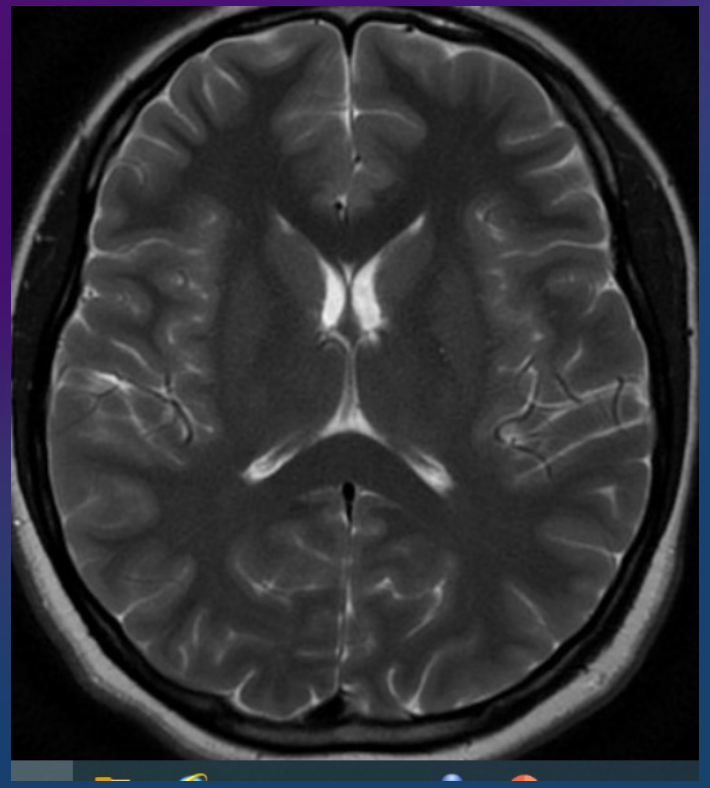
	not experienced	no more of a problem	mild problem	moderate problem	severe problem
Headaches	0	1	2	3	4
Feelings of dizziness	0	1	2	3	4
Nausea and/or vomiting	0	1	2	3	4
Noise sensitivity (easily upset by loud noise)	0	1	2	3	4
Sleep disturbance	0	1	2	3	4
Fatigue, tiring more easily	0	1	2	3	4
Being irritable, easily angered	0	1	2	3	4
Feeling depressed or tearful	0	1	2	3	4
Feeling frustrated or impatient	0	1	2	3	4
Forgetfulness, poor memory	0	1	2	3	4
Poor concentration	0	1	2	3	4
Taking longer to think	0	1	2	3	4
Blurred vision	0	1	2	3	4
Light sensitivity (easily upset by bright light)	0	1	2	3	4
Double vision	0	1	2	3	4
Restlessness	0	1	2	3	4
Are you experiencing any other difficulties? Please specify, and rate as above.					
1.	0	1	2	3	4
2.	0	1	2	3	4

TIME FRAME

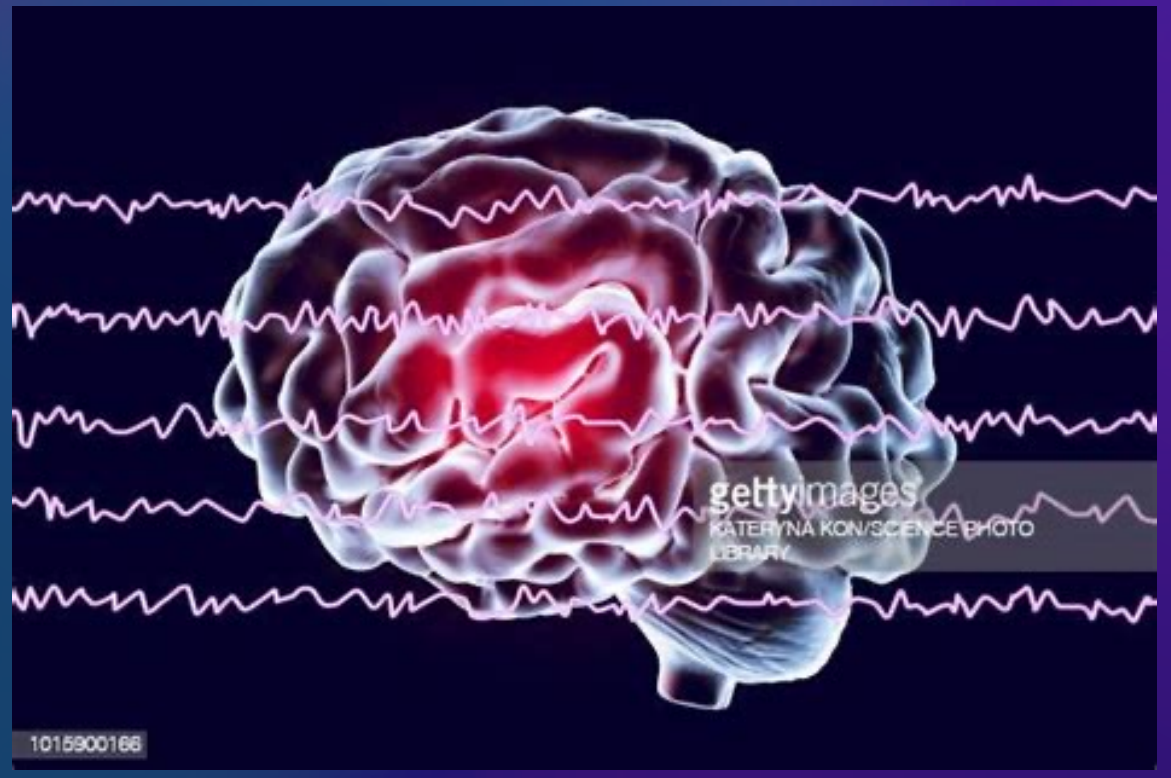
- Immediate symptoms (Amnesia, LOC, Dizzyness)
- Delayed symptoms by hours or days (Headaches, Neck pain)
- Symptoms with activities or environments (Nausea ,Photophobia)
- Cognitive issues with work/school (Memory ,Concentration)

NORMAL BRAIN ANATOMY… BUT ALTERED FUNCTION

Benjamin Bell 1704-1806
Edinburgh Neurosurgeon



Alexis Littre 1654-1726
Neuropathologist



IMPORTANT FEATURES OF ASSESSMENT

- Hematoma or laceration
- Nystagmus
- Amnesia of events
- Blurry or double vision (even temporary or transient)
- Reading or screen intolerance
- Photophobia/sonophobia
- Evidence of balance impairment

IMPORTANT FEATURES OF MECHANISM

- Situational awareness
- Speed and mass of impacting object
- Scrubbing of speed
- Multiple impacts
- Airbags/seatbelt
- Head position upon impact
- Force amplifiers (trailer hitch, brushbars)

EXPERIMENTAL STUDIES OF TBI/CONCUSSION

Wayne State Tolerance Curve

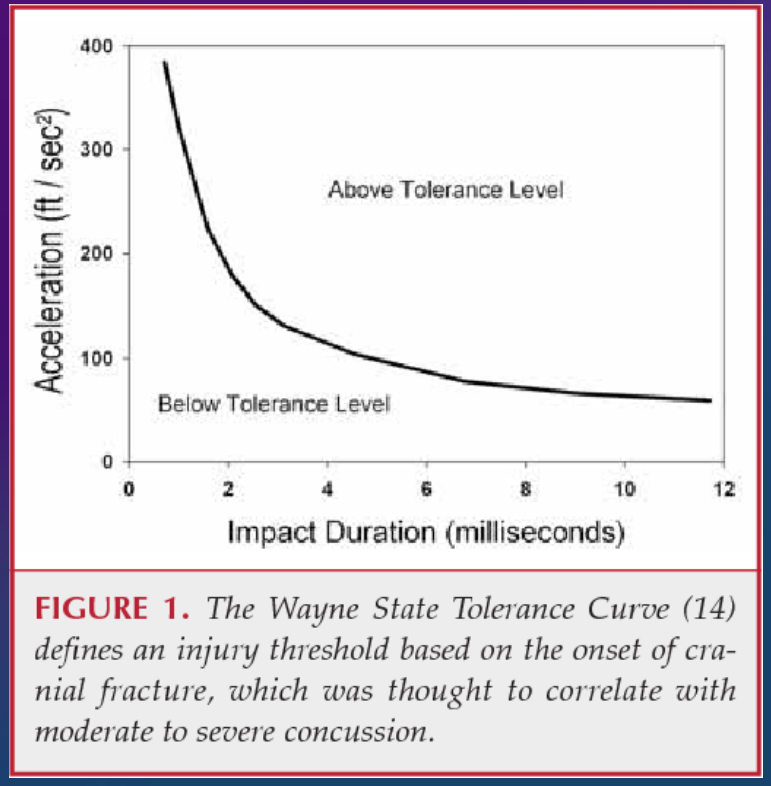
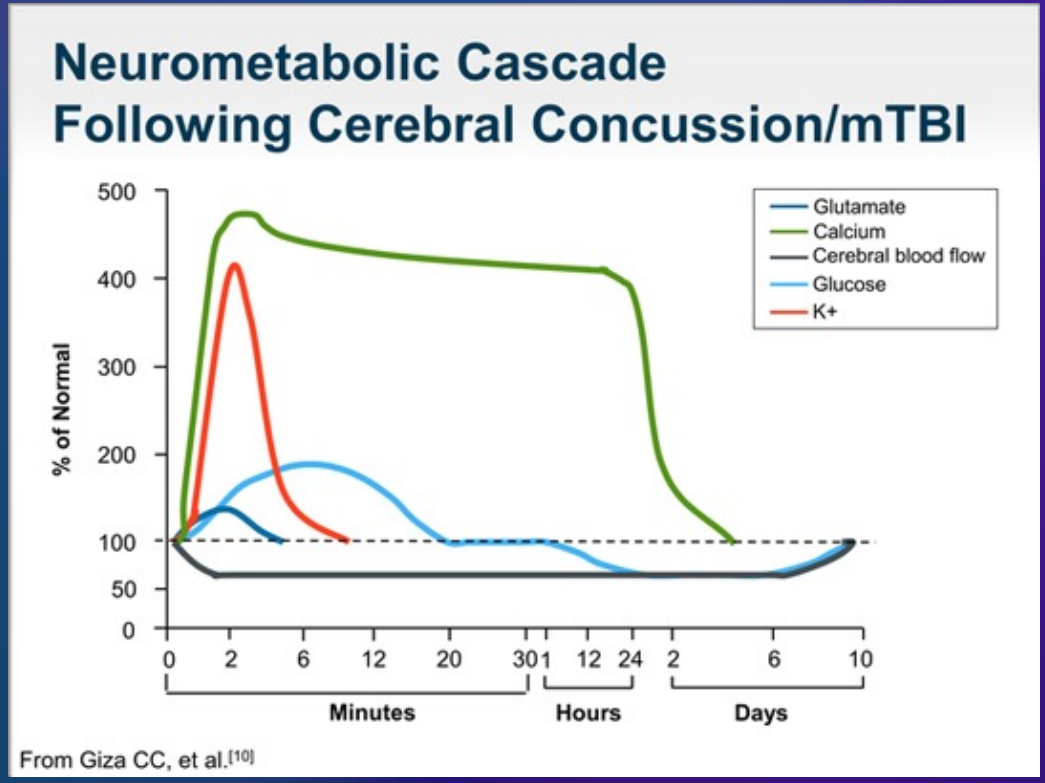


FIGURE 1. *The Wayne State Tolerance Curve (14) defines an injury threshold based on the onset of cranial fracture, which was thought to correlate with moderate to severe concussion.*

Hovda Concussion Cascade



ANATOMICAL FACTORS

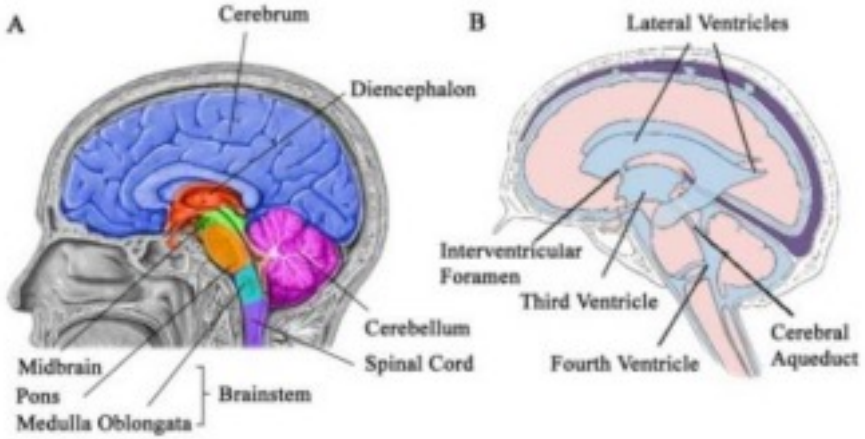


Figure 6. *(A) Internal structures of the human brain [12]. (B) Ventricular system of the human brain [13].*

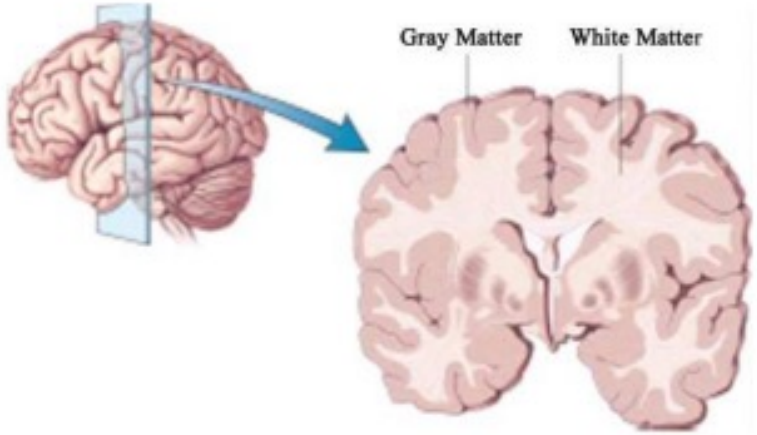


Figure 7. *Coronal cross section of human brain, showing the white and gray matters.*

ANATOMICAL FACTORS

NON MODIFIABLE FACTORS

- Genetics (APOE)
- Concussion past history
- Frequency of previous concussions
- Female vs Male
- Hx of migraines
- Predilection for motion sickness

MODIFIABLE HOST FACTORS

- Microvascular injury
- Blood brain barrier (BBB) disruption
- Microgial activation
- Neural inflammation
- Altered cerebral metabolism

US health body rules collision sports cause CTE in landmark change

- US National Institutes of Health acknowledge causal link
- Concussion in Sport Group conference takes place this week

SYMPTOMOLOGY ASSESSMENTS

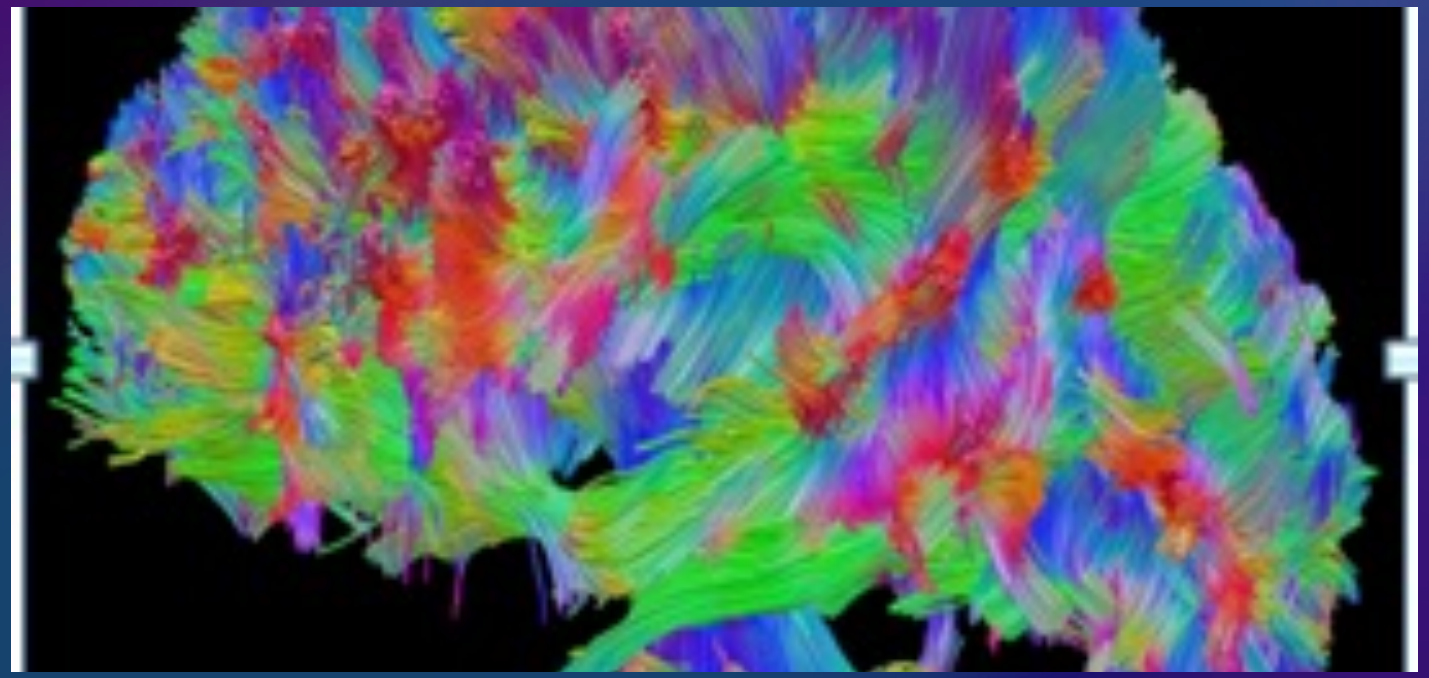
- Rivermead
- Sport concussion Assessment tool (SCAT)
- Post concussion Scale
- IMPACT 21 concussion scale
- "How are you doing ?"
  - Best to use validated tests with reliability
  - Can increase awareness of failure to progress (focus more on bad days)
  - Confirm subsystem involvement.
- Gaudet (Occup Med 2019)
  - 91 % RTW at 90 days post injury
  - 41 % of workers continued to complain of ongoing symptoms

CLINICAL ASSESSMENTS

- Balance testing
  - BESS (balance error scoring system
  - SOT (sensory organization test)
  - Force plate testing (Kin Com)
- Exercise testing
  - Buffalo concussion Treadmill testing
  - 5 step RTP (return to play protocol)
- Computerized Neurocognitive testing
  - IMPACT testing
  - NVC (neurologic vital signs testing)
- VOMS testing
  - Ocular movements
  - Ocular synchronization
  - Induced symptomatology

PHYSIOLOGIC ASSESSMENTS

- Reconciliation of symptomatology with "Objective Testing"
- Clinical testing is objective , but can be potentially confounded intentionally /unintentionally



PHYSIOLOGICAL ASSESSMENT

Objective Physiological testing

- Kamins (BMJ 2017) reviewed 5834 articles (2005- 2017)
- 82 studies were included

MODALITIES ASSESSED AND RECOVERY RANGE

- F MRI (functional MRI) (18 studies) (3 days--- 23 months)
- Diffusion MRI (7 studies) (5 days– 180 days)
- MR Spectroscopy (10 studies) (7 days --- 30 days)
- Cerebral blood flow (2 studies) (30 days– 40 days)
- EEG (electro encephalogram) (15 studies) (7 days --- 45 days --- 4 years)
- Blood and urine biomarkers (10 studies) (12 hrs.---- 144 hrs.)
- Exercise and heart rate (5 studies) (inconclusive)
- Transcranial Magnetic stimulation (4 studies) (10 days--- 9 months)

HISTORICALLY… " 3 MONTHS FOR FULL RECOVERY."

- **Majority of pts experience significant improvement in 2-4 weeks**
- McCrea (2003 JAMA) study was essentially the basis for the 3 month recovery framework
  - Neuropsych evals on days 2, 7 , 90
  - Collegiate level athletes (excellent fitness)
  - symptoms and functional deficits as endpoints… **not …** cerebral activity as determinates for recovery
  - "mild to moderate "concussions only
- McCrea (2017 Journal of Athletic trainers) study noted 1 in 5 had prolonged recovery based on physiological data

IS IT A CEREBRAL CONCUSSION?

1st criteria **Plausible injury mechanism**

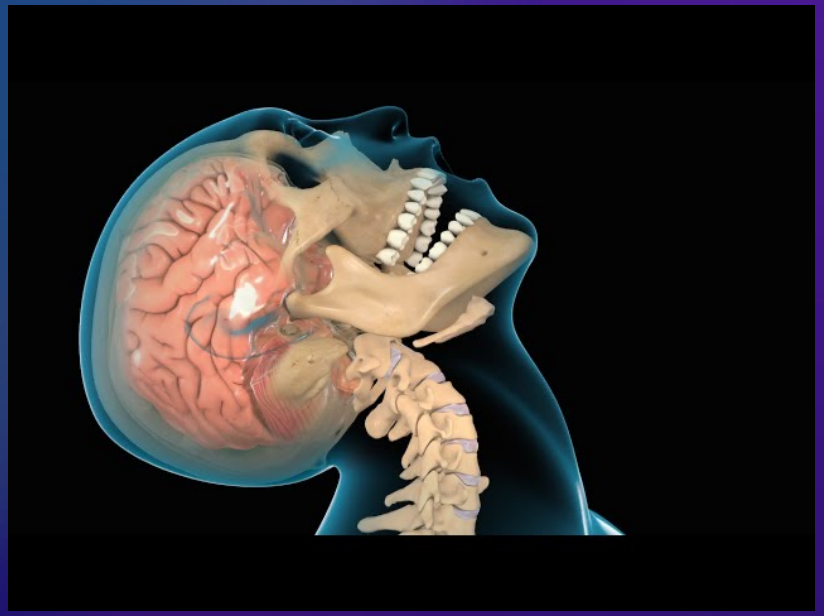
appropriate forces, adequate description, personal memories vs learned info

2 nd criteria **Query signs and symptoms**

alteration in mental status, loc, confusion , amnesia etc.

3 rd criteria **Rule out confounding factors**

EtOH, drugs, severe pain , significant fearful event



MECHANISM OF INJURY

Sports related compared to MVA

- Seiger (2015 J Head trauma rehab)
  - 13-21 years old
  - Football recovery 32 days vs. MVA 97 days

MVA Based concussions

- Cassidy (2014 APRM)
- Median time to recovery 100 days
- 23 % still unresolved at 1 year
- Negative factors for recovery
  - Age> 50 yo
  - No high school diploma
  - Having poor expectations for recovery
  - Somatic symptoms

EMPLOYMENT STATUS POST CEREBRAL CONCUSSION

Silverberg (2017 APMR) reassessed at 8 months

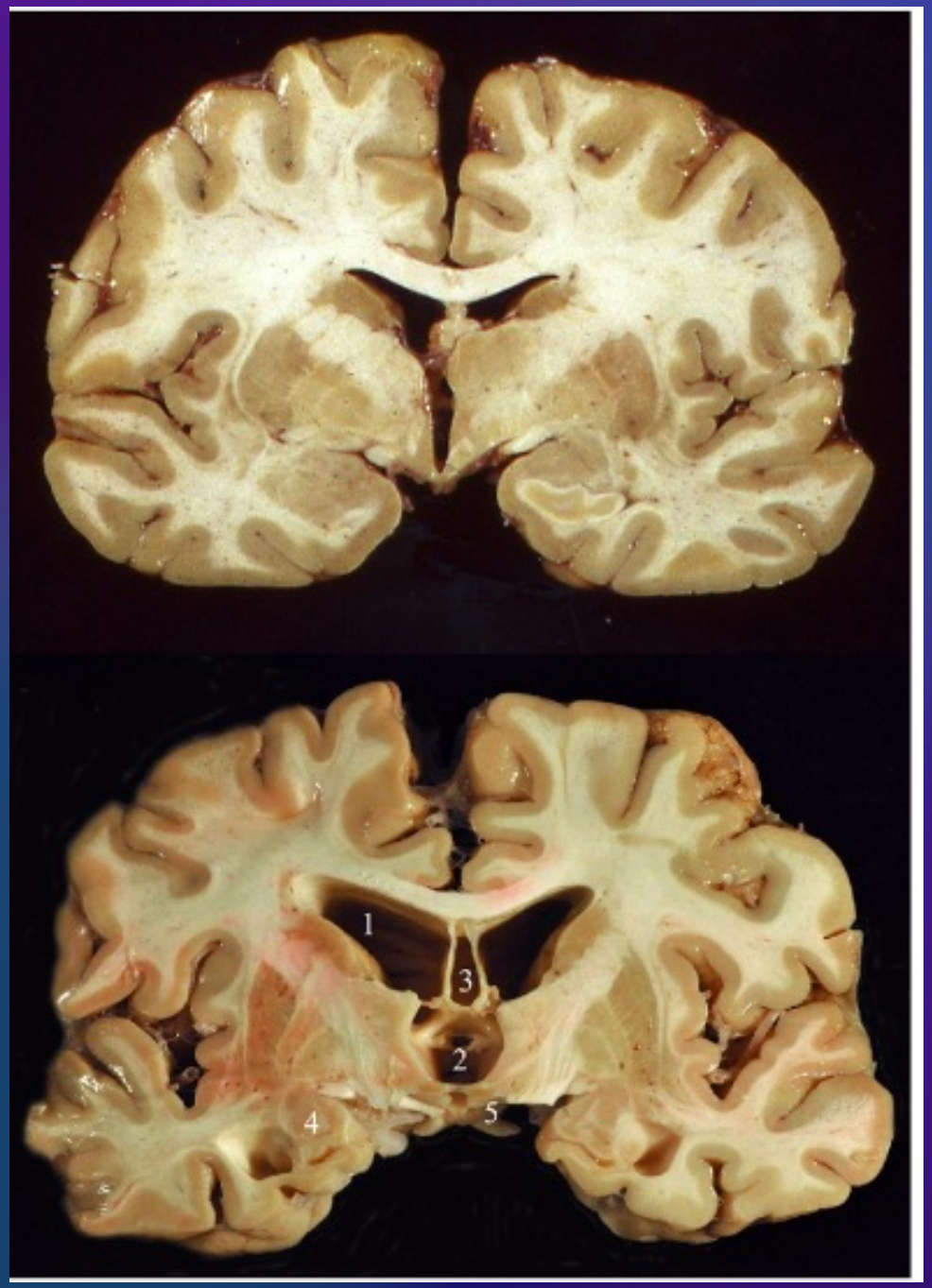
- 58% full RTW
- 44% increased PCS complaints
- 18% depression
- 24% anxiety
- 30 % bodily pain

PUNCH DRUNK

- Harrison Martland studied Boxers and identified a distinct syndrome which he called "Dementia pugilistica" 1928.
- Subsequent studies confirmed these findings in the 1950's,1960's and noted cerebral atrophy, neuronal loss, gliosis and neurofibrillary tangles.
- 1973 J. Corsellis identified all of the above with the addition of thinning of the corpus callosum and enlargement of the ventricles of the brain.
- T. Tokuda 1991 took the old pathology from 1973 and using modern techniques identified TAU proteins.
- 2006 Bennet Omalu vs. Roger Goodell
- Ann McKee and the Boston university Brain Bank 2011

CTE BRAIN

- Atrophy of temporal lobes
- Enlarged ventricles
- Hippocampal atrophy
- Frontal lobe atrophy



Normal

CTE

QUESTIONS?

THANK YOU

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