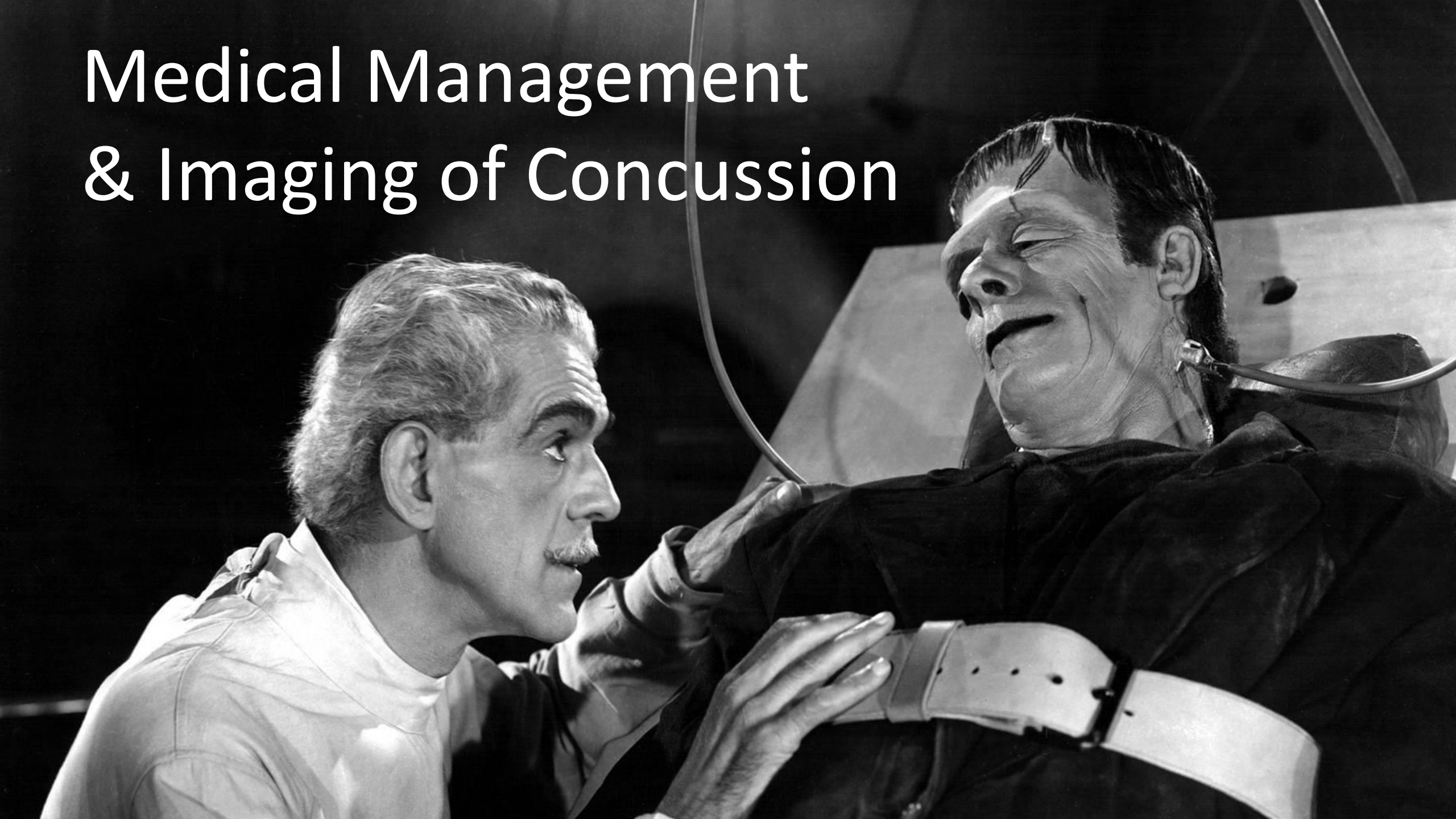
Medical Management & Imaging of Concussion



uchealth

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No financial disclosures

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Outline

1. **Medical management of concussion: 10 minutes**
   - All recent, EBM papers on medication management
2. **Imaging of concussion: 10 minutes**
   - What studies and why
   - Why these aren’t done routinely
3. **Questions: 5-10 minutes**

Sideline Management

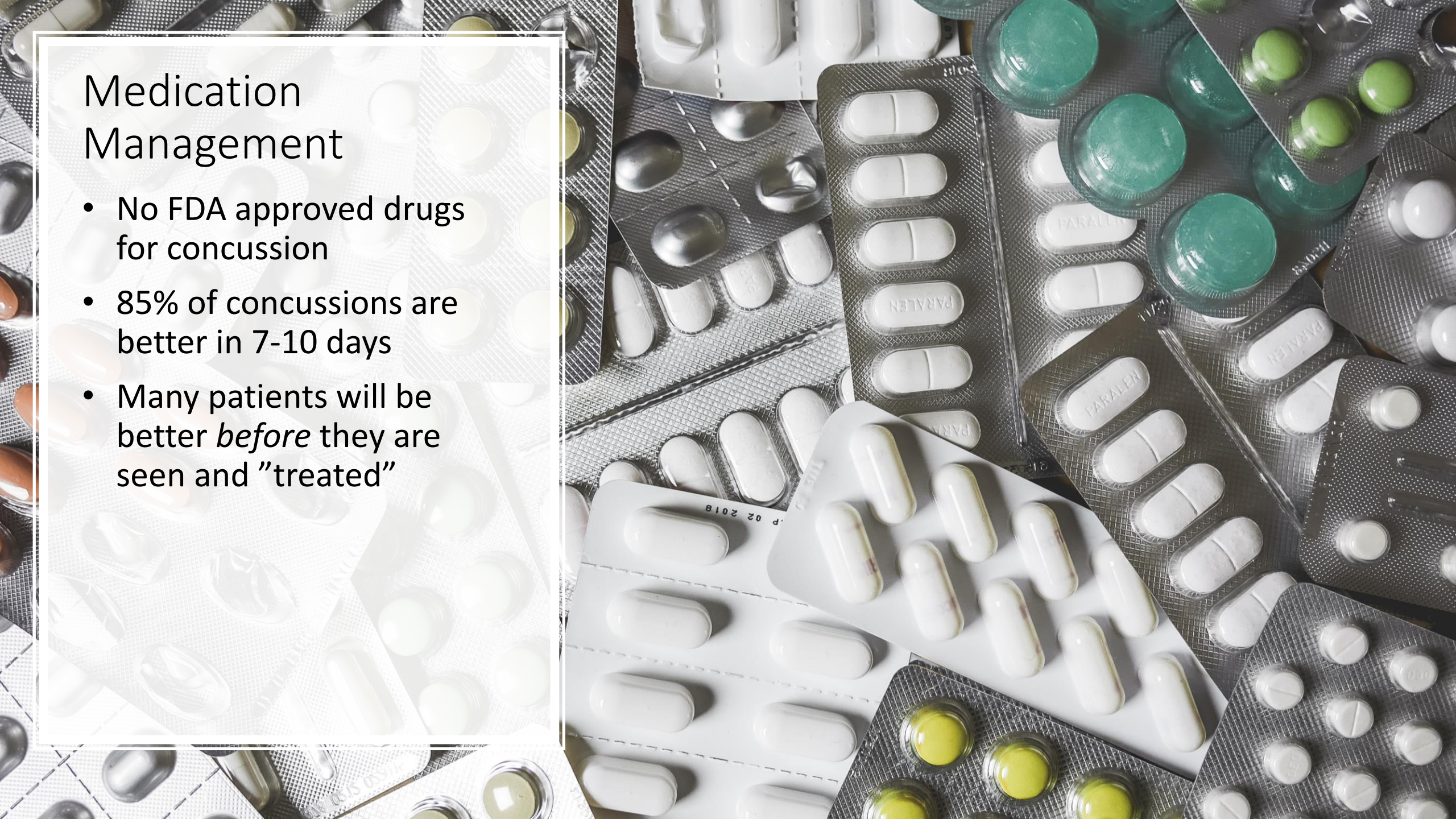
- High index of suspicion
- Low threshold to remove athletes from play
- Monitor and serially examine players
- Determine disposition
  - **“Its not a concussion until it’s definitely not a subdural”**
- Educate parents and athlete

Keep your eyes open

- Retinal detachment
- Diabetes
- Leukemia
- Malignancy
- Intracranial masses
- Medication overuse headache
- Cervicogenic headache
- Transient quadriparesis
- Brachial plexopathy
- Drug and alcohol abuse

Medication Management

- No FDA approved drugs for concussion
- 85% of concussions are better in 7-10 days
- Many patients will be better *before* they are seen and ”treated”

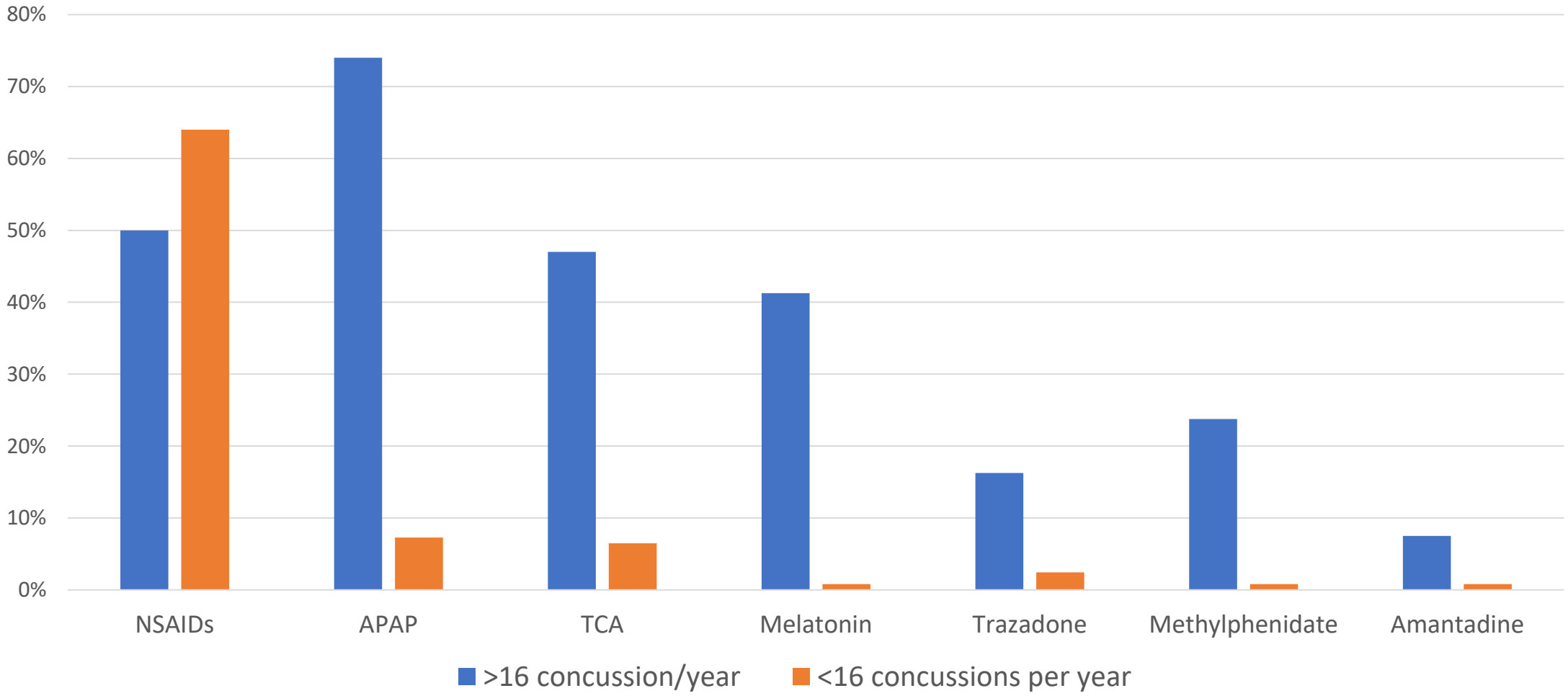


Medication overuse headache

- 70% of patients meet the criteria for medication overuse headache[1] (>15 days of OTC meds per month)
  - 69% of whom get better with discontinuation of the medication[1]

[1]Heyer GL

Medication usage by annual experience



Stache 2010

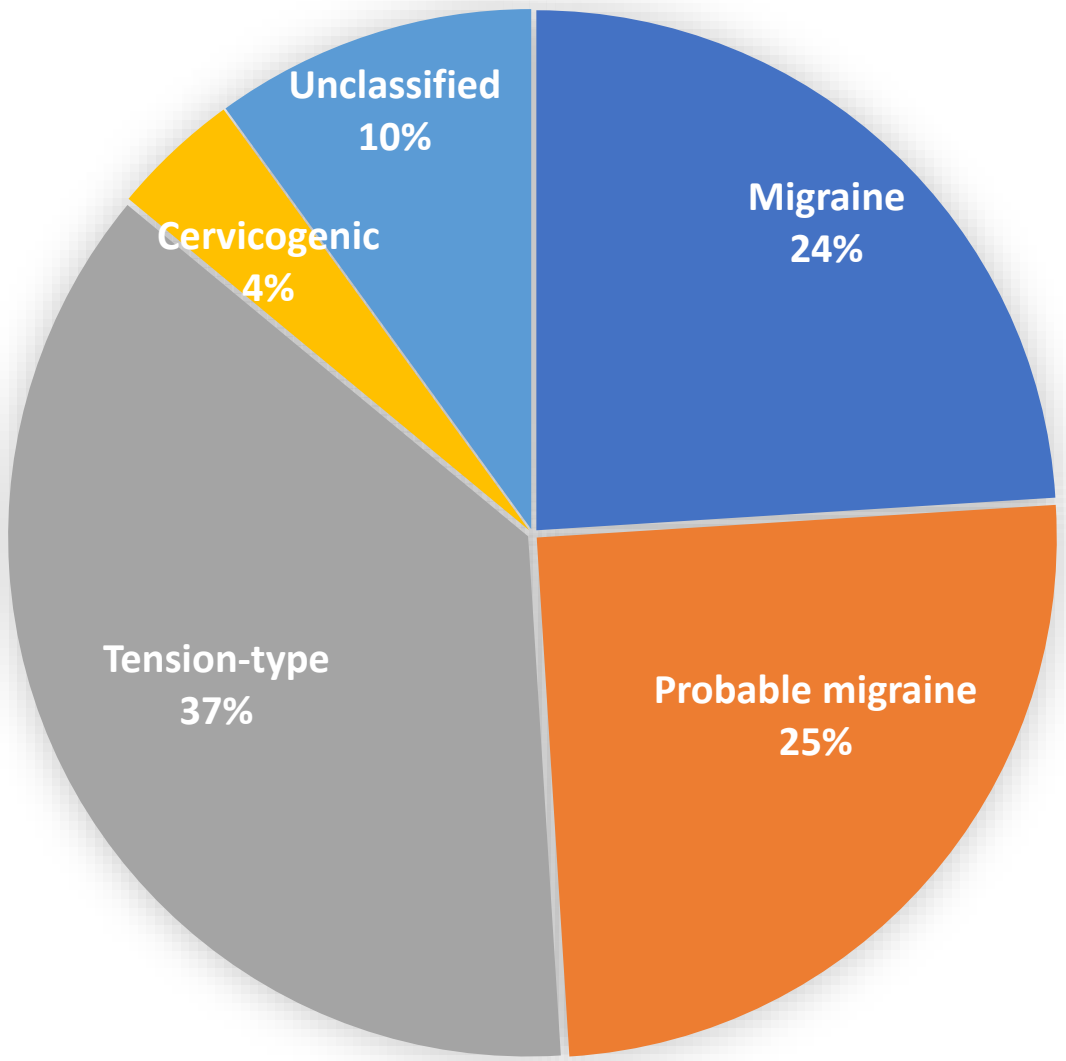
Tricyclic Antidepressants

- Amitriptyline, Nortriptyline, Desipramine, Doxepin
- No prospective studies
- Retrospective review showed 17% of kids were prescribed it
- **82% reported improvement in headache**
- 23% reported vivid dreams, oversedation, irritability, or heart palpitations

Halstead 2016

Bramley 2015

Post-Traumatic Headache Type at **3 months**



49% Migraine

Lucas, 2011

Triptans

- No prospective studies
- Superior to placebo for post-traumatic migraine
- 70% effective in a military population
- Increased risk of minor side effects in adolescents compared to children
- No more than 3 times per week, or 9 times per month (MOH)
- Theoretical risk of vasospasm in the hyperacute setting given decreased cerebral blood flow

Pinchefsky 2015

Erickson 2015

Choe 2015

Adverse Effects of Sumatriptan

Common

- **Cardiovascular:** Chest discomfort (1% to 5%)
- **Dermatologic:** Application site pain (26%), Flushing (7%), Injection site pain, Injection site reaction (59% to 63%)
- **Musculoskeletal:** Muscle weakness (5%), Neck pain (up to 5% .)
- **Neurologic:** Abnormal sensation (oral, 5% to 6% ; subQ, 7.8% to 42%), Burning sensation (1% to 7%), Dizziness (up to 12%), Numbness (1% to 5%), Paresthesia (0.1% to 5%), Pins and needles (14%), Sensation of hot and cold (oral, 2% to 3% ; subQ, 11%), Vertigo (oral, up to 2% ; subQ, 12%)
- **Respiratory:** Pain in throat (3%)
- **Other:** Heavy feeling (up to 7%), Malaise, Pressure (up to 7% .), Tightness sensation (up to 5%)

Serious

- **Cardiovascular:** Cardiac arrest, Cardiac dysrhythmia, Coronary artery spasm, Hypertensive crisis, Myocardial infarction, Peripheral ischemia, Sudden cardiac death, Transient myocardial ischemia
- **Gastrointestinal:** Ischemic colitis
- **Hematologic:** Splenic infarction
- **Immunologic:** Anaphylactoid reaction, Anaphylaxis, Hypersensitivity reaction
- **Neurologic:** Cerebral hemorrhage, Cerebrovascular accident, Intracranial hemorrhage, Seizure, Subarachnoid hemorrhage
- **Ophthalmic:** Blindness AND/OR vision impairment level, Functional visual loss, Transient blindness
- **Other:** Serotonin syndrome

Amantadine

- Dopaminergic med, maybe NMDA agonist effects
- **3-4 weeks of 100mg BID***
- Improvement in symptoms and IMPACT scores
- Safe in pediatric and adult populations
- Mixed results in more severe TBI

Reddy 2013

Green 2004

Tenuovo 2006

***Why is this time frame an issue?**

Methylphenidate

- Studied in more severe TBI for fatigue and improved cognitive function, attention, and speed of function
  - Mixed results
- No studies to date on its effectiveness on mild TBI
- No real role in acute concussion
- Maybe in prolonged recovery?

Meehan 2011

Diet and Supplements

- Melatonin
  - 0.5-10mg, 1-2 hours before bed
  - May need 1 month of treatment
- Omega-3 Fatty Acids
  - 2200 mg DHA x 30 days (study pending)
- Creatine*
- Reservatrol*
- Ketogenic diet

Ashbaugh 2016

*Animal studies only

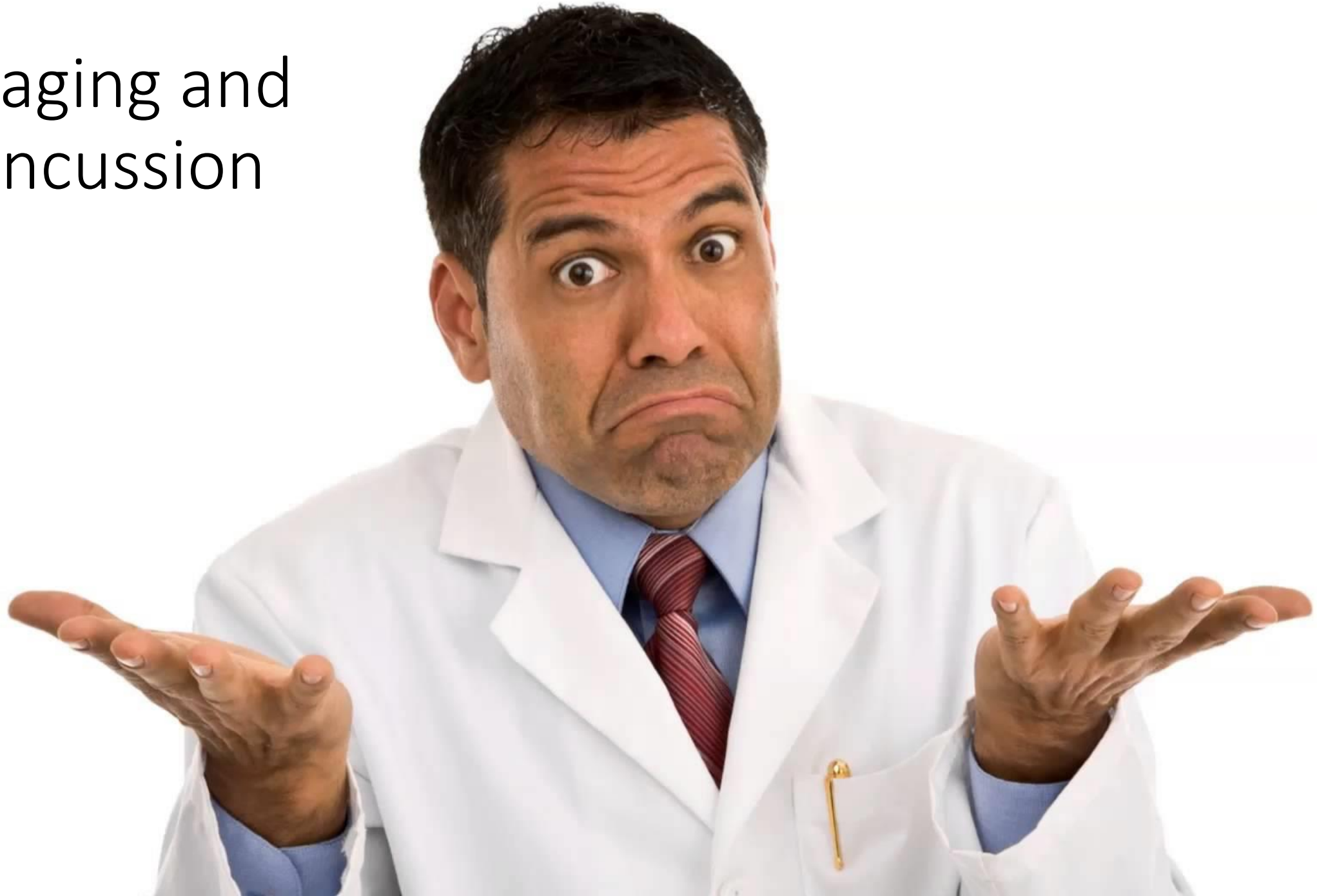
The End of the Beginning…

Imaging and Concussion

Concussion is a “clinical diagnosis, you don’t need imaging!

Whew…this lecture is easy!

Imaging and Concussion



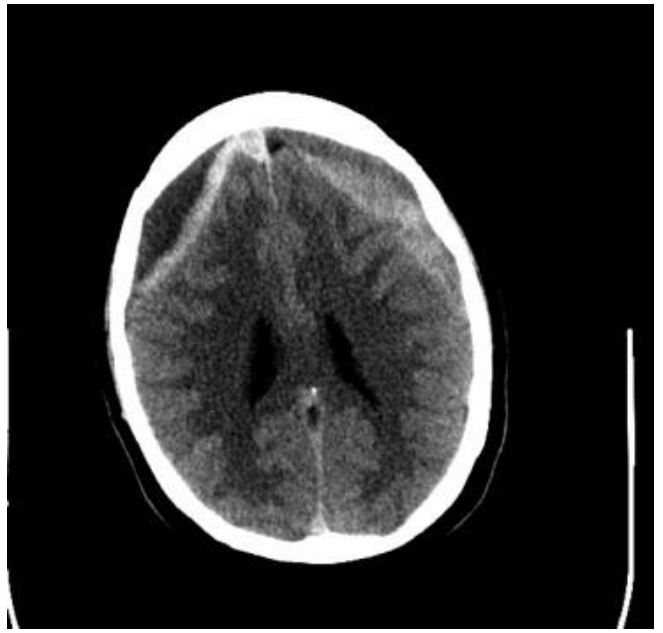
The Holy Grail

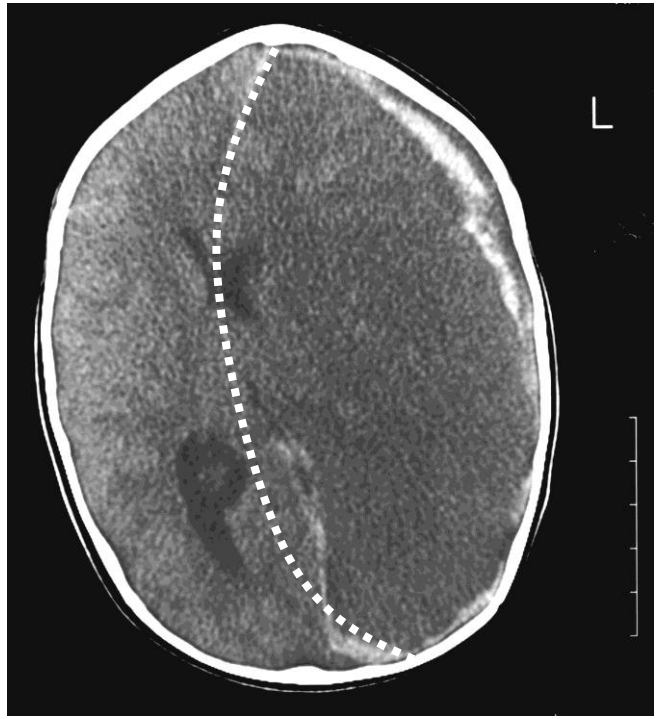
- Cheap
- Widely available
- Objective
- Determines severity
- Prognostic
- Surveillance
- Identifies safe return to play
- Identifies long-term prognosis
- Identifies long-term vulnerability

CT*

- **Not sensitive for concussion**
- Useful in acute and emergent situations.
- No real role in outpatient management
- “Overused” study
  - New Orleans Criteria
  - Canadian CT Head Rule

*Quick, cheap, available

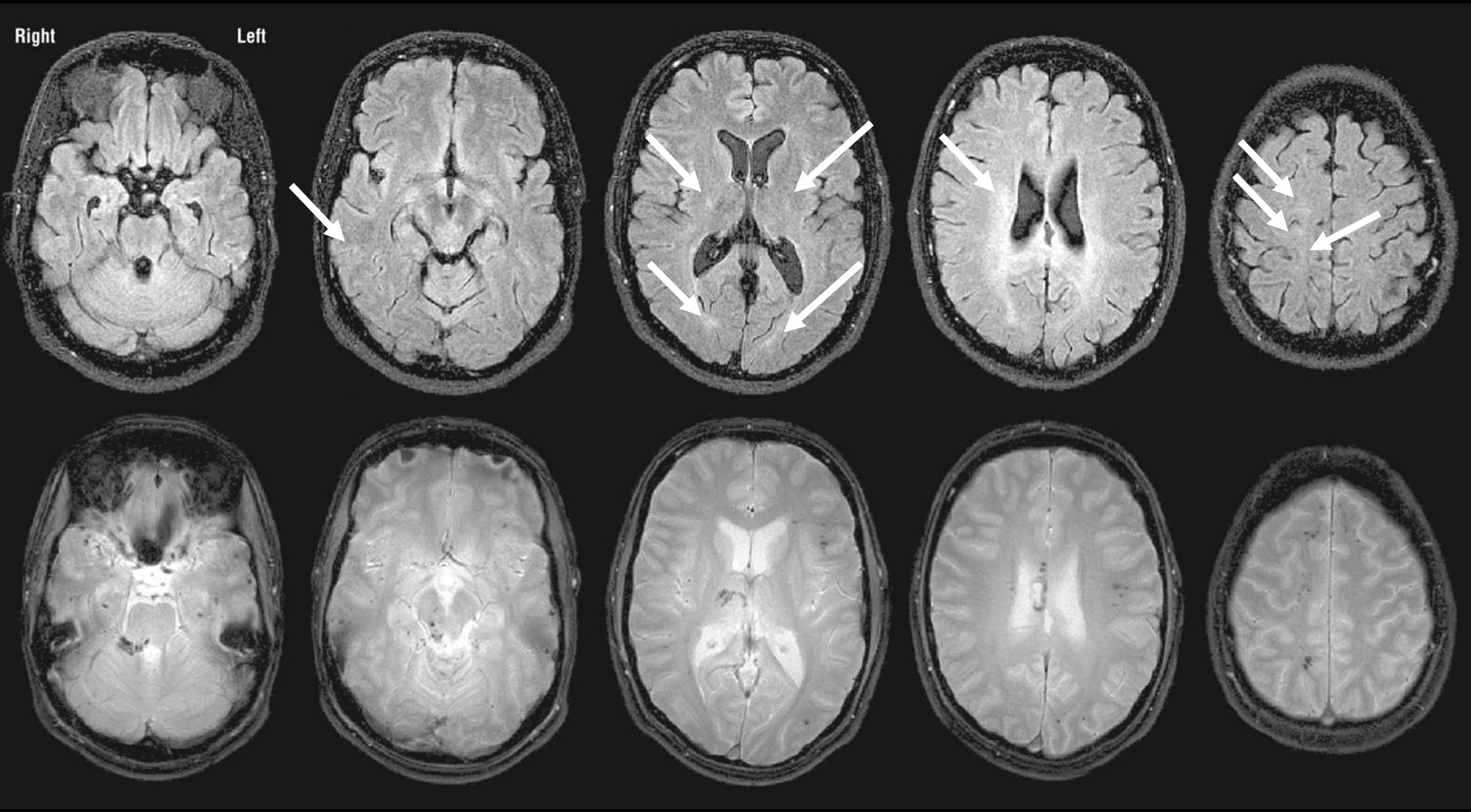




MRI*

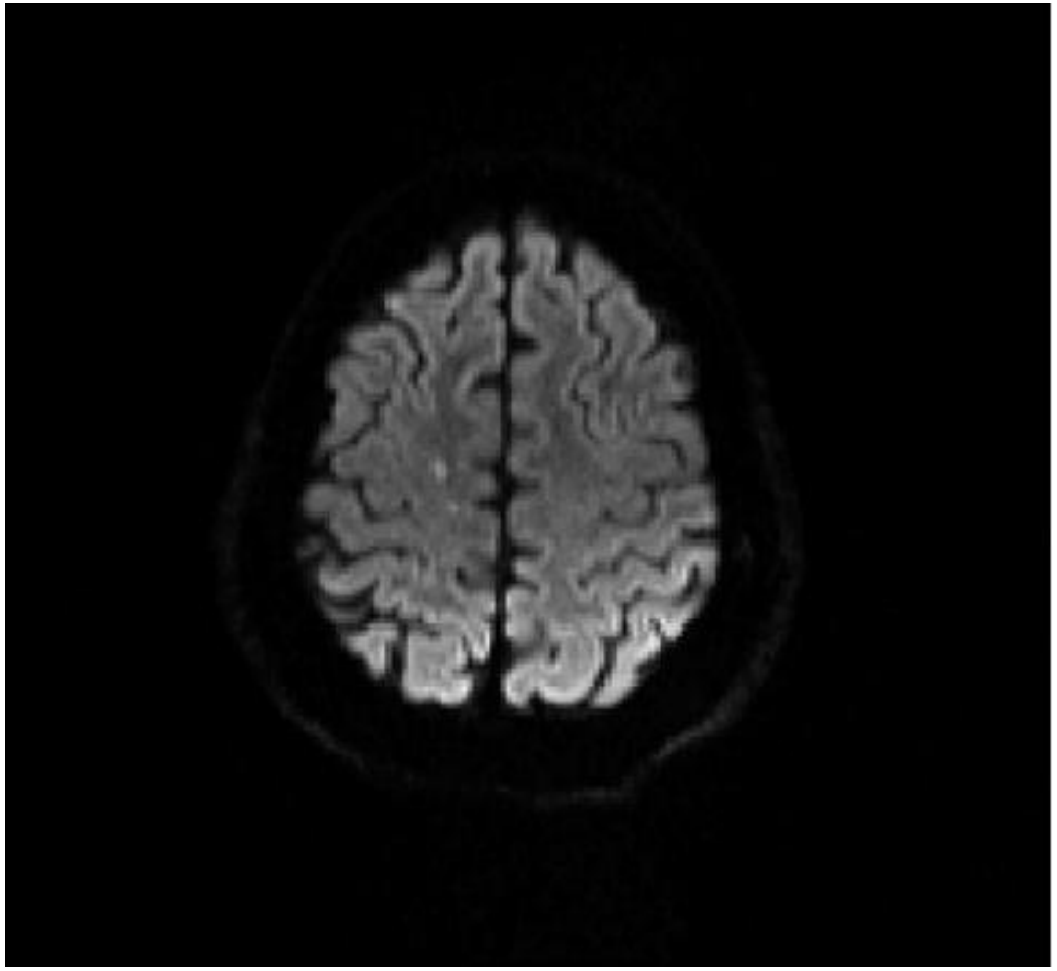
- Ideal outpatient study
- Sensitive to structural abnormalities
- Will show foramen magnum
- DWI and FLAIR sequences are sensitive for edema
- GRE and SWI are sensitive for hemorrhage

*Less quick, less cheap, less available


Right
Left

MRI with Diffusion Weighted Imaging (DWI)*

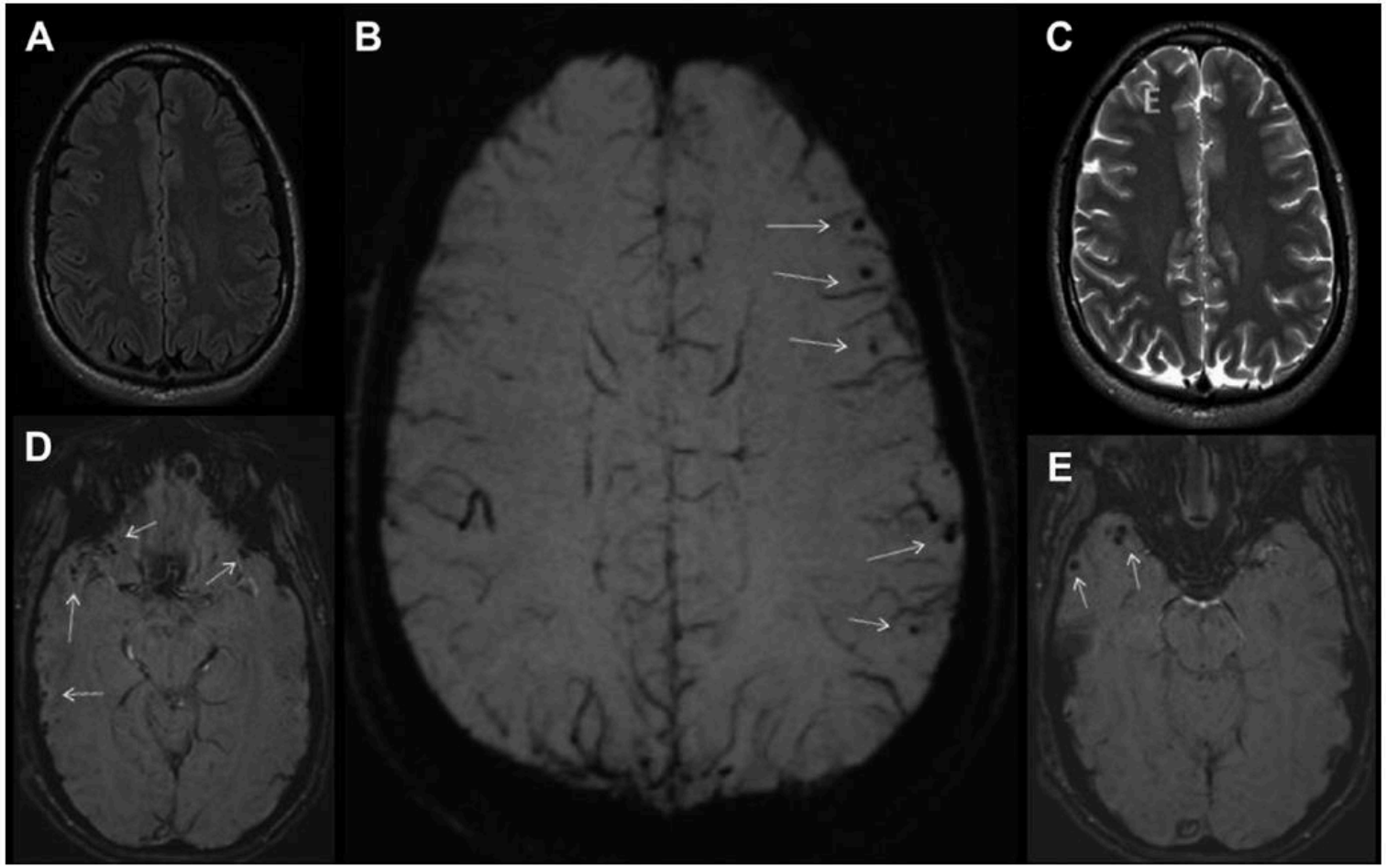
- More sensitive to diffuse axonal injury than standard MRI
- Most useful in acute cases *prior* to chronic changes occurring because the edema tends to leave



Less cheap, less quick, less available

MRI with Susceptibility-weighted imaging (SWI)

- High resolution gradient MRI technique
- Exquisitely sensitive to venous blood products



Less cheap, less quick, less available

Unpublished Data

- 110 outpatient MRIs ordered over 4 years
- 11 had “any abnormality”
- 0% of these caused a change in clinical management

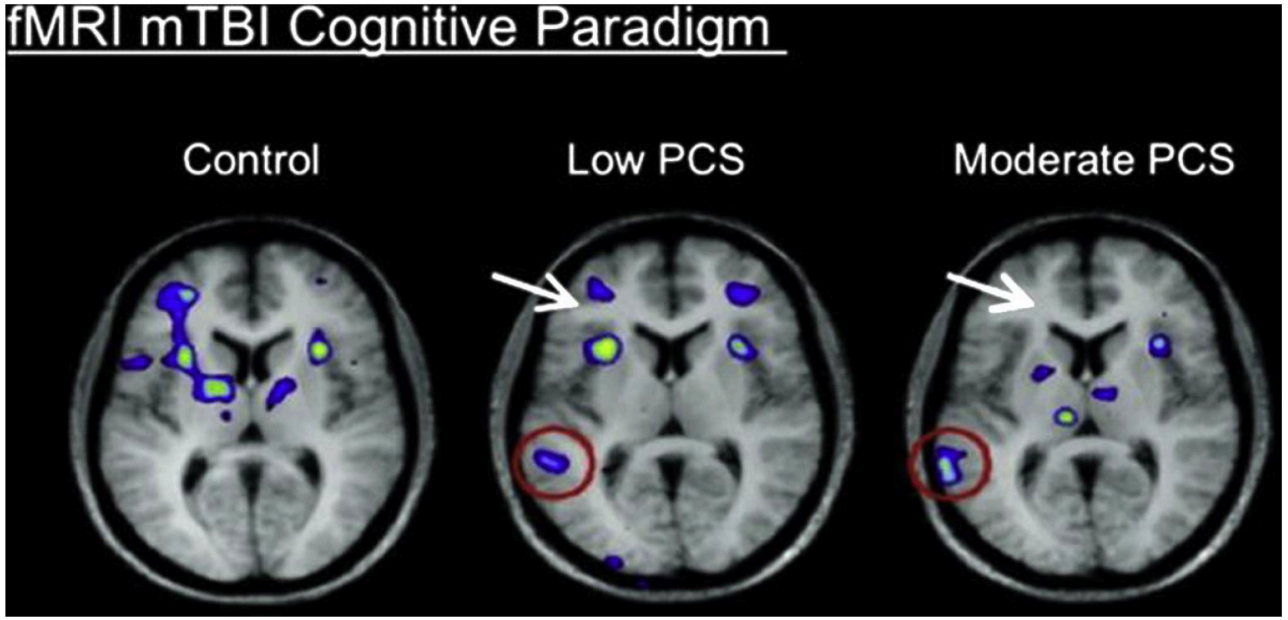
Concussion is a CLINICAL diagnosis, not an imaging diagnosis

Laker, Rodriguez, Mcmahon, Unpublished

fMRI*

(functional MRI)

- Non-invasive, MRI-based study
- Utilizes a neurocognitive task
- Blood-oxygen level dependent signal
- Conflicting results
  - Some report consistent changes at various time points
  - Others no significant differences

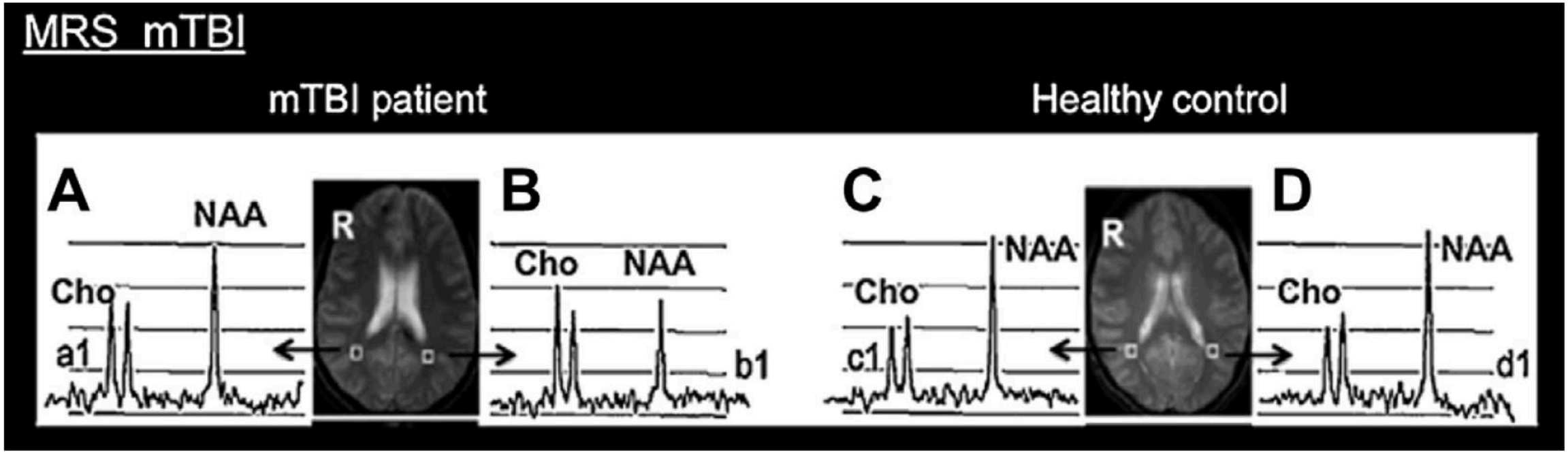


Hutchison 2014
Terry 2012
Dettwiler 2014
Keightley 2012
Churchill 2017

*Severity, prognosis, function

MRI Spectroscopy*

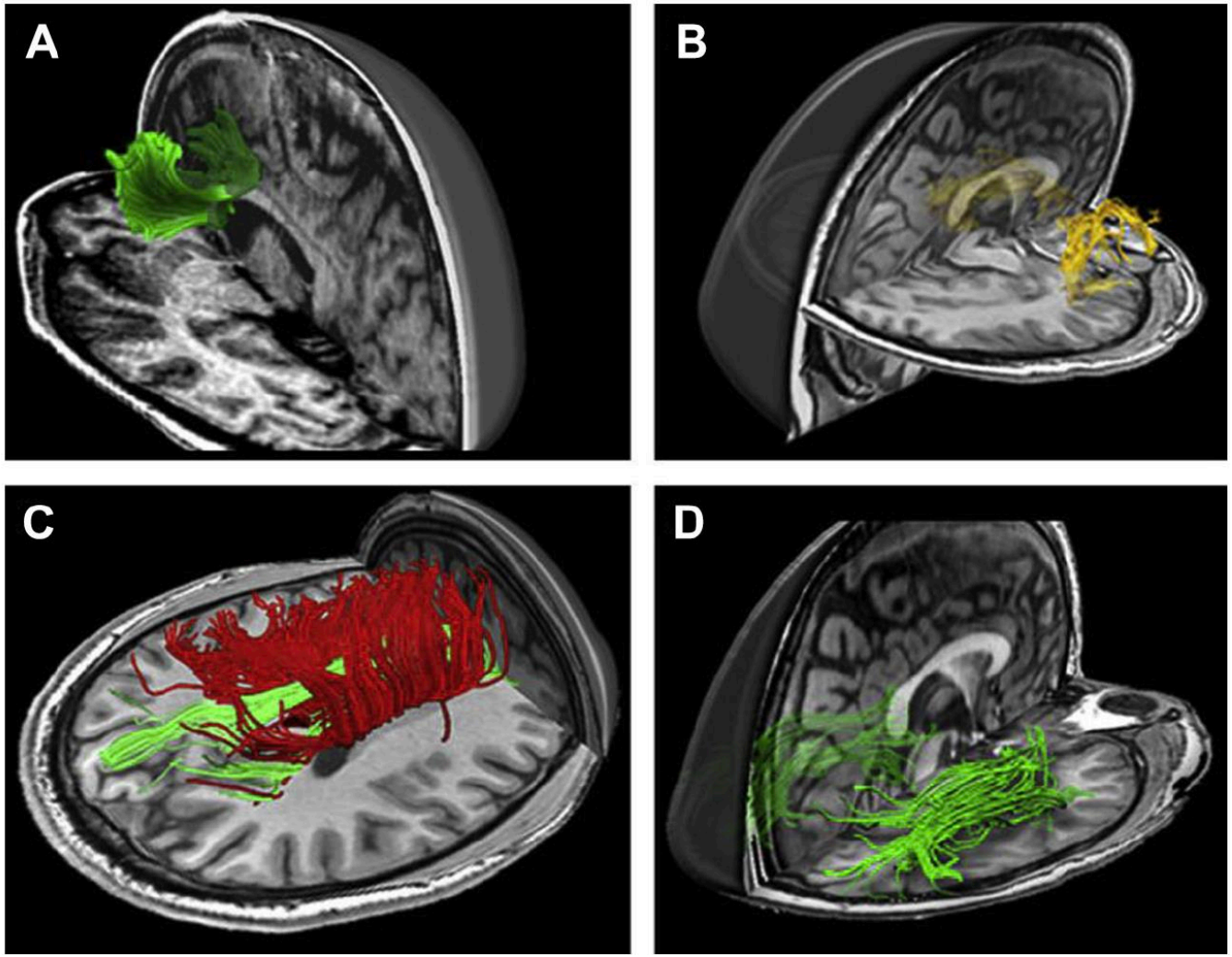
- Identifies cellular breakdown products
- N-acetylaspartate= axonal damage
- Choline= myelin damage
- May be able to predict outcomes
- May be correlated with neuropsychological abnormalities



*Return to play, severity, surveillance

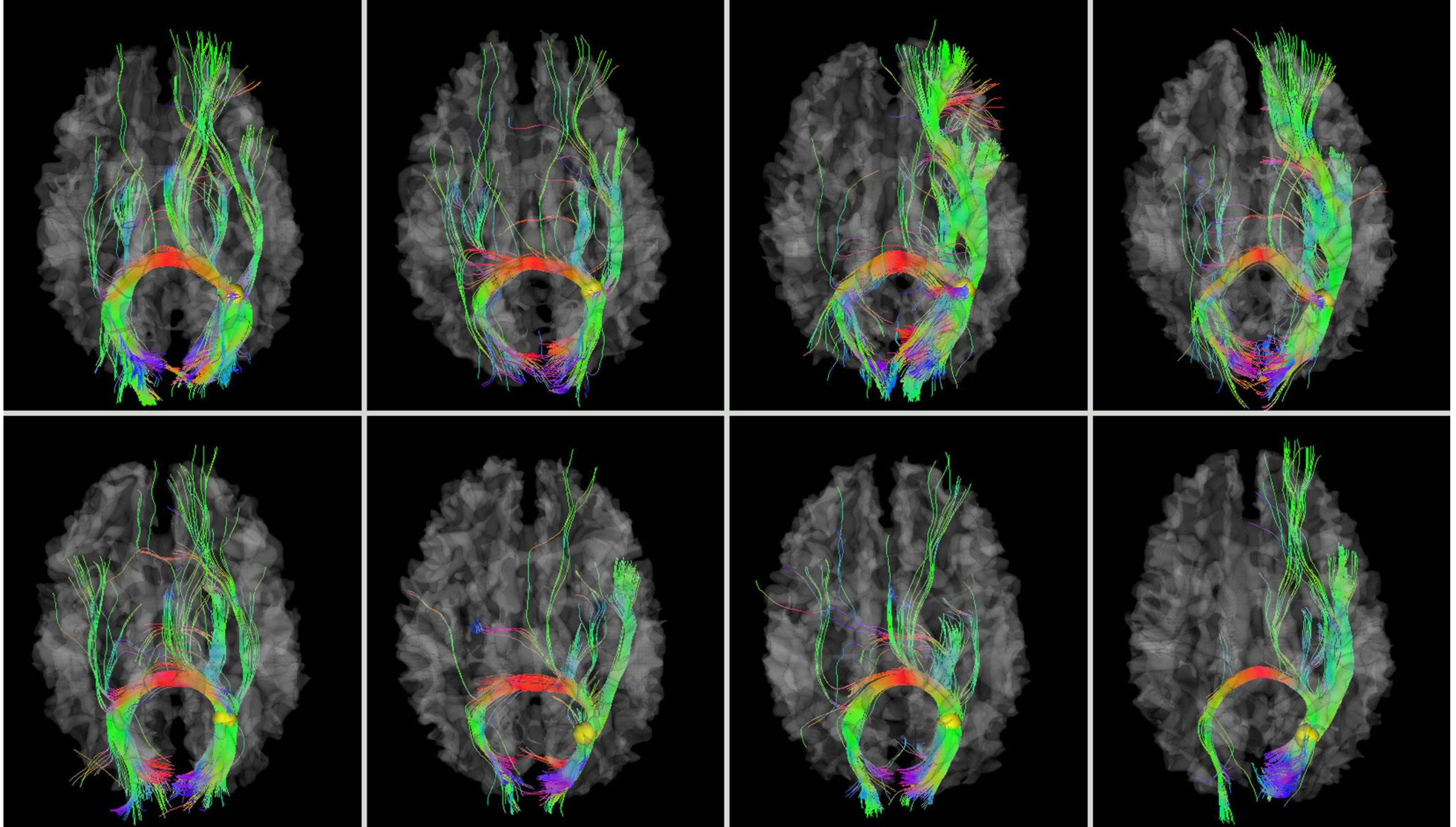
Diffusion Tensor Imaging

- Identifies microstructural abnormalities using water flow properties
- Can identify diffuse axonal injury and white matter tract shearing
- Chronic (>3 months) injuries may not show up
- Though a few studies show abnormalities up to 5 years post-injury
- Some changes in findings based number of concussions



Breton 2017

*long-term prognosis determination?, vulnerability



Why don’t you see more of these imaging types in clinical practice?

or

?

Recommended reading

April Issue of BJSM

- SCAT5
- Berlin Consensus Statement
- Physiologic time to recover