Concussions: What Community Health Care Practitioners Need to Know

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CHEO Pediatric Teleconference
April 1st 2016
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A Child's Brain is a Child's Future

Protect It!!!!

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Objectives

- To give a brief background on concussions
- To describe the pathophysiology (its important…..no really)
- Outline the symptoms
- Acute Management
- Getting them back on the ice
- To describe the long term impact of multiple concussions
- Neuroimaging
- Neurocognitive testing
- Prevention
- Not put anyone to sleep

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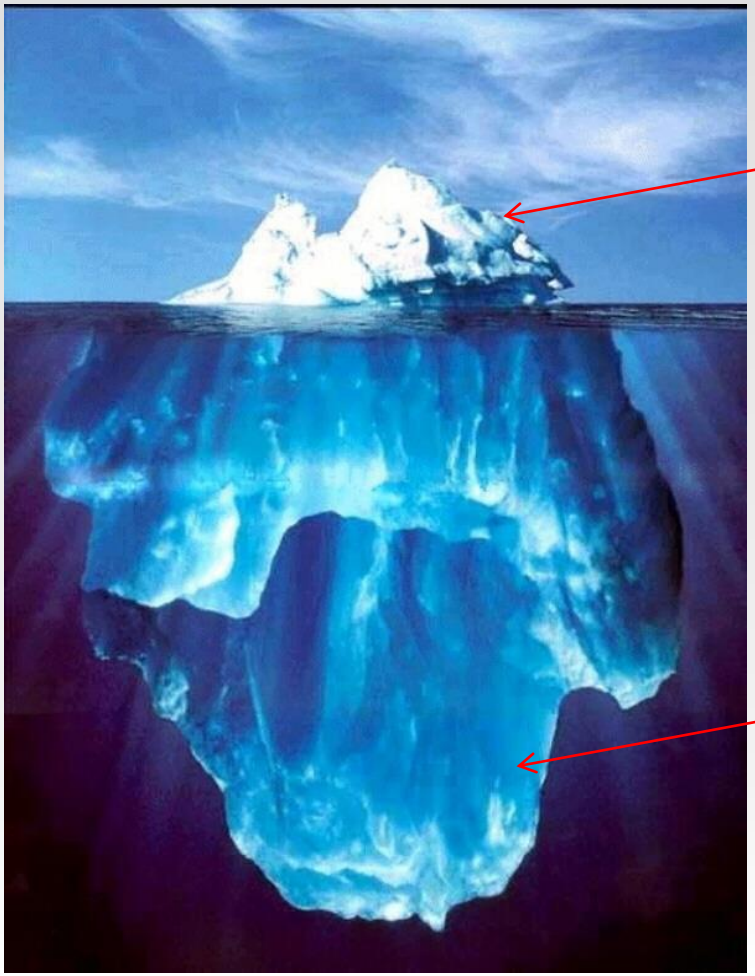
Concussions: Why We Care….

- Up to 4 million sports related concussions every year in the North America
- Kids Can Die (Rowan Stringer)
- Approximately 225,000 new patients each year show long-term deficits from mild TBI,
  - approximately = to the # of patients diagnosed annually with breast cancer, multiple sclerosis, and traumatic spinal cord injury combined*

*Meaney,DF and D.H Smith, Biomechanics of Concussion. Clin Sports Med 30 (2011) 19–31

What we know:



We are here

But every week…..

5 years from now

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"Certain Certainties"

1. 99.97% of minor hockey players wont play Professional Hockey
2. The Average NHL career is less than 100 games

So I tell all kids….

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DEFINITIONS

- *Concussion* is defined as
  - "a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces"
- Truth is there is not an accepted criteria
- Changing Nomenclature

McCrory P, Meeuwisse W, Johnston K, Dvorak J, Aubry M, Molloy M, Cantu R. Consensus Stateent on Concussion in Sport: the 3rd International Conference on Concussion in Sport held in Zurich November 2008. Br J Sports Med. 2009 May;43 Suppl 1:i76-90.

My Definitions

1. Any mental status change following trauma that cannot be attributed to extracranial factors or a preexisting condition

2. 8 day phenomenon

3. Concussion = **Force**
   = “Mass x Acceleration”

Common Themes Of Concussions

1. Short-lived.
   - Indeed *Most* patients are symptom-free within 10 days.

2. Resolution typically follows a sequential course; symptoms may be prolonged.+/- LOC

3. Functional disturbance NOT a structural injury.

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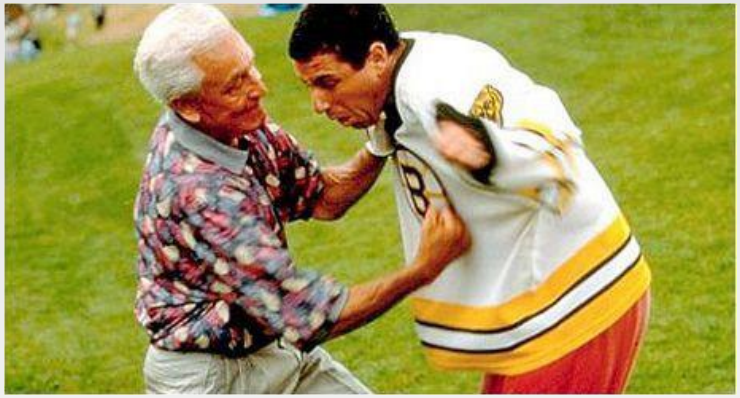
4. May be caused either by a direct blow to the head, face, neck or elsewhere on the body with an ‘‘impulsive’’ force transmitted to the head.

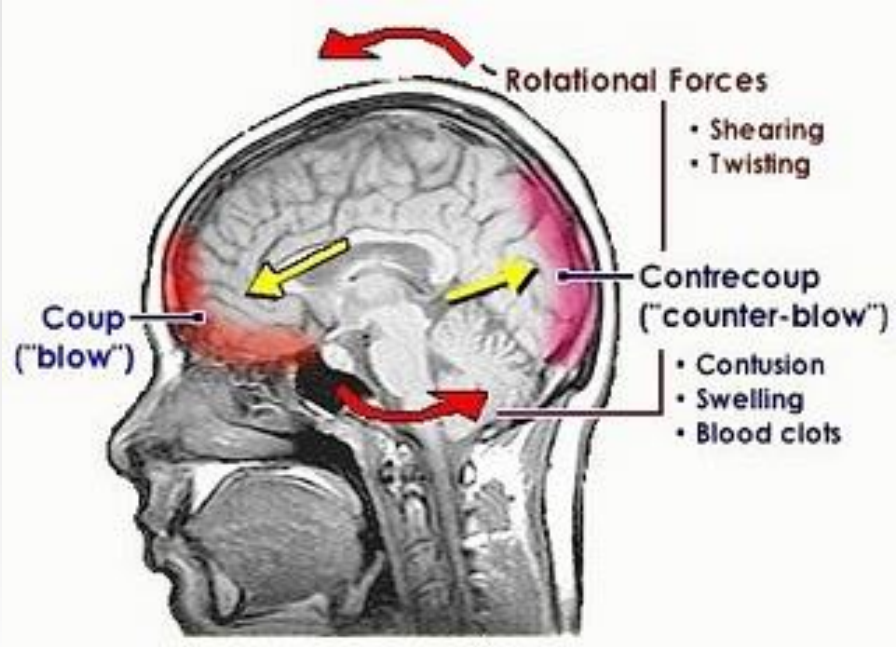


5. Occurs with head injury due to contact and/or acceleration/deceleration forces.

McCrory P, Meeuwisse W, Johnston K, Dvorak J, Aubry M, Molloy M, Cantu R. Consensus Stateent on Concussion in Sport: the 3rd International Conference on Concussion in Sport held in Zurich November 2008. Br J Sports Med. 2009 May;43 Suppl 1:i76-90.

Biomechanics - Acceleration required

- In 1941 Denny-Brown:
- Used a pendulum to hit cats and dogs in the skull.



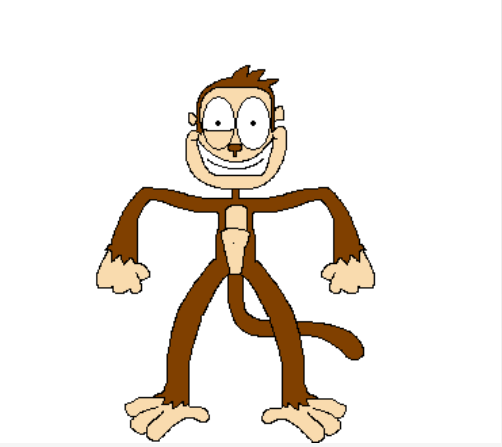
- Denny-Brown, D Brain (1941) 64:93-164

BIOMECHANICAL

Rotational vs Linear Acceleration

- Ommaya and Gennarelli (1974)

- Rotational acceleration is more closely linked to concussion



- Rihn JA, Anderson DT, Lamb K, et al. Cervical spine injuries in American football. Sports Med 2009;39(9):697–708.
- Broglio SP, Schnebel B, Sosnoff JJ, et al. The biomechanical properties of concussions in high school football. Med Sci Sports Exerc 2010;14(1):13–7.

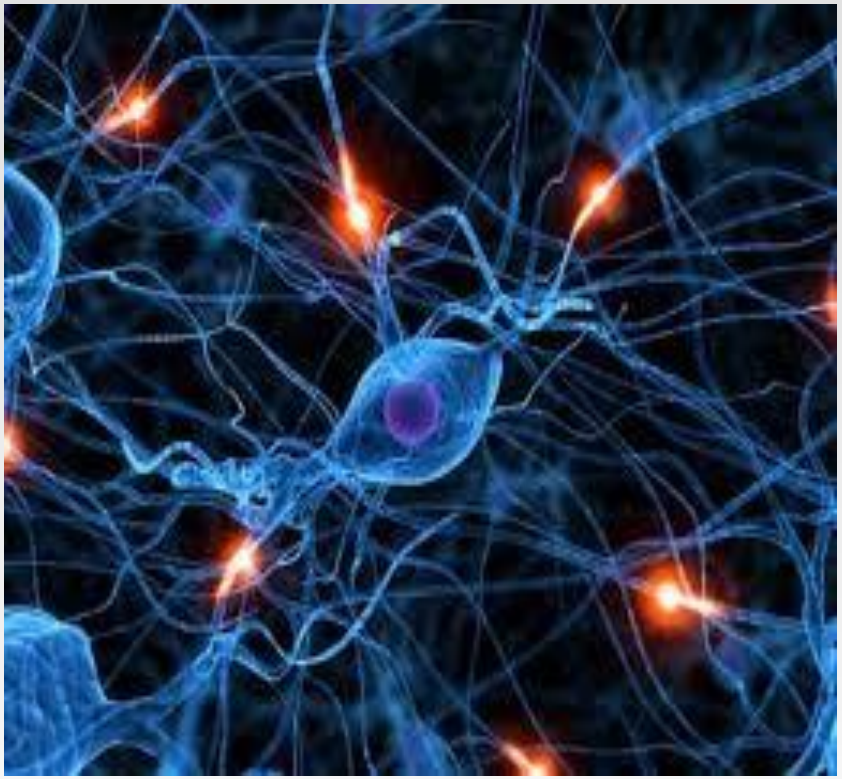
My Additions to the "rule"

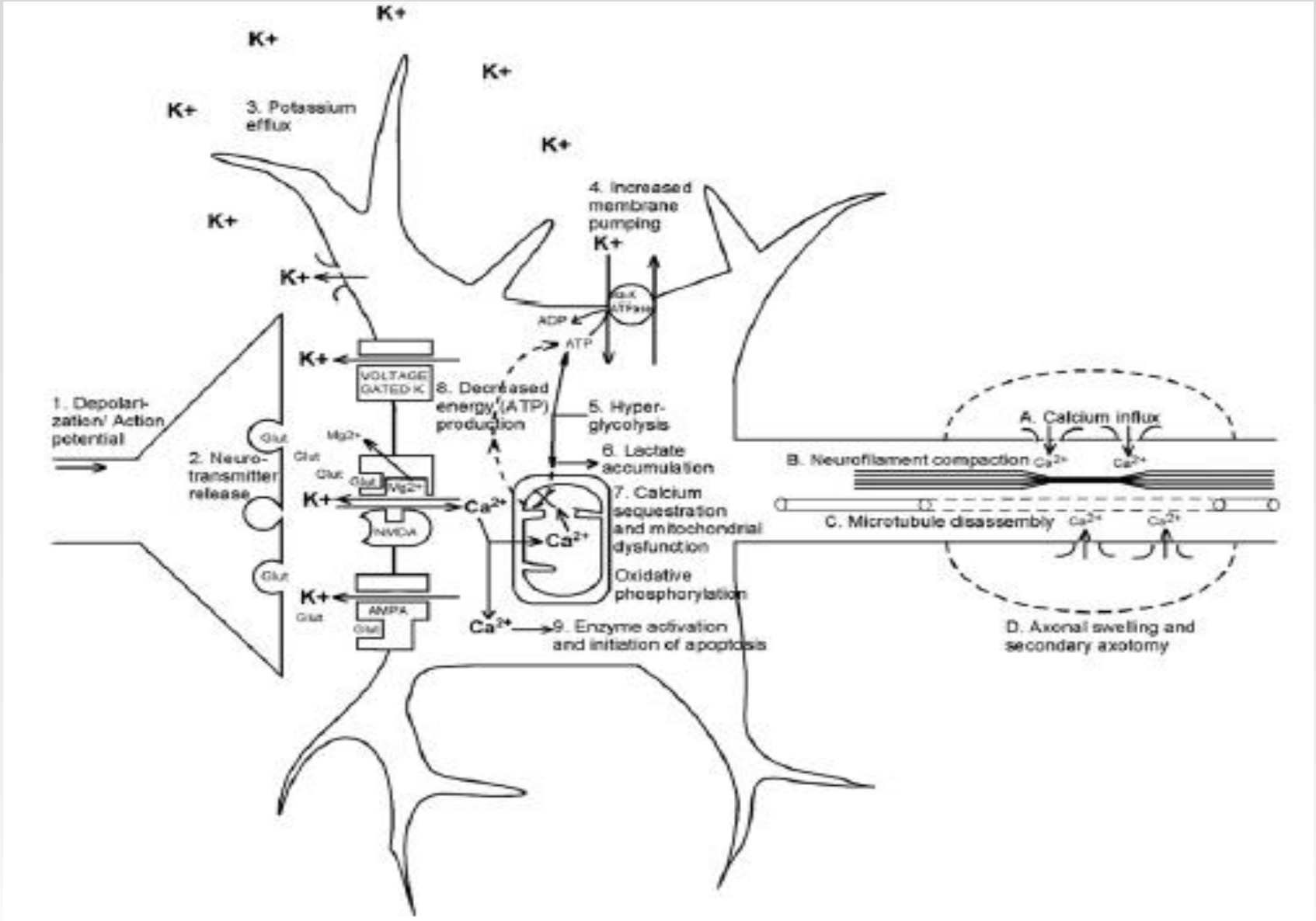
6. You can't predict how any one person is going to recover

7. Often extenuating circumstances influence recovery

Pathophysiology

- In 10 seconds





Barkhoudarian, G., Hovda, DA & CC Giza (2011). The Molecular Pathophysiology of Concussive Brain Injury. Clin Sports Med 30 (2011) 33–48

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EPIDEMIOLOGY: How big a problem is this?

- Up to 3.8 million of concussions occur annually as a direct result of participation in athletics
- High Risk vs Low Risk Sports vs activities of daily living
- An accurate number is difficult to estimate**

- *Langlois JA, Rutland-Brown W, Wald MM. The epidemiology and impact of traumatic brain injury: a brief overview. J Head Trauma Rehabil 2006;21(5): 375–8.
- ** Delaney JS; Abuzeyad F; Correa JA; Foxford R Recognition and characteristics of concussions in the emergency department population. AUDelaney JS; Abuzeyad F; Correa JA; Foxford R SOJ Emerg Med 2005 Aug;29(2):189-97
- Delaney, SJ, Lacroix, VJ, Leclerc, S, et al. Concussions during the 1997 Canadian football league season. Clin J Sports Med 2000; 54:1488.
- *Bernstein DM. 1999. Recovery from mild head injury. Brain Inj 1999 Mar;13(3):151-72*

Concussion Incidence in 8 Contact Sports

- A Metanalysis of 23 studies found Hockey had the greatest incidence of concussions

- 3.6/1000 athlete exposures

Tommasone BA and Valovich McLeod TC 2006 Contact Sport Concussion Incidence. Athl Train. 41(4): 470–472

In HEO

- 20000 Kids
- 4 hours/week
- 36 weeks

- = 10368 concussions/yr

Signs/Symptoms

- Amnesia, retrograde or antegrade
- Disorientation
- Appearing dazed
- Acting confused
- Forgetting game rules or play assignments
- Inability to recall score or opponent
- Inappropriate emotionality
- Physical incoordination
- Imbalance
- Seizure
- Slow verbal responses
- Personality changes
- Headache
- Dizziness
- Nausea or vomiting
- Difficulty balancing
- Vision changes
- Photophobia
- Phonophobia
- Feeling “out of it”
- Difficulty concentrating
- Tinnitus
- Drowsiness
- Sadness
- Hallucinations
- None initially

“Just doesn’t seem right”

- Symptoms may not be apparent until **hours later***
- 9 days (?)

**** McCrory P, Meeuwisse W, Johnston K, Dvorak J, Aubry M, Molloy M, Cantu R. Consensus Stateent on Concussion in Sport: the 3rd International Conference on Concussion in Sport held in Zurich November 2008. Br J Sports Med. 2009 May;43 Suppl 1:i76-90.***

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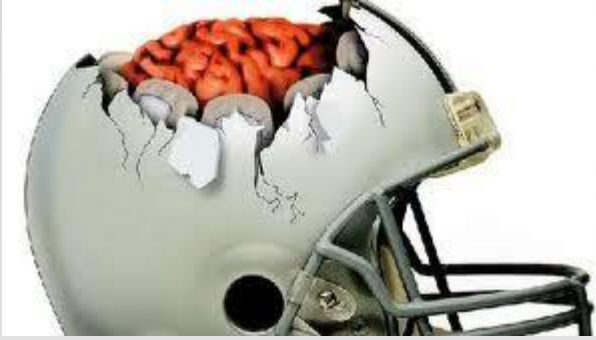
Repeat Insult

- A repeated head injury can result in a prolonged period of PCS (CROSBY) and have more deleterious consequences (SIS).



Second Impact Syndrome

- “Rapid and progressive brain injury resulting from a second episode of closed-head injury while the athlete still is symptomatic from the first episode.” -1984

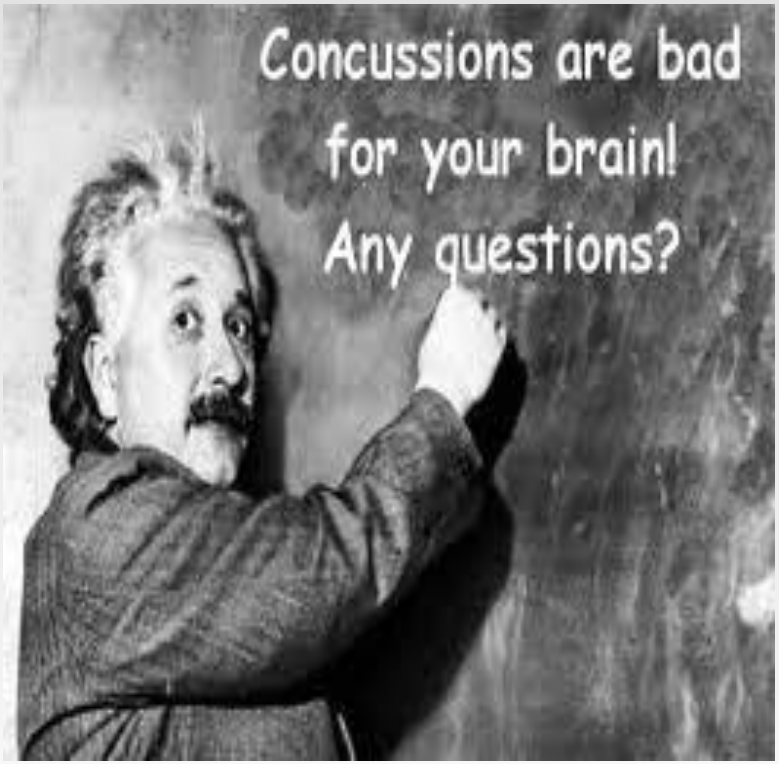
Saunders, RL, Harbaugh, RE. The second impact in catastrophic contact-sports head trauma. JAMA 1984; 252:538.

Collins MW; Lovell MR; Mckeag DB. Current issues in managing sports-related concussion. JAMA 1999 Dec 22-29;282(24):2283-5.

Cantu, RC, Voy, R. Second impact syndrome: a risk in any sport. Physician Sports Med 1995; 23:27

Long Term Effects

- Approximately 225,000 new patients each year show long-term deficits from mild TBI,
  - approximately = to the # of patients diagnosed annually with breast cancer, multiple sclerosis, and traumatic spinal cord injury combined



Meaney,DF and D.H Smith, Biomechanics of Concussion. Clin Sports Med 30 (2011) 19–31

Potential Long Term Effects: Top 10

1. Alzheimer's
2. Learning disability
3. Decreased attention
4. ALS
5. Parkinson's
6. Personality change
7. Depression
8. Suicide Ideation
9. Substance Abuse
10. Chronic Pain Issues

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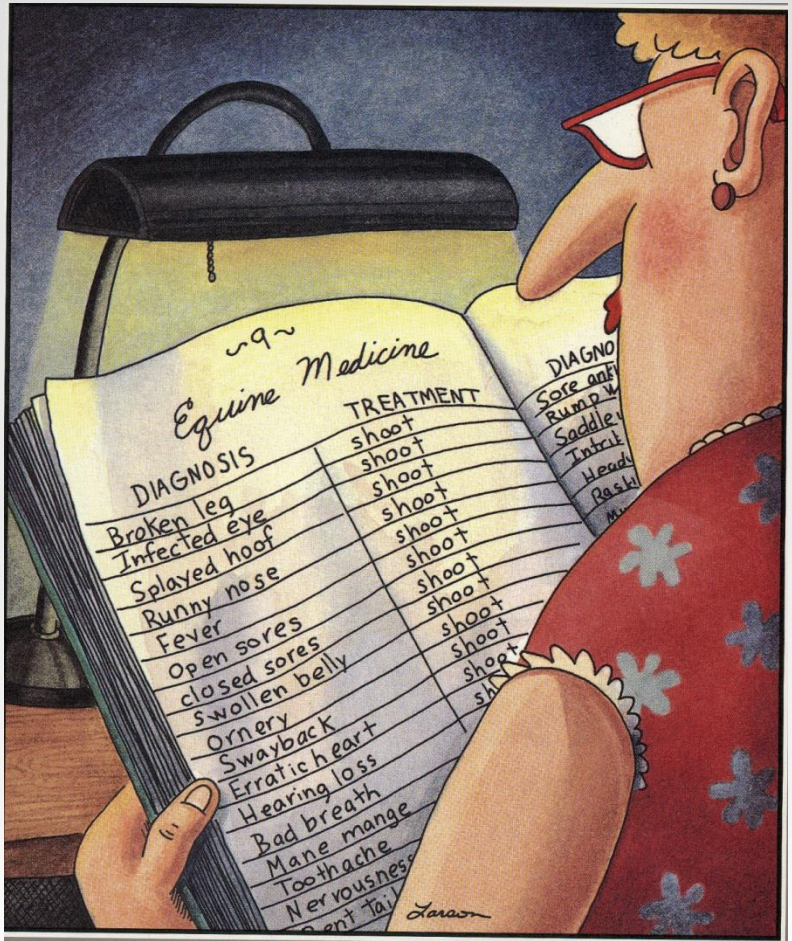
Chronic Traumatic Encephalopathy

- Frequent, diffuse, extracellular amyloid plaques.
- Sparse intraneural neurofibrillary tangles.
- Seen in Alzheimer's Disease, but in a very distinct distribution (antorhinal cortex/hippocampus).

- Omalu, Neurosurgery 2005, "The NFT distribution is notably different from that observed in normal aging and AD."

Management



Like most veterinary students, Doreen breezes through Chapter 9.

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Current Issues

Eval: On the Sideline/Bench

- Depends on the sport

Sideline Assessment of Concussion

Assess orientation and recent events

MADDOCK'S Questions or Westmead Post Traumatic Amnesia Scale

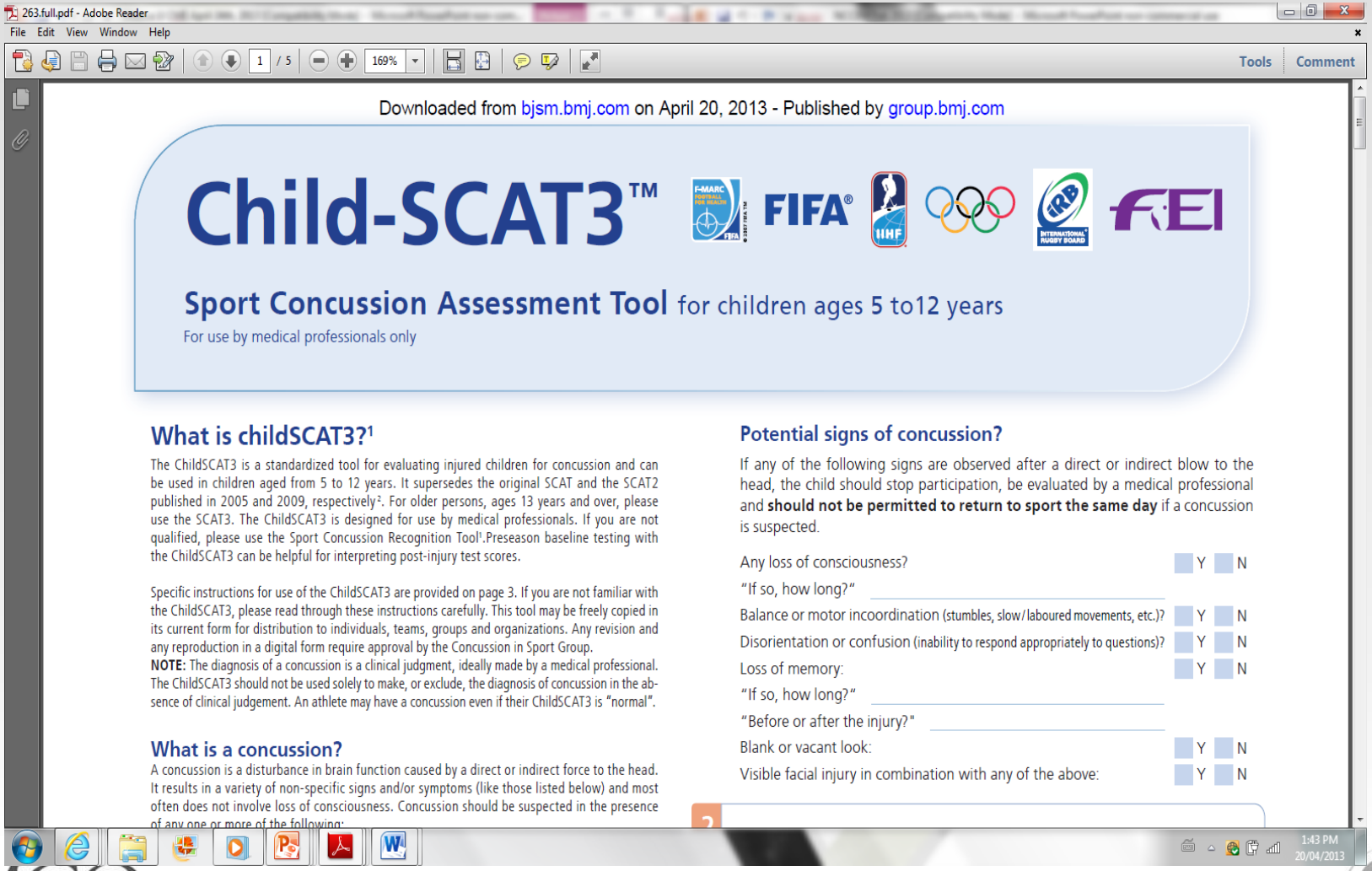
Sports concussion assessment tool (SCAT3) or Child Scat

Neurologic examination*

Postural Stability (BESS), King Devick

Baseline Values

SCAT 3/CHILD SCAT 3



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1 / 5 169% Tools Comment

Child-SCAT3™

Sport Concussion Assessment Tool for children ages 5 to12 years

For use by medical professionals only

What is childSCAT3?[1]

The ChildSCAT3 is a standardized tool for evaluating injured children for concussion and can be used in children aged from 5 to 12 years. It supersedes the original SCAT and the SCAT2 published in 2005 and 2009, respectively[2]. For older persons, ages 13 years and over, please use the SCAT3. The ChildSCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Recognition Tool[1].Preseason baseline testing with the ChildSCAT3 can be helpful for interpreting post-injury test scores.

Specific instructions for use of the ChildSCAT3 are provided on page 3. If you are not familiar with the ChildSCAT3, please read through these instructions carefully. This tool may be freely copied in its current form for distribution to individuals, teams, groups and organizations. Any revision and any reproduction in a digital form require approval by the Concussion in Sport Group.

NOTE: The diagnosis of a concussion is a clinical judgment, ideally made by a medical professional. The ChildSCAT3 should not be used solely to make, or exclude, the diagnosis of concussion in the absence of clinical judgement. An athlete may have a concussion even if their ChildSCAT3 is "normal".

What is a concussion?

A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific signs and/or symptoms (like those listed below) and most often does not involve loss of consciousness. Concussion should be suspected in the presence of any one or more of the following:

Potential signs of concussion?

If any of the following signs are observed after a direct or indirect blow to the head, the child should stop participation, be evaluated by a medical professional and **should not be permitted to return to sport the same day** if a concussion is suspected.

Any loss of consciousness?	Y N
"If so, how long?"	
Balance or motor incoordination (stumbles, slow/laboured movements, etc.)?	Y N
Disorientation or confusion (inability to respond appropriately to questions)?	Y N
Loss of memory:	Y N
"If so, how long?"	
"Before or after the injury?"	
Blank or vacant look:	Y N
Visible facial injury in combination with any of the above:	Y N

2

1:43 PM 20/04/2013

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Maddocks Questions

- ✓ Scientifically validated (any incorrect response indicates concussion)
- ✓ Quick, simple and practical

1. Which field are we at?
2. Which team are we playing today?
3. Who is your opponent at present?
4. Which half/period is it?
5. How far into the half is it?
6. Which side scored the last touchdown/goal/point?
7. Which team did we play last week?
8. Did we win last week?

OK So they have a concussion….What to do next

- Observation is recommended for at least 24 hours after a MTBI because of the risk of intracranial complications.

Commission on Clinical Policies and Research, American Academy of Family Physicians The management of minor closed head injury in children. Committee on Quality Improvement, American Academy of Pediatrics.. SOPediatrics 1999 Dec;104(6):1407-15.

Lawler, KA, Terregino, CA. Guidelines for evaluation and education of adult patients with mild traumatic brain injuries in an acute care hospital setting. J Head Trauma Rehabil 1996; 11:18.

Warning Signs

- The following warning signs should prompt the caregiver to seek immediate medical help:

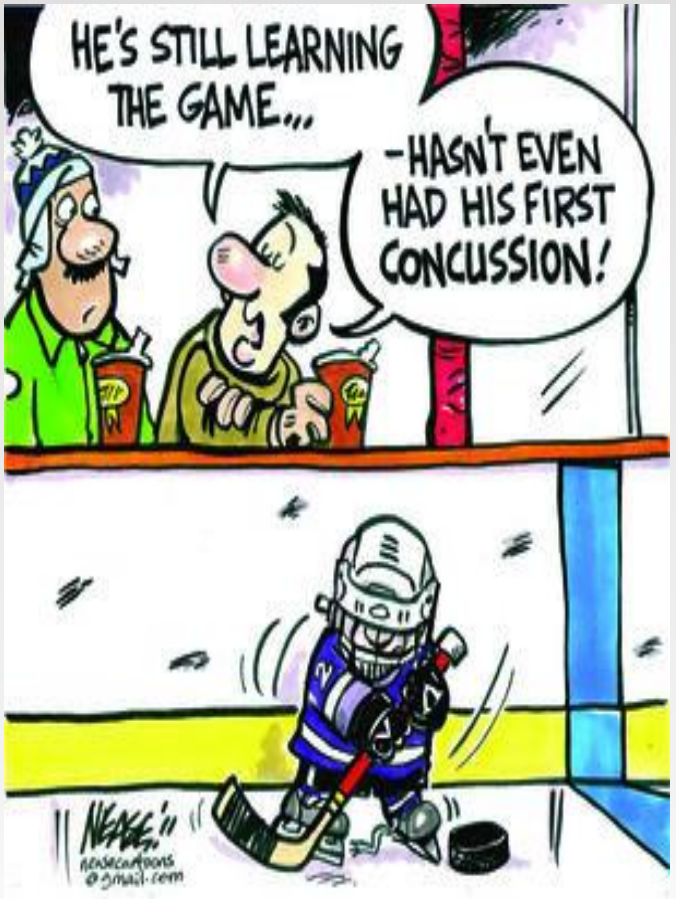
1. Inability to awaken the patient
2. Severe or worsening headaches
3. Somnolence or confusion
4. Restlessness, unsteadiness, or seizures
5. Difficulties with vision
6. Vomiting, fever, or stiff neck
7. Urinary or bowel incontinence
8. Weakness or numbness involving any part of the body

Recovery

- Between 80-90% of kids get better within 10-14 days.
- I wouldn't see these kids (3 week- 1 yr)
- Post Concussion Syndrome?
- Issues arise with preexisting conditions, comorbid conditions, secondary gains etc

Factors Influencing Recovery

- Age
- Gender
- History of prior concussion
- Cognitive reserve
- Pre-existing Medical Conditions



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Multiple Concussions

- Collins et al 1999
  - demonstrated long term mild deficits in executive function with those who suffered more than 2 concussions
  - No definitive consensus on the relationship between the number of concussions and persistent cognitive impairment

- 2003 JAMA Guskiewicz et al
  - ≥3 concussions = 3x more likely to have another concussion
  - ≥3 concussions: 30% had symptoms > 1 week

- 2004 Brain Injury Iverson et al
  - ≥3 concussions = more preseason symptoms
  - ≥3 concussions = 7.7x more likely to have memory problems 2 days after injury

- 2005 Neurosurgery Moser et al
  - ≥2 concussions = same neuropsych scores while symptoms free as 1 week post-concussion for first-time concussions
- 2006 BJSM Iverson et al
  - 1-2 concussions versus 0 = no difference on ImPACT

Multiple Concussions

J Neurotrauma. 2011 Sep 20. [Epub ahead of print]

Repeated mild lateral fluid percussion brain injury in the rat causes cumulative long-term behavioral impairments, neuroinflammation, and cortical loss in an animal model of repeated concussion.

Shultz SR, Bao F, Omana V, Chiu C, Brown A, Cain DP.

University of Melbourne, Medicine, Melbourne Brain Centre, Royal Parade, Level 1, Room 1.02, Parkville, Victoria, Australia, 3050, 61 3 9035 6522, 61 3 9318 1157; sshultz@unimelb.edu.au.

Abstract

There is growing evidence that repeated brain concussion can result in cumulative and long-term behavioral symptoms, neuropathological changes, and neurodegeneration. Little is known about the factors and mechanisms that contribute to these effects. The current study addresses the need to investigate and better understand the effects of repeated concussion through the development of an animal model. Male Long-Evans rats received 1, 3, or 5 mild lateral fluid percussion injuries or sham injuries spaced 5 d apart. After the final injury, rats received either a short (24 h) or long (8 weeks) post-injury recovery period, followed by a detailed behavioral analysis consisting of tests for rodent anxiety-like behavior, cognition, social behavior, sensorimotor function, and depression-like behavior. Brains were examined immunohistochemically to assess neuroinflammation and cortical damage. Rats given 1, 3, or 5 mild percussion injuries displayed significant short-term cognitive impairments. Rats given repeated mild percussion injuries displayed significantly worse short- and long-term cognitive impairments. Rats given 5 mild percussion injuries also displayed increased anxiety- and depression-like behaviors. Neuropathological analysis revealed short-term neuroinflammation in 3-injury rats, and both short- and long-term neuroinflammation in 5-injury rats. There was also evidence that repeated injuries induced short- and long-term cortical damage. These cumulative and long-term changes are consistent with findings in human patients suffering repeated brain concussion, provide support for the use of repeated mild lateral fluid percussion injuries to study repeated concussion in the rat, and suggest neuroinflammation may be important for understanding the cumulative and chronic effects of repeated concussion.

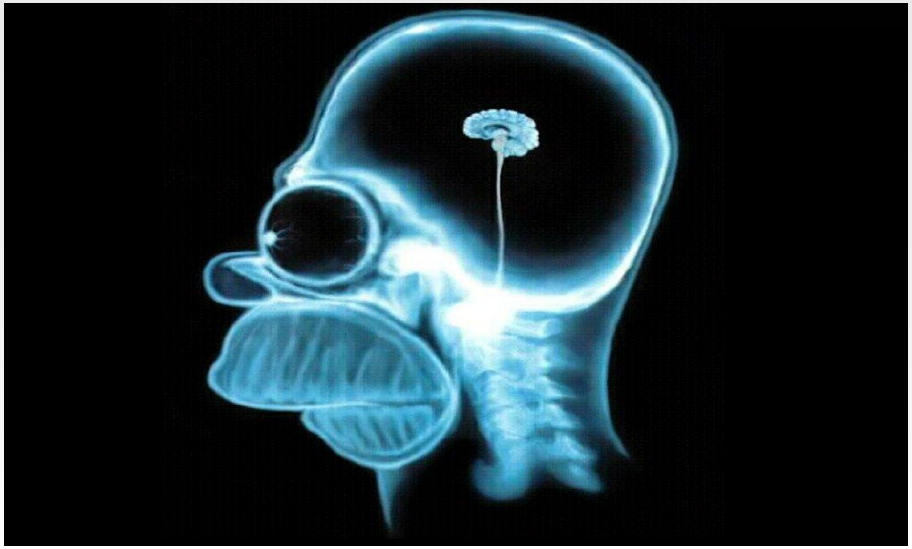
PMID: 21933013 [PubMed - as supplied by publisher]

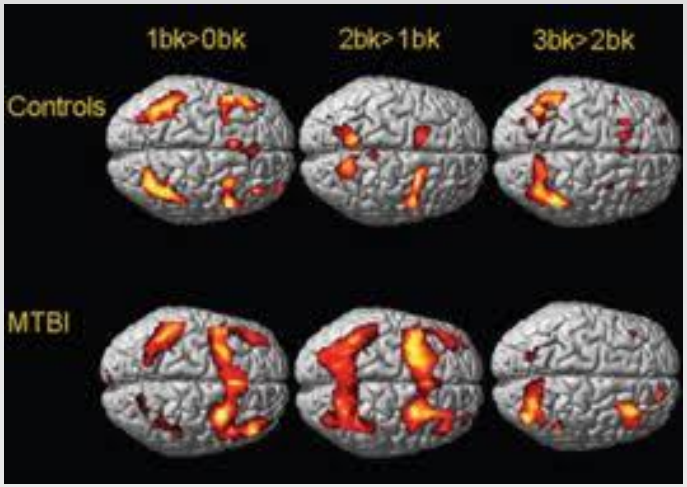
Multiple Concussions: When to call it quits?

- There is no “magic” number
- All areas of grey
- Based on age and how much does the sport mean to them

Neuroimaging

- Neuroimaging is usually normal in patients with a concussion or MTBI
  - This makes managing patients largely based solely on symptoms
- However there is a defined incidence of abnormalities, which may be clinically important





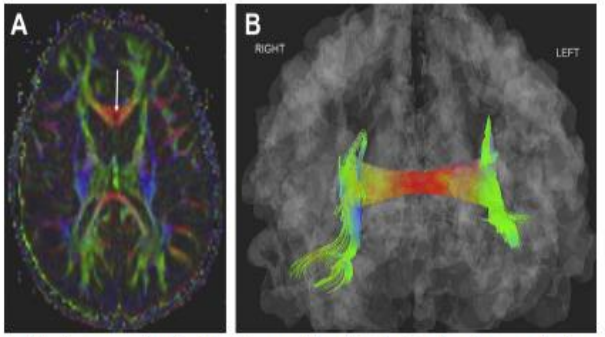


Fig. 3. Diffusion tensor imaging in a 15-year-old male following head trauma during snowboarding. (*A*) Color fractional anisotropy map displayed using the "red, green, blue" convention described in the text. (*B*) Same data reconstructed to provide a 3D tractography image that can be further analyzed to evaluate the integrity of each of the major tracts in the brain.

Wilde et al 2008's study involving adolescents, found increased FA and decreased ADC correlated with the more intense post concussion symptoms and emotional distress when compared with the controls.

Wilde EA, McCauley SR, Hunter JV, et al. Diffusion tensor imaging of acute mild traumatic brain injury in adolescents. Neurology 2008;70(12):948–55.

Treatment

- New School vs Old School

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Treatment

- Goal is to “Clear” them as quickly and safely as possible.
- Return them to school or work and then back to activity
- Medication is always a last resort

General Principles: Initially

1. Limit Cognitive and Physical Stress
   - ➢ But it's a balance
2. Sleep hygiene
3. Hydrate
4. DIET
5. Supplements

"Cleared"

1. Medically cleared
2. Emotionally ready
3. Psychologically ready
4. Cardiovascularly ready

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

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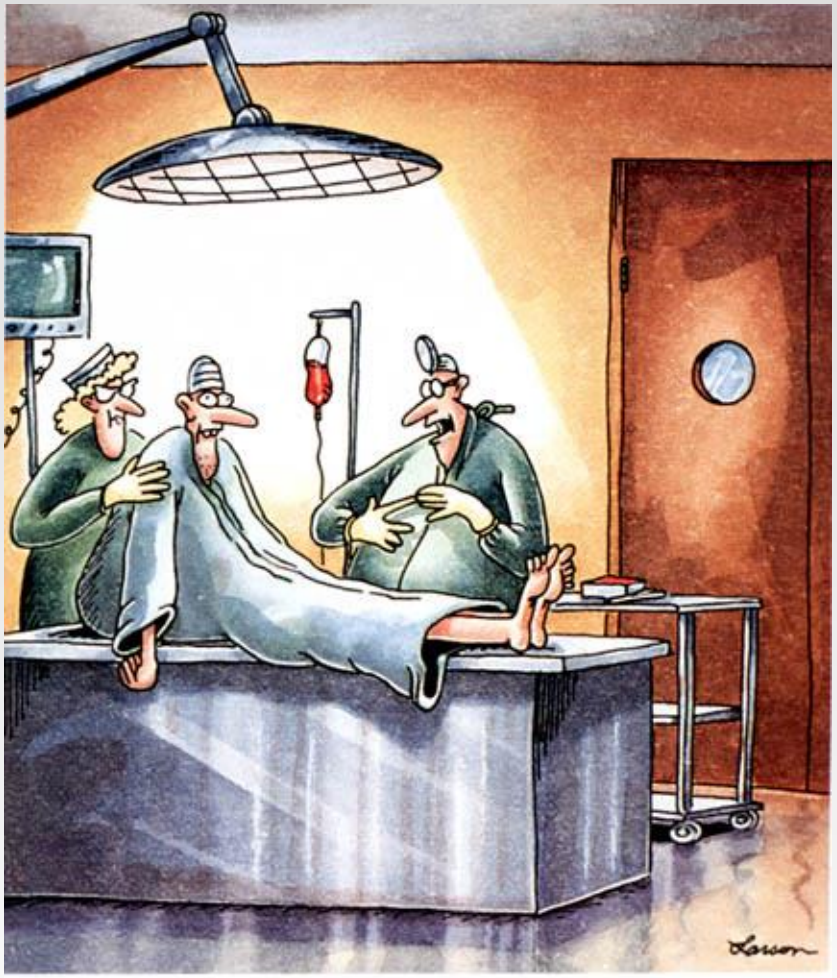
- They DO NOT need to be symptom free before returning to school (this holds true for longer more complex concussions)

- They need to be symptom free and back to school full time before returning to sport

Return To Activity (Cognition)

0	Complete Cognitive Rest	**No reading, homework, text messaging, video game playing, online activity, crossword puzzles or similar activities. The most stimulating activities at this level would be watching television, watching movies or listening to music.**
1	Minimal Cognitive Activity	**No reading, homework, crossword puzzles or similar activity. Less than 5 text messages per day, less than 20 minutes per day of online activity or video games.**
2	Moderate Cognitive Activity	**Reading less than 10 pages per day, doing less than 1 hour of homework per day, less than 1 hour of online activity and video games per day, and less than 20 text messages per day.**
3	Significant Cognitive Activity	**Reading less, doing less homework, working less online, text messaging less, and doing less crossword puzzles or other similar activities than you would normally do, but more than listed in previous levels.**
4	Full Cognitive Activity	**You have not limited your cognitive activity at all.**



"OK, Mr. Dittmars, remember, that brain is only a temporary, so don't think too hard with it."

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Concussion and RTP

- Now there are strict guidelines
  - You are still vulnerable to repeat injury even when your symptoms have resolved
  - 1:1

"Mr. Osborne, may I be excused? My brain is full."

Return To Activity (Physical)

Step	Level of activity
1	No activity, complete rest. Once asymptomatic, proceed to level 2.
2	Light aerobic exercise such as walking or stationary cycling, no resistance training.
3	Sport specific exercise - for example, skating in hockey, running in soccer; progressive addition of resistance training at steps 3 or 4.
4	Non-contact training drills.
5	Full contact training after medical clearance.
6	Game play.

- "Now this is not the end. It is not even the beginning of the end, but it is, perhaps, the end of the beginning.``

Links for Concussion Information

Required concussion course for Mass Coaches/Staff:
www.nfhslearn.com/electiveDetail.aspx?courseID=15000
www.cdc.gov/Concussion

General concussion informational links:
www.cdc.gov/concussioninyouthsports
www.thinkfirst.ca
www.concussioncentre.com

For Coaches:
www.cdc.gov/concussion/pdf/Coach_Guide-a.pdf
www.cdc.gov/concussion/pdf/coaches_Engl.pdf
For School Nurses:
www.cdc.gov/concussion/HeadsUp/schools.html
For Athletes/Parents:
www.cdc.gov/concussion/pdf/athletes_Eng.pdf
www.cdc.gov/concussion/pdf/parents_Eng.pdf

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