

CONCUSSIONS

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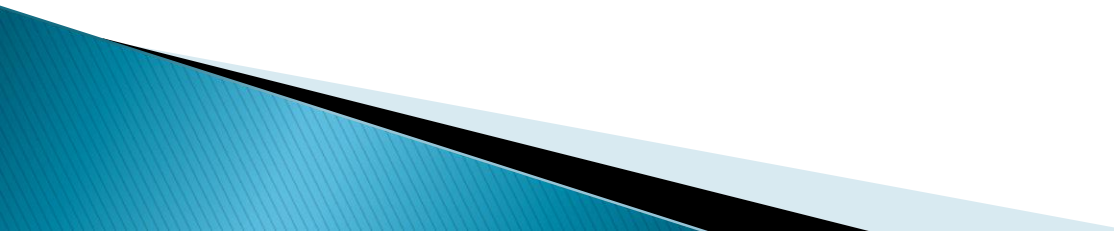
TEXAS TECH UNIVERSITY
Health Sciences Center
Paul L. Foster School of Medicine



Along with water bottles and towels, Annie is responsible for fetching the concussion kit.

Definition

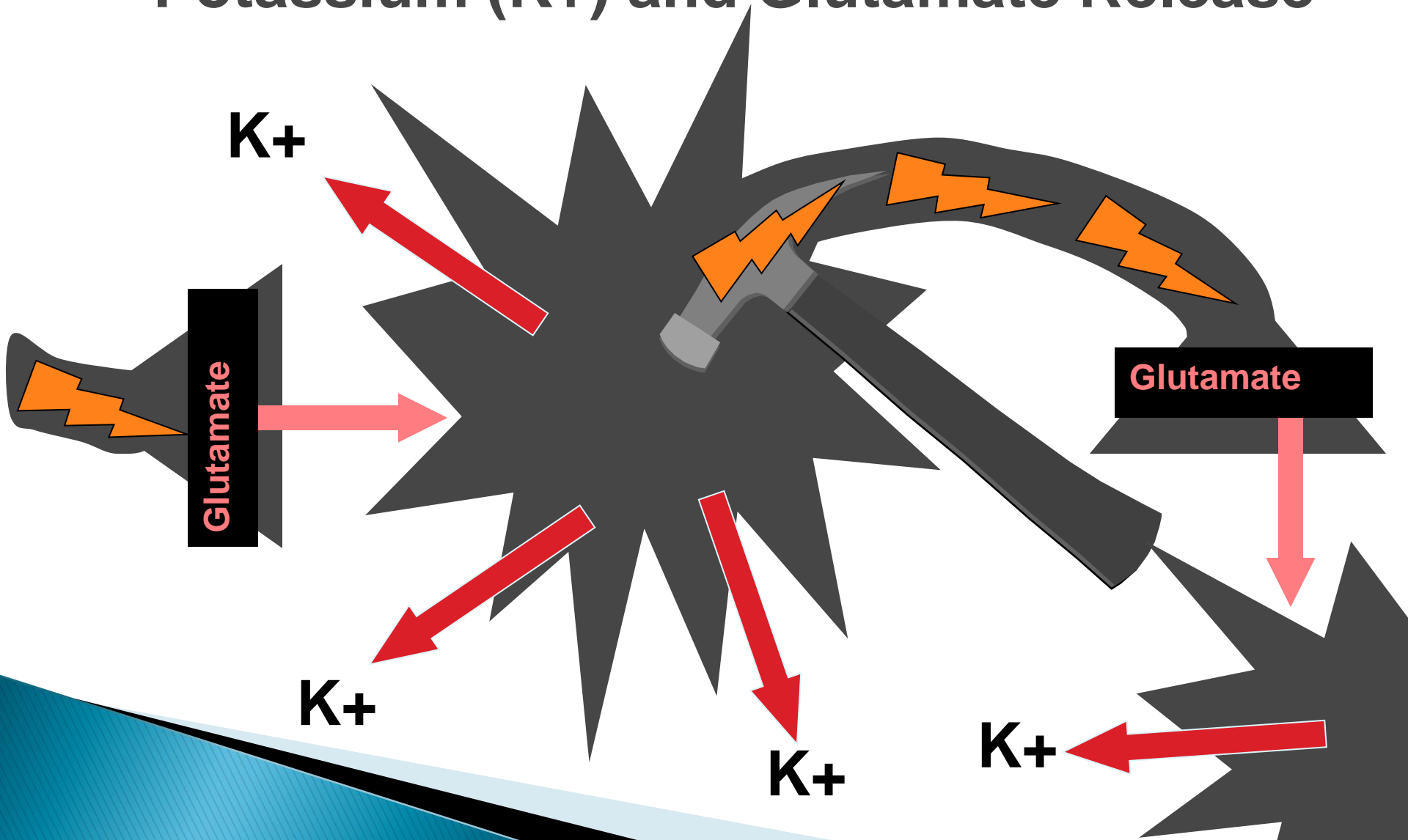
A sport concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. Several common features that incorporate clinical, pathological, and biomechanical injury constructs that may be utilized in defining the nature of a concussive head injury.



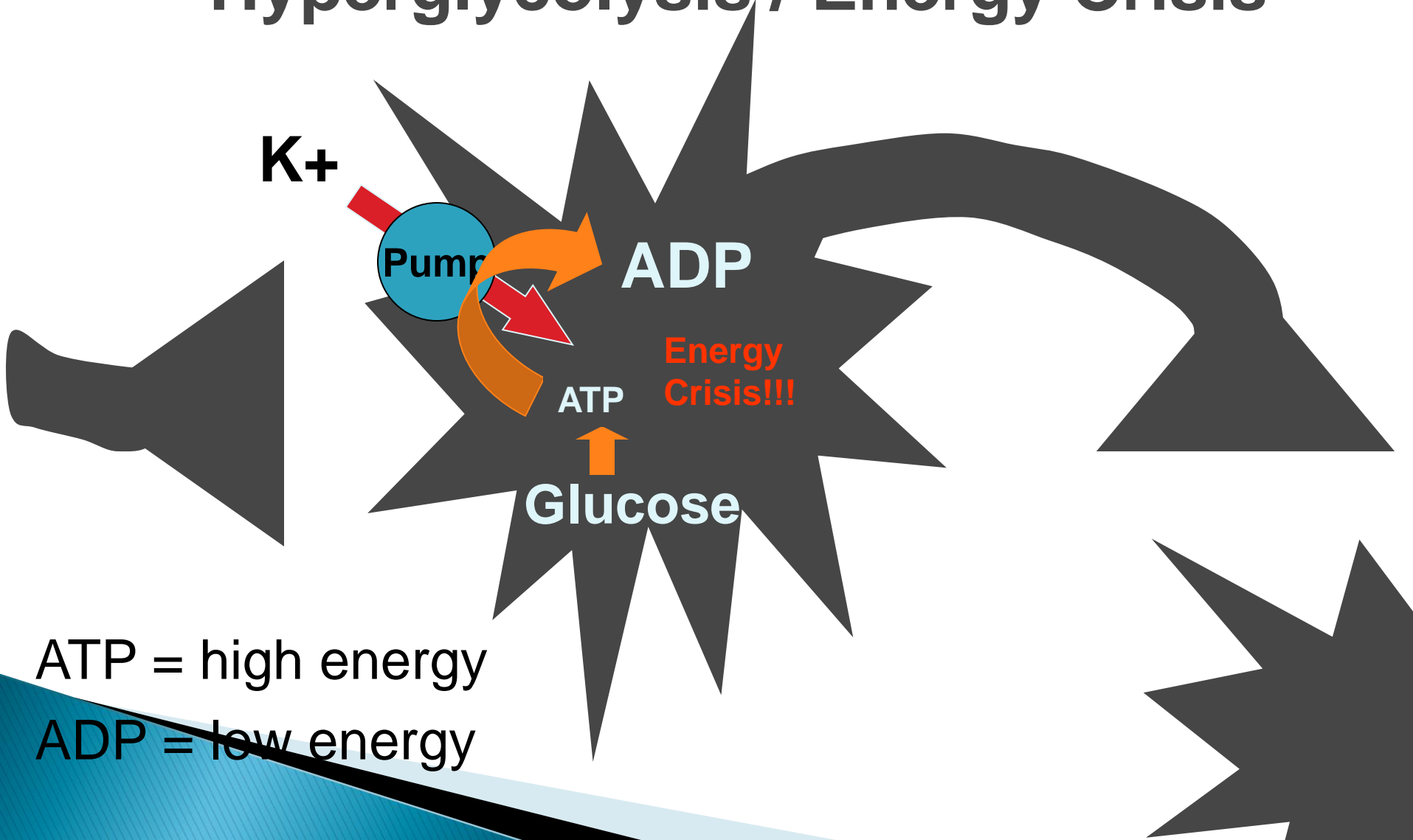
Definition

- ▶ This is a Mild traumatic brain injury
- ▶ Multiple concussions can lead to a myriad of symptoms called chronic traumatic brain injury oroften referred to as dementia pugilistica

Post-Concussive Cellular Response: Potassium (K⁺) and Glutamate Release



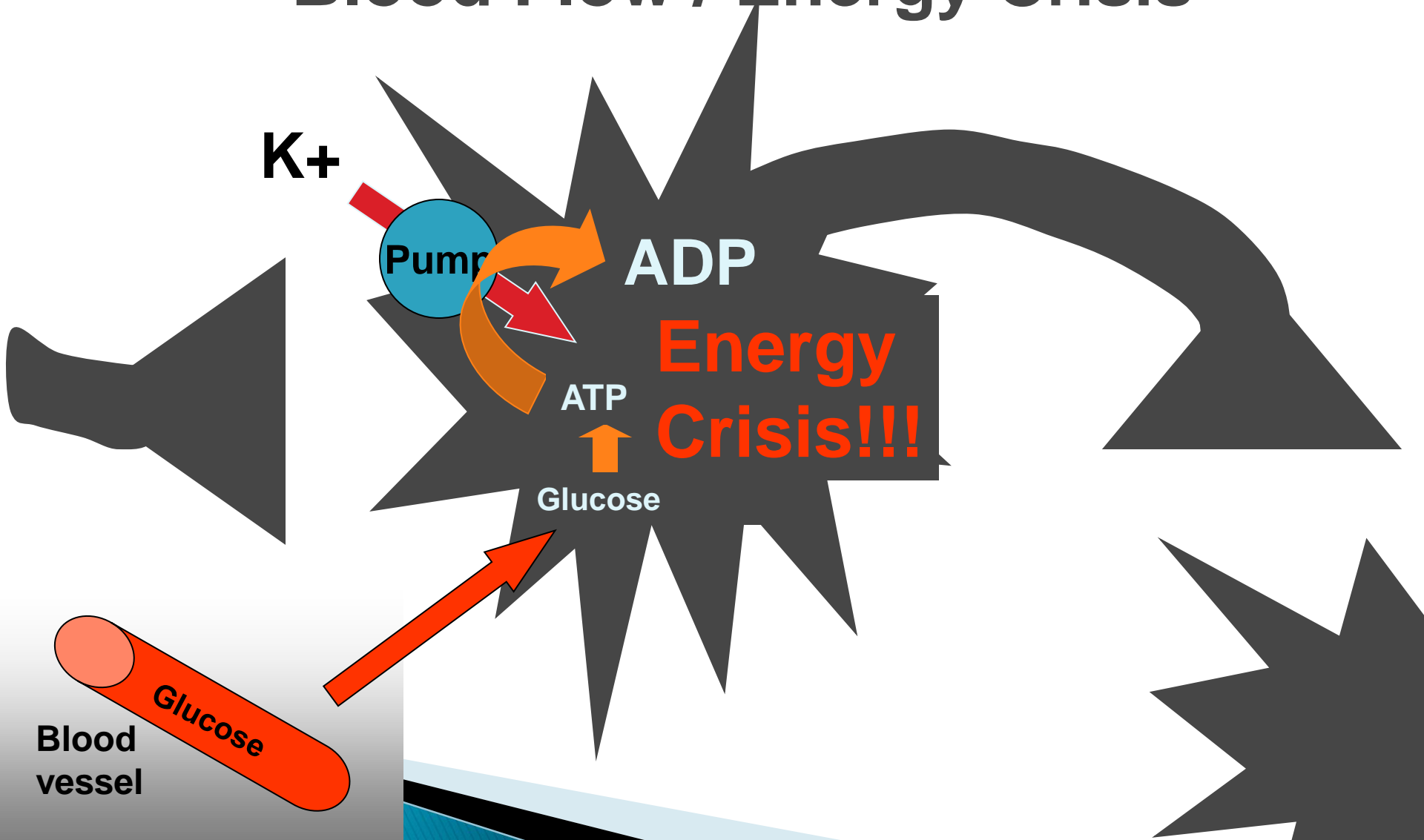
Post-Concussive Cellular Response: Hyperglycolysis / Energy Crisis



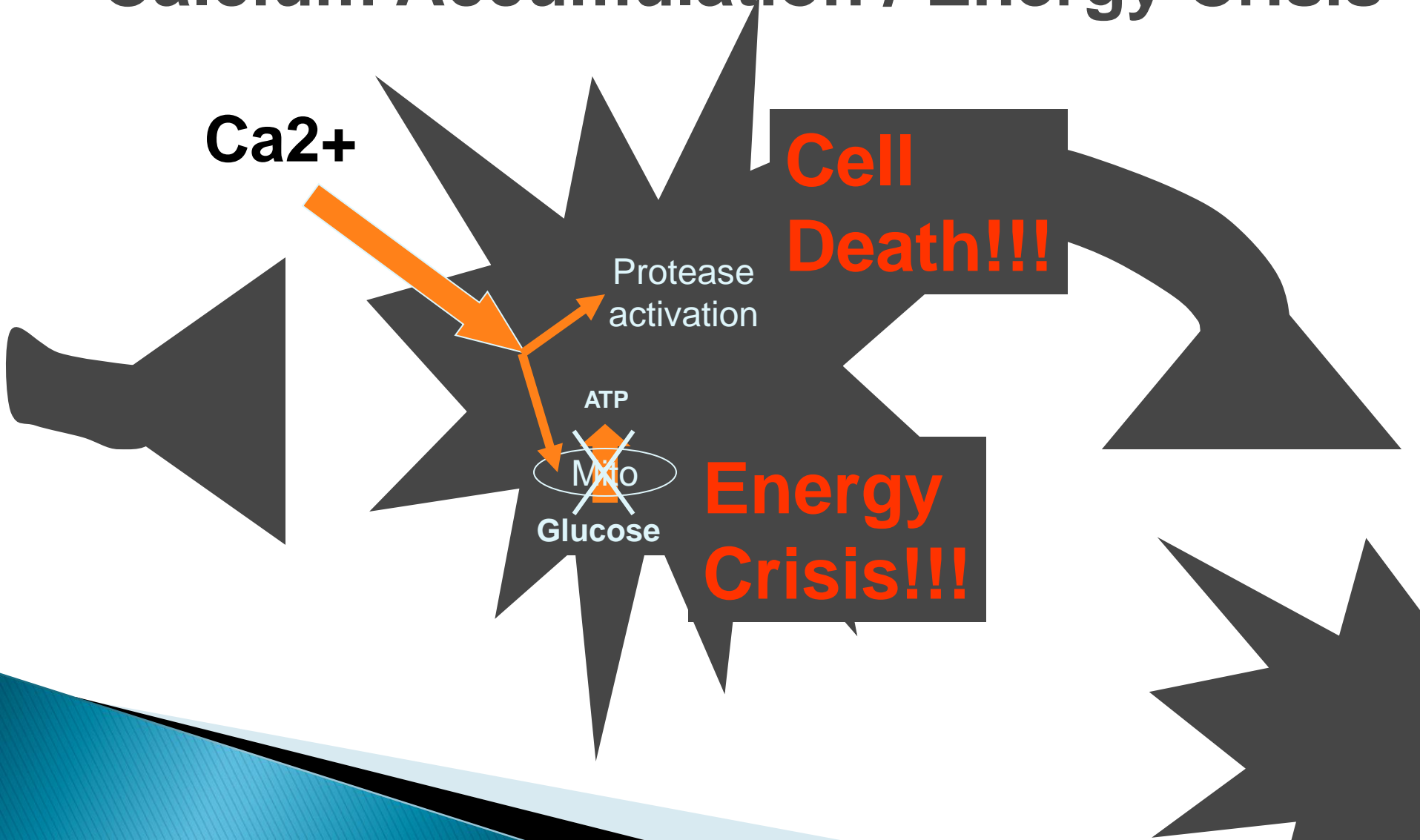
ATP = high energy

ADP = low energy

Post-TBI Cellular Response: Blood Flow / Energy Crisis



Post-Concussive Cellular Response: Calcium Accumulation / Energy Crisis

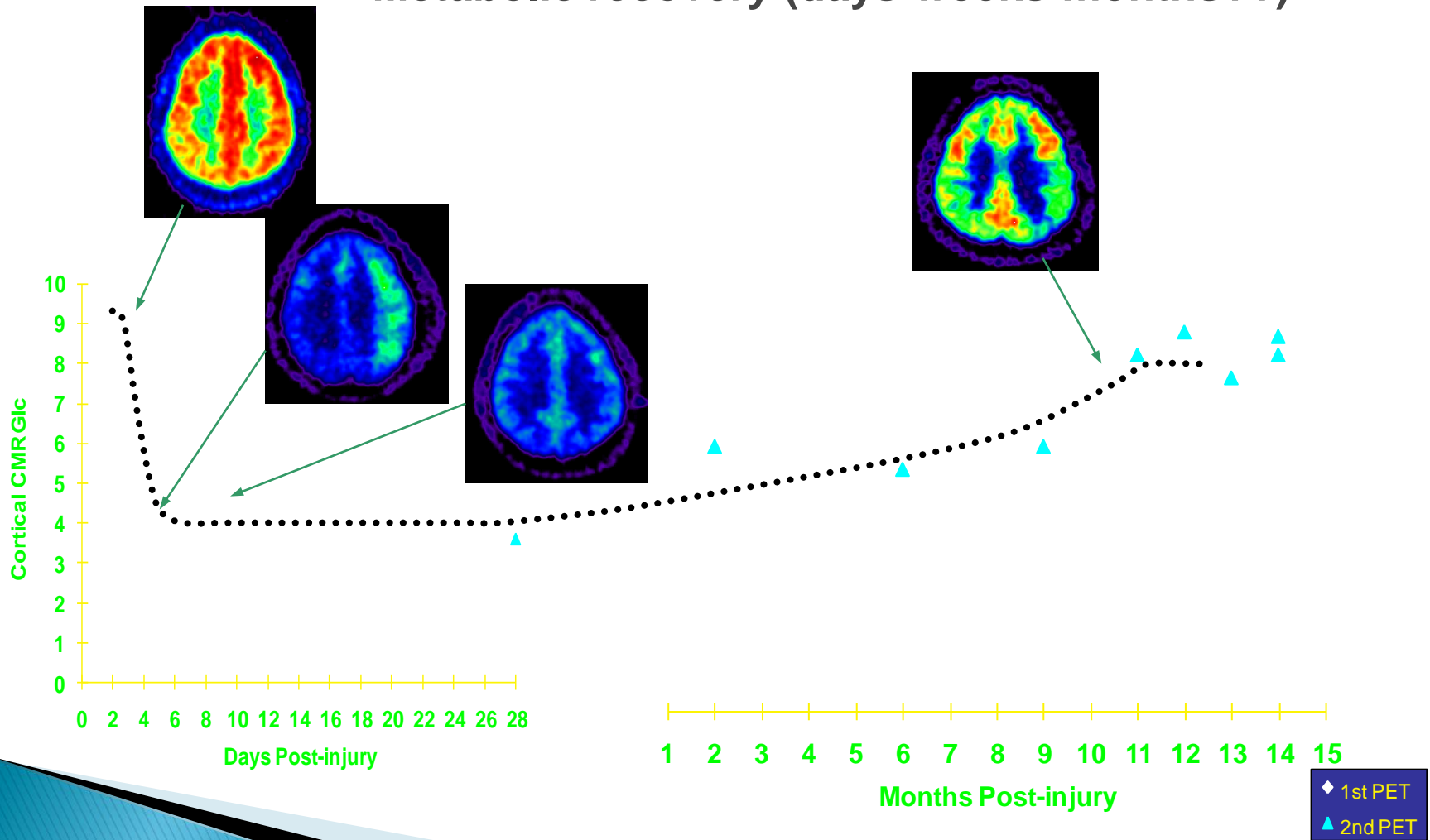


Triphasic metabolic response in humans

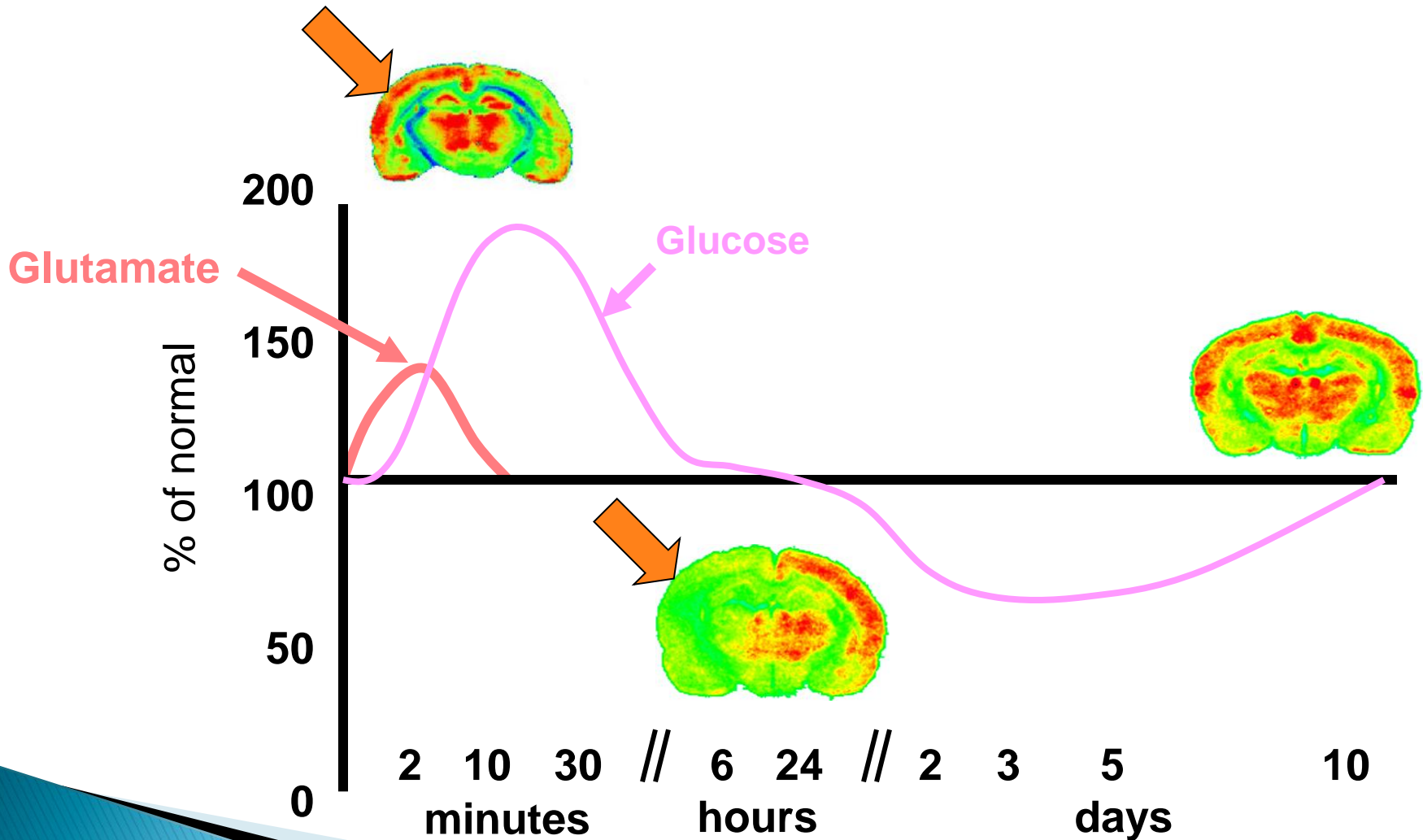
Hyperglycolysis (hours-days??)

Metabolic “depression” (days-months??)

Metabolic recovery (days-weeks-months??)



Neurometabolic Cascade: Glucose Utilization in Animals



By Gone Years

TABLE 49-15 Colorado Medical Society Guidelines for the Management of Concussion in Sports

Grade 1	Confusion without amnesia, no loss of consciousness	Remove from contest. Examine immediately and Every 5 min for development of amnesia or postconcussive symptoms at rest and with exertion. Permit return to contest if amnesia does not appear and no symptoms appear for at least 20 min.
Grade 2	Confusion with amnesia, no loss of consciousness	Remove from contest and disallow return. Examine frequently for signs of evolving intracranial symptoms. Re-examine the next day. Permit return to practice after 1 full wk without symptoms.
Grade 3	Loss of consciousness	Transport from field to nearest hospital by ambulance (with cervical spine immobilization if indicated). Perform thorough neurological evaluation emergently. Admit to hospital if pathologic signs are detected. If findings are normal, instruct family for overnight observation. Permit return to practice only after 2 full wk without symptoms.

Table 4 Initial management following first event

Grade	On-site evaluation	Neurologic evaluation	Same day return to play
Grade 1	Yes	Not required, but may be pursued depending on clinical evaluation	Yes, if normal sideline assessment while at rest and with exertion, including detailed mental status examination
Grade 2	Yes	Yes	No
Grade 3	Yes	Yes	No

November 2004
Prague, Czech Republic
2nd International Conference on
Concussion in Sport.

IS NOW OLD AND OUTDATED!



New and Improved

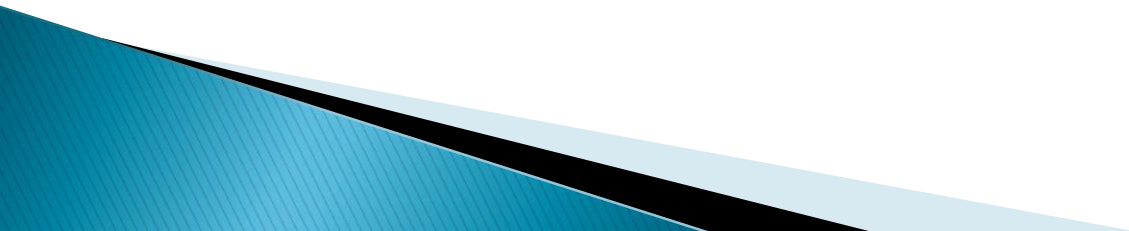
- ▶ Consensus Statement on Concussion in Sport
3rd International Conference on Concussion
in Sport Held in Zurich, November 2008

CONCUSSION SEVERITY

Simple Concussion vs. Complex
Concussion.....

NO LONGER EXISTS !

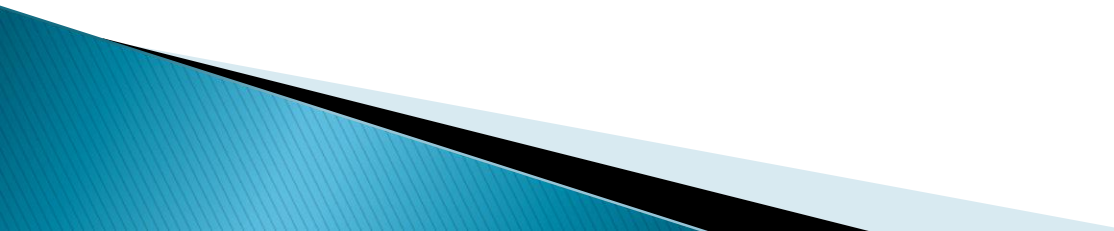
There is only concussions!



CONCUSSION SEVERITY

- ▶ It was also noted that concussion severity could only be determined in retrospect after all concussion symptoms have cleared, the neurologic examination is normal, and cognitive function has returned to baseline.

THE DOWN ATHLETE

- ▶ In the absence of immediate danger, an unconscious injured athlete should remain at the site of the injury until the spine is fully immobilized!
 - ▶ Helmet and shoulder pads should not be removed on the field by EMS personnel!
- 

The SCAT CARD

- ▶ The new scat card is 4 pages long
- ▶ It is designed to help with on field evaluation
- ▶ And with evaluation later on to tract the patients recovery (or lack there of).

Reporting Concussions

- ▶ For NCAA athletes via survey –
 - 6.3% of athletes suffer concussions as observed by trainers
 - 70.4% of players report concussion – like symptoms anonymously

Mental status testing


Orientation	Time, place, person, and situation (circumstances of injury)
Concentration	Digits backward (e.g., 3-1-7-, 4-6- 8-2, 5-3-0-7-4; Months of the year in reverse order
Memory	Names of teams in prior contest; Recall of 3 words and 3 objects at 0 and 5 minutes; Recent newsworthy events; Details of the contest (plays, moves, strategies, etc.)

External provocative Tests	40-yard sprint; 5 push ups; 5 sit ups; 5 knee bends; (any appearance of associated symptoms is abnormal, e.g., headaches, dizziness, nausea, unsteadiness, photophobia, blurred or double vision, emotional lability, or mental status changes)
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Neurologic tests

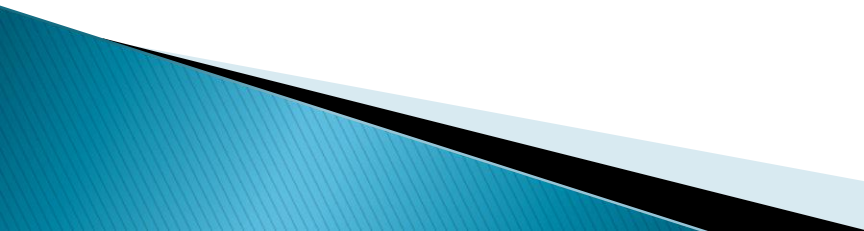
Pupils	Symmetry and reaction
Coordination	Finger-nose-finger, tandem gait
Sensation	Finger-nose (eyes closed) and Romberg

Maddocks Questions

- What field are we at?
 - What team are we playing?
 - What period is it?
 - How far into the period is it?
 - Who scored last?
 - Who did we play last week?
 - Did we win last week?
- 

Management of Concussion: Acute Injury

ANY symptoms or signs of a concussion:

1. The player should not be allowed to return to play in the current game or practice.
 2. The player should not be left alone; and regular monitoring for deterioration is essential over the initial few hours following injury.
 3. The player should be medically evaluated following the injury.
 4. Return to play must follow a medically supervised stepwise process.
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From Michael Collins PhD, AMSSM 2011 – Salt Lake

Which On-Field Symptoms Increase Risk of Post Concussion Syndrome in High School Football Players?

- 176 Male HS Football Players (Mean Age = 16.2 years)
- Athletes had baseline computer NP testing and were reevaluated within 3 days of injury.
- All followed until clinical recovery (**Mean = 4.1 evaluations**)
 - Within RCI of baseline for computer-based neurocognitive/symptom scores
- **32% of sample required < 7 days until recovery (N = 56) “Rapid Recovery” (Mean = 4.9 days)**
- 39% of sample required 7-14 days until recovery (N = 68)
- **17% of sample required > 21 days until recovery (N = 31) “Protracted Recovery” (Mean = 33.2 days)**
- 12% lost to follow up (e.g. did not RTP or no follow-up in clinic) (N = 21)
- MANOVA used to determine differences between rapid/> 3 week recovery
- ATC’s documented on-field markers (e.g. LOC, Amnesia) and on-field Symptoms (e.g. headache, dizziness, etc)



From Michael Collins PhD, AMSSM 2011 – Salt Lake

Which On-Field Markers/Symptoms Predict **3 or More Week**
Recovery from MTBI In High School Football Players **p<.01

On-Field Marker	N	Chi ²	P	Odds Ratio	95% Confidence Interval
Posttraumatic Amnesia	92	1.29	0.257	1.721	0.67-4.42
Retrograde Amnesia	97	.120	0.729	1.179	0.46-3.00
Confusion	98	.114	0.736	1.164	0.48-2.82
LOC	95	2.73	0.100	0.284	0.06-1.37

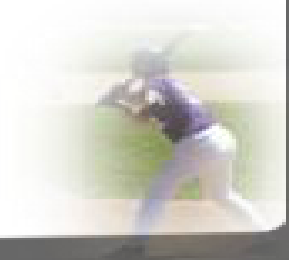
On-Field Symptom	N	Chi ²	P	Odds Ratio	95% Confidence Interval
Dizziness**	98	6.97	0.008	6.422	1.39-29.7
Headache	98	0.64	0.43	2.422	0.26-22.4
Sensitivity LT/Noise	98	1.19	0.28	1.580	0.70-3.63
Visual Problems	97	0.62	0.43	1.400	0.61-3.22
Fatigue	97	0.04	0.85	1.080	0.48-2.47
Balance Problems	98	0.28	0.59	0.800	0.35-1.83
Personality Change	8	0.86	0.35	0.630	.023-1.69
Vomiting	97	0.68	0.41	0.600	0.18-2.04

The total sample was 107. Due to the normal difficulties with collecting on-field markers, there were varying degrees of missing data. The number of subjects who had each coded ranged from 92-98. The N column represents the number of subjects for whom data were available for each category. Markers of injury are not mutually exclusive.

From Michael Collins PhD. AMSSM 2011 – Salt Lake

On-Field Symptom Summary

- ❖ **Brief LOC (<30 sec) not predictive of subacute or protracted outcomes following sports-concussion**
- ❖ **Amnesia important for sub-acute presentation, but may not be as predictive of protracted recovery**
- ❖ **On-Field dizziness best predictor of protracted recovery and “post concussion syndrome”**
- ❖ **Etiology of dizziness?**
 - ❖ **Migraine variant?**
 - ❖ **Central Vestibular Dysfunction?**
 - ❖ **Peripheral Vestibular Dysfunction?**
 - ❖ **Cervicogenic?**
 - ❖ **Psychiatric?**
- ❖ **Need clinical tools/physical examinations to better assess**
 - ❖ **dizziness construct**



Management of Concussion

*A player should never return to play while symptomatic!! **“When in doubt, sit them out!”***

While the athlete is being observed, hide a necessary piece of equipment such as a helmet, to safeguard an ill-advised return to play.

3rd International Conference on CIS, Zurich 2008

TABLE 1. Graduated Return to Play Protocol

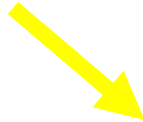
Rehabilitation Stage	Functional Exercise at Each Stage of Rehabilitation	Objective of Each Stage
1. No activity	Complete physical and cognitive rest	Recovery
2. Light aerobic exercise	Walking, swimming or stationary cycling keeping intensity <70% MPHR; no resistance training	Increase HR
3. Sport-specific exercise	Skating drills in ice hockey, running drills in soccer; no head impact activities	Add movement
4. Non-contact training drills	Progression to more complex training drills, eg, passing drills in football and ice hockey; may start progressive resistance training	Exercise, coordination, and cognitive load
5. Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6. Return to play	Normal game play	

Return to Play Process

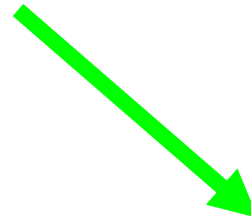
Symptom free at rest



**Symptom free
with exercise**

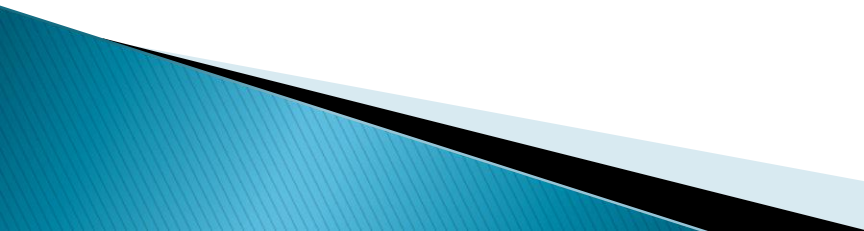


Normal Neuropsychiatric Testing



Return

Return to Play Process

- ▶ There was a change in the Zurich conference
 - ▶ “If you are taking care of professional athletes – there now is a caveat that allows professional level athletes to return to play on the same day....Must be with professional at ease with working with concussions”
 - ▶ This is not current practice guidelines now!!!
 - ▶ Sit them out as you would any other athlete!
- 

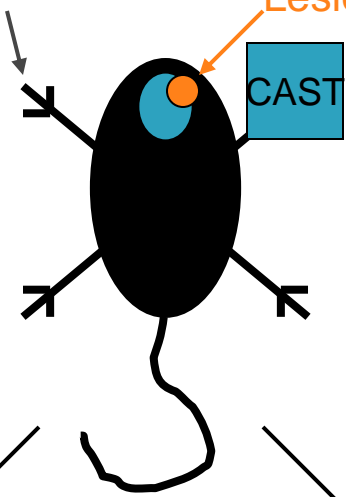
Overuse injury

Focal brain injury causes weakness in the opposite limb.

Weakness

Lesion

If the good limb is casted, then the animal is forced to use the weak limb....



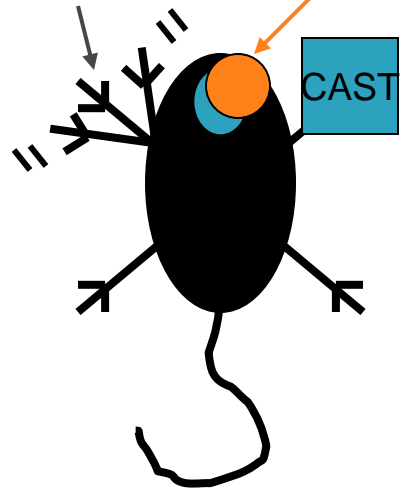
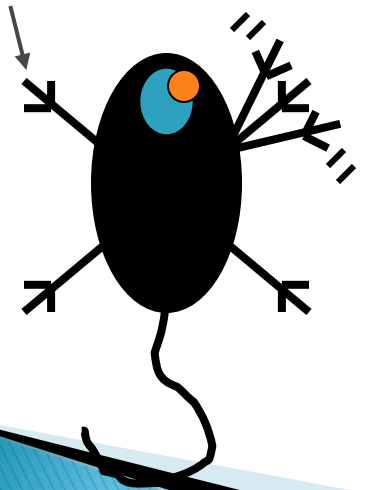
Animal will use the good limb > weak limb during recovery.

....which results in a larger focal brain lesion.

Weakness

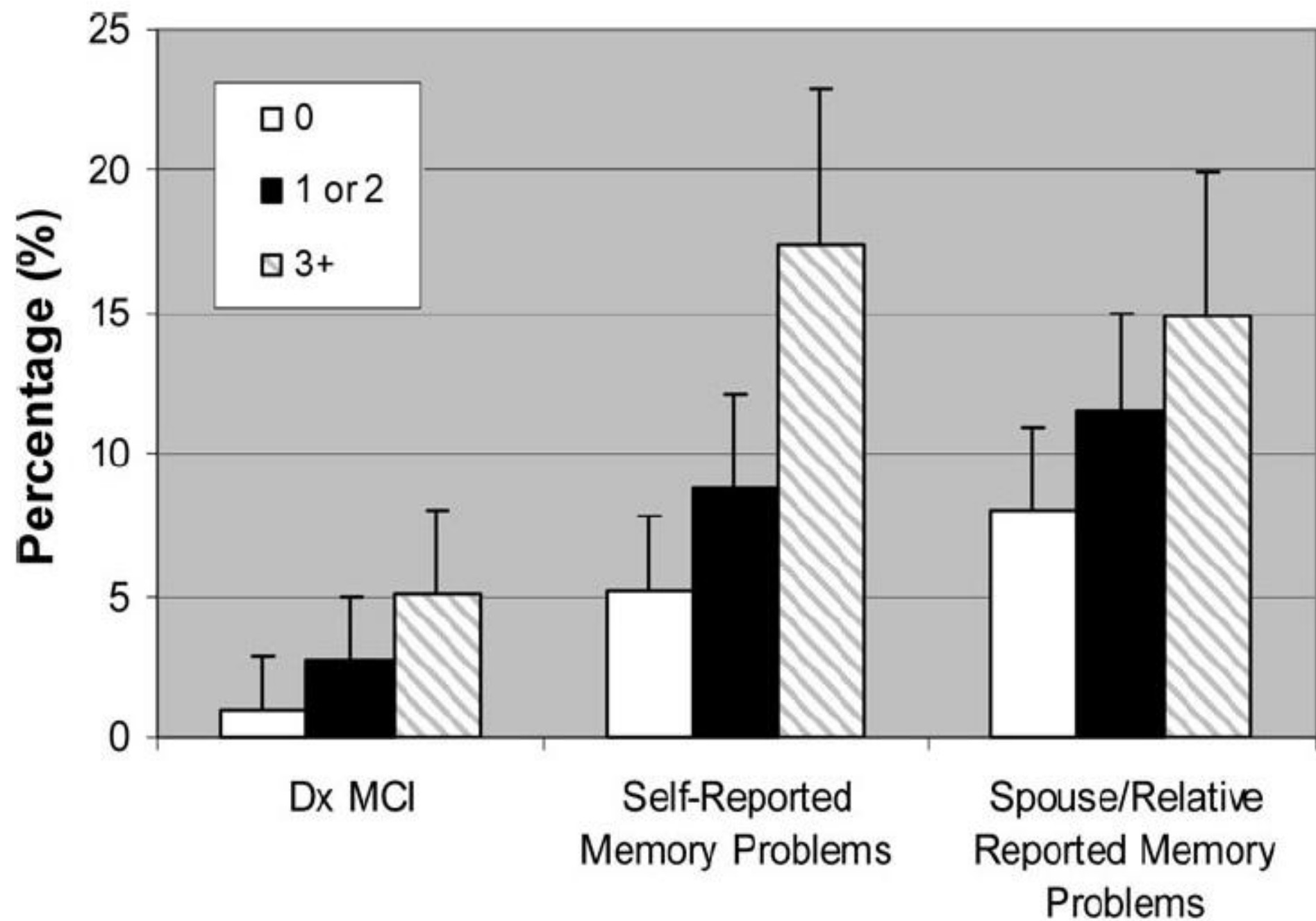
Weakness

Bigger Lesion

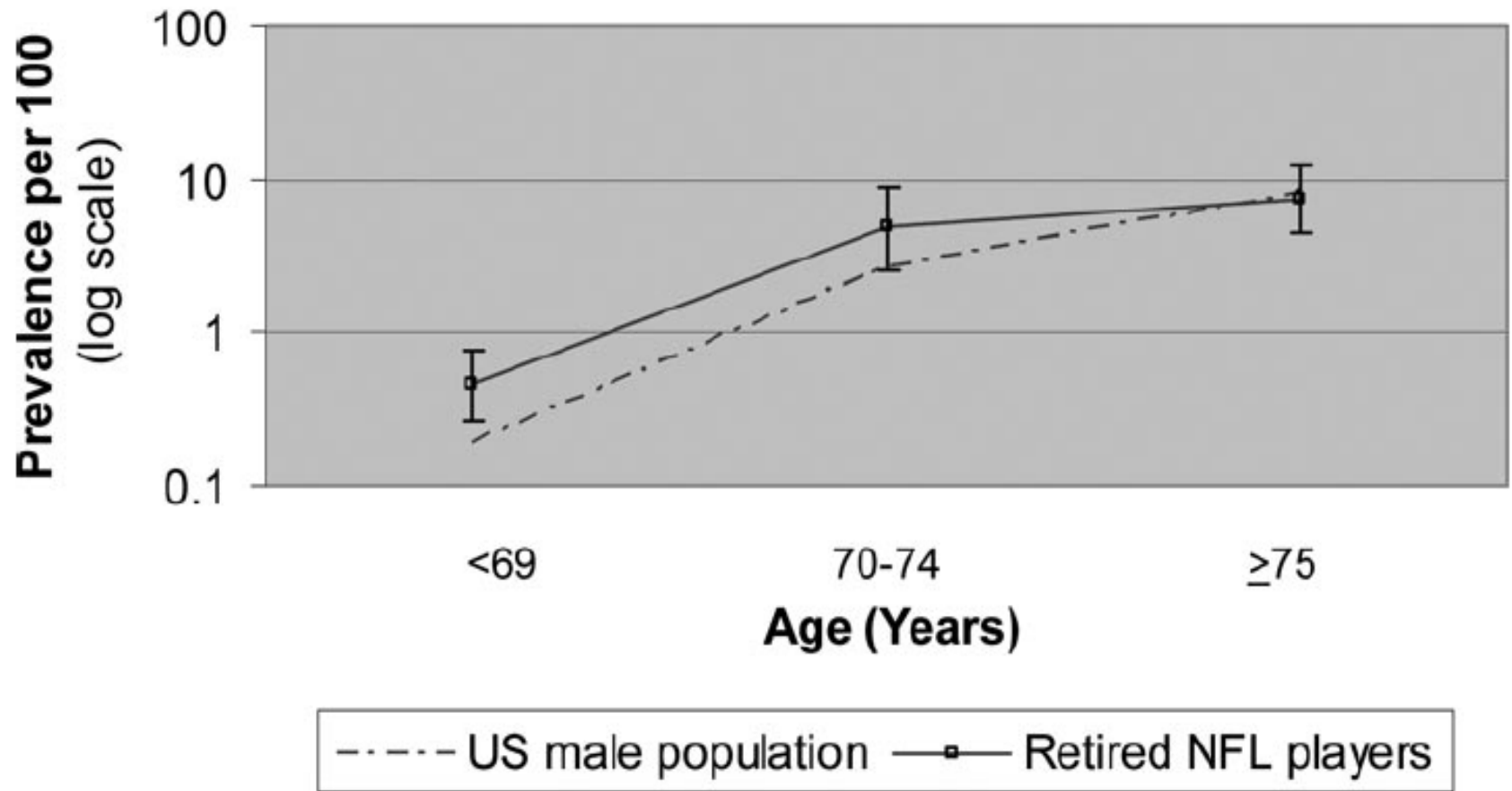


Neuropsychiatric Testing

- ▶ ImPACT
 - www.impacttest.com
- ▶ HeadMinder
 - www.headminder.com
- ▶ CogSport
 - www.cogsport.com
- ▶ ANAM



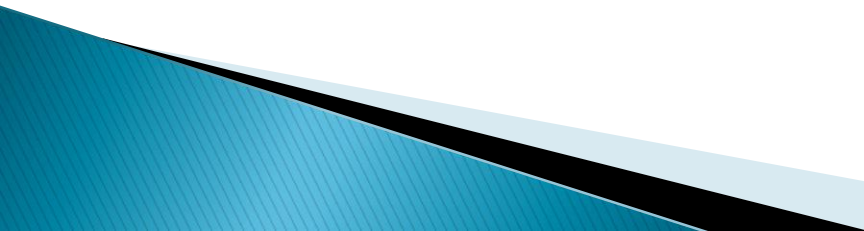
Alzheimer's Disease Prevalence for NFL Retirees and US male population

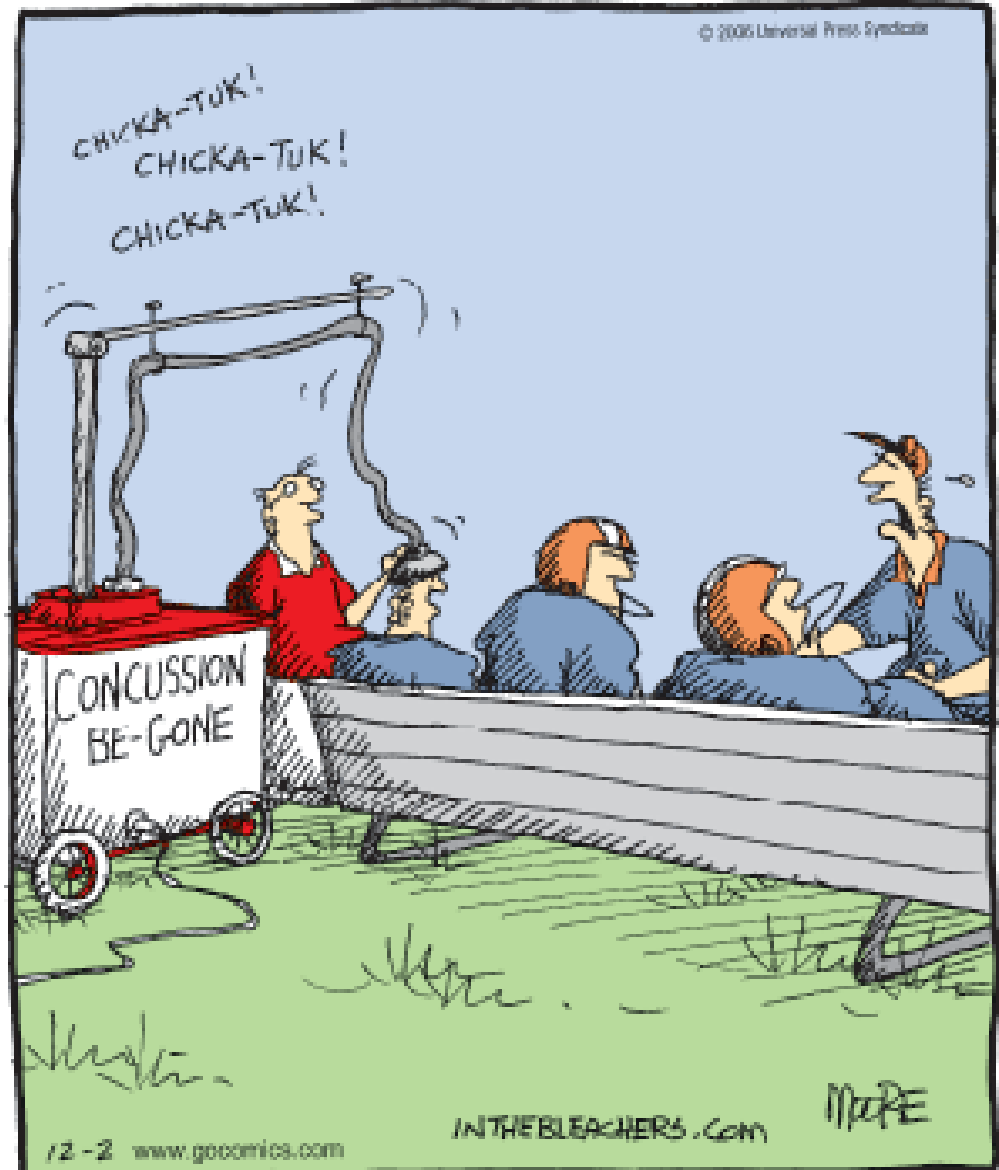


Alzheimers in the NFL

- ▶ In the general population the chance that a 30–49 year old male will have Alzheimer's is 1 in 1,000
- ▶ For ex–NFL Players the chance of Alzheimer's is 1 in 53

Second Impact Syndrome

- An athlete who has sustained an initial head injury, most often a concussion, sustains a second head injury before symptoms associated with the first head injury have fully cleared.
 - Cerebral vascular congestion from loss of autoregulation, cerebral swelling, inc ICP. Death results from transtentorial brainstem herniation. Time course 2–5 minutes
 - 50% mortality rate
- 



"Yo, Dewey! Got another one over here when you're done."