



UR
MEDICINE

GOLISANO
CHILDREN'S HOSPITAL

Concussion in the Pediatric Patient: An Update

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MEDICINE *of* THE HIGHEST ORDER

Learning Objectives

1. Describe the physiologic injury that occurs in concussion
2. Describe the particular risk and burden of concussion in the pediatric population
3. Describe the most current guidelines regarding pediatric concussion management including Return-to-Learn and Return-to-Play

Disclosures

- There are no relationship or commercial sponsorships to disclose

Concussion defined : Mild Traumatic Brain Injury

- Traumatically induced, transient disruption in brain *function* that results from a complex pathophysiologic process
- Concussion injury is a result of direct or indirect biomechanical forces to the head.
- The injury initiates a 'neuro-metabolic cascade' that follows *microscopic axonal injury* and involves alterations in the axon's normal ionic and metabolic functions.
- This disruption requires increased energy use to repair, but decreased cerebral blood flow and disruptions of mitochondrial function results in imbalances in supply & demand

Am Med Society for Sports Medicine position statement: concussion in sport 2013

Neurometabolic Cascade

Mechanical impact or Force (Linear & rotational) →

→ Mechanical stretch and injury to axons →

→Release of excitatory Neurotransmitters

→Disruption of ion channels

→-Efflux of K^+ from and influx of Ca^{2+} into the neuron

→ Results in cellular inflammation (microglial activation)and diminished blood flow hinder cell's ability to function normally

→ Na^+/K^+ Pump overworked attempting to restore balance

→ Increased need for ATP to restore ionic balance, repair the neuron while continuing 'normal' neurologic functioning

→ Increased Glycolysis leads to Lactic Acid production

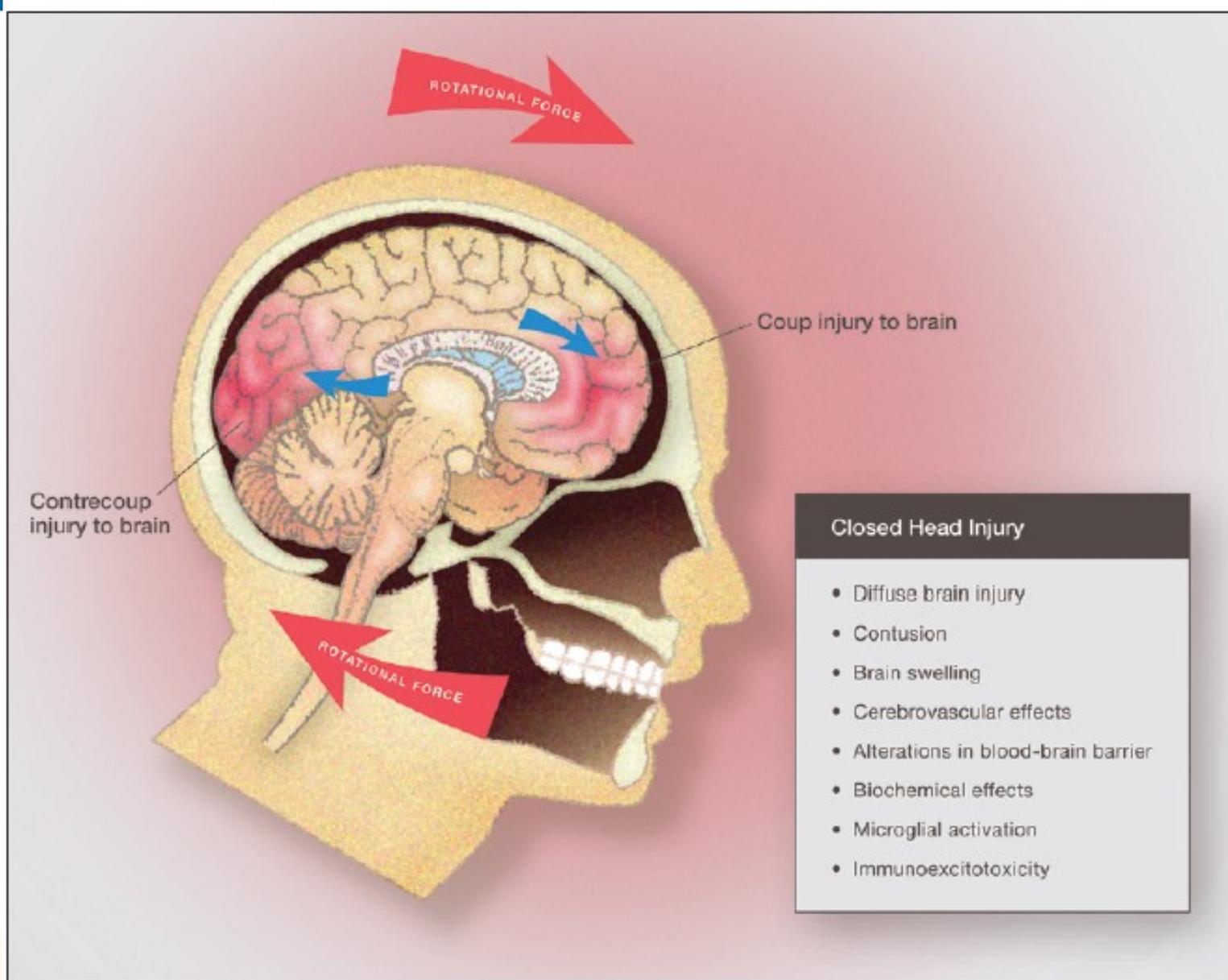
→ Acidosis contributes to impaired cellular function & cerebral edema

→Influx of Ca^{2+} impairs mitochondrial production of ATP

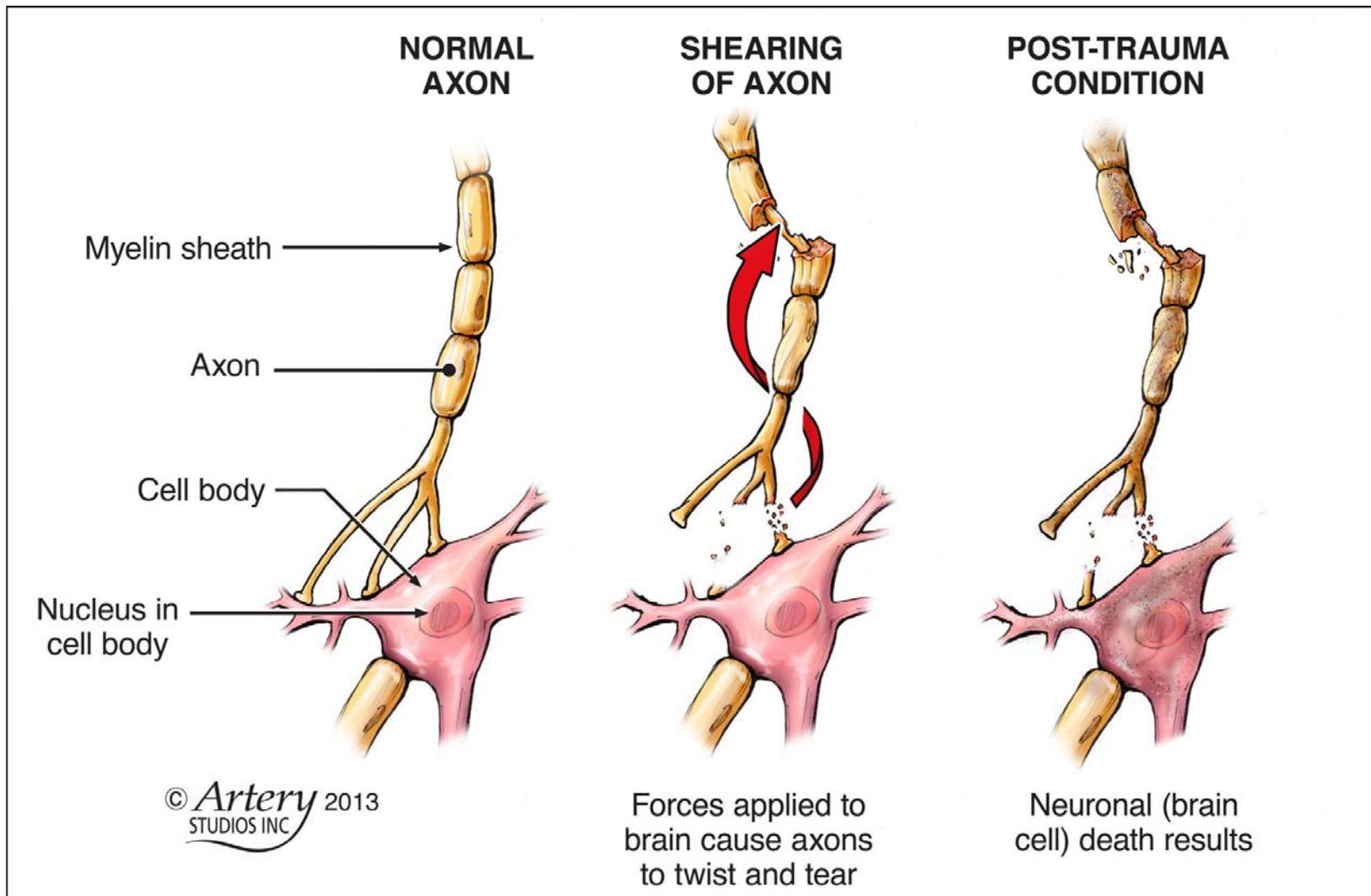
→ Cellular energy crisis

→ **Clinical symptoms of concussive injury**

Mechanical forces in Concussive Injury



Neuronal Injury in Concussion



Cellular Processes affected

- Derangement in ion functioning
- Neurotransmitter release
- Alterations in cerebral blood flow; perfusion, autoregulation & vasospasm
- Alteration in metabolism; increased ATP requirement coupled with mitochondrial dysfunction (hence, decreased ability to produce ATP)
- Slowed synaptic functioning
- Altered axonal connectivity
- Possible cell death

Meeryo, et al. A pediatric perspective on concussion pathophysiology. *Current Opinion Pediatrics* 2012, 24; 689-695

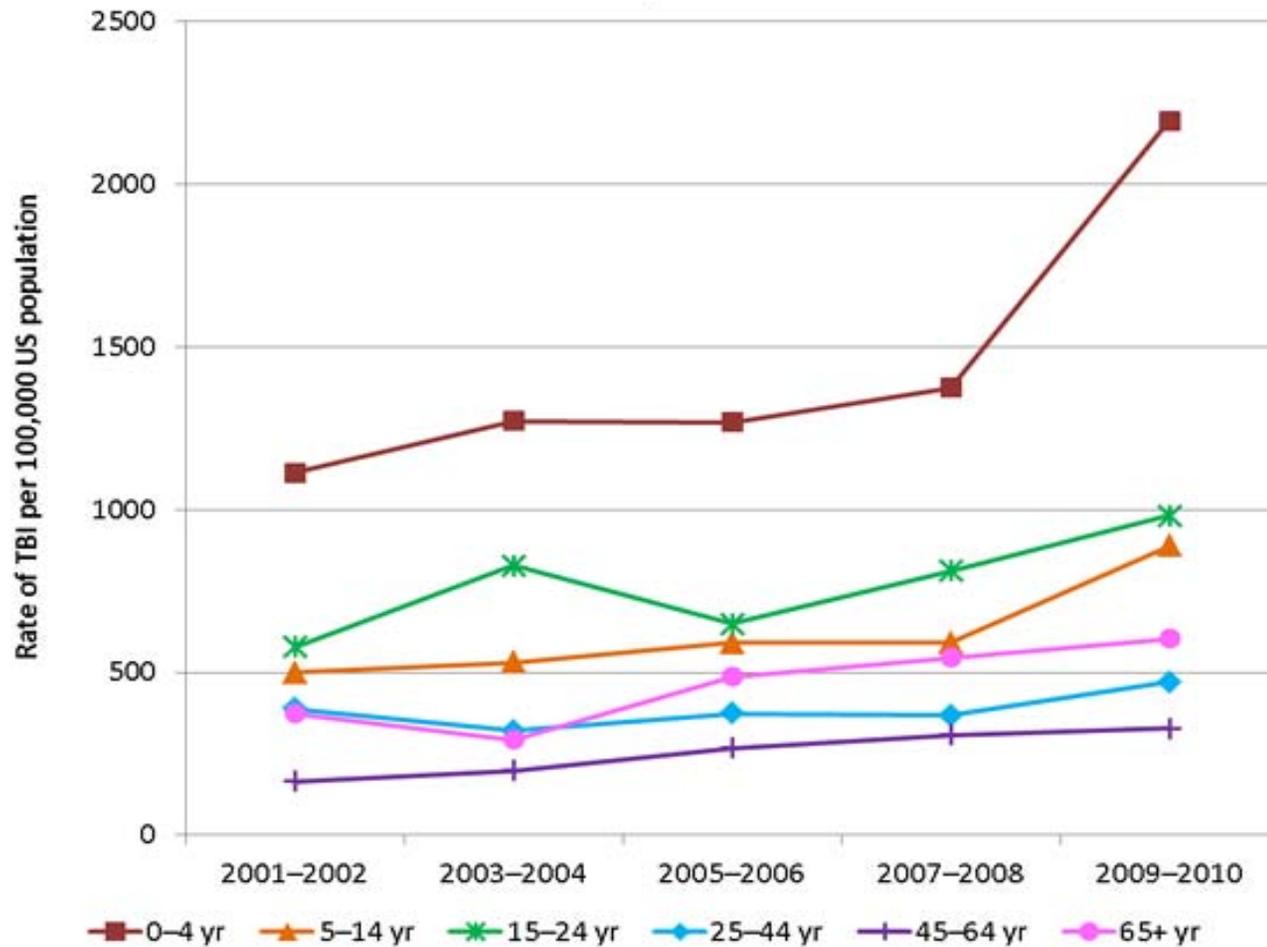
Concussive injury

- Symptoms are a direct result of the brain trying to function in the presence of this metabolic imbalance
- Concussed brain is less responsive to neural activation; premature cognitive & physical activity may prolong dysfunction
- Until recovery is achieved, there is increased vulnerability to second injury and that such injury results in worsening of the metabolic derangements at the cellular level
- Symptoms of concussion are often more pronounced in children and adolescents, raising concern for unique impact of concussion on the immature brain

Some Statistics

- Direct & indirect costs from MTBI totaled an estimated \$12 billion in the US in 2000
- In 2010 >2.5 million people were seen with TBI in ED's nationwide
- In 2009 estimated 248,418 persons < 19 years of age sustained a head injury annually from sport & recreational activities (CDC, MMWR, 10/2011)
- During the last decade the number of sport & recreational concussions in children and adolescents have increased by 60% (Gilchrist, et al. MMWR 2011:60(39);1337-42)
- A history of concussion is associated with a 2-5.8 times >risk of a repeat concussive injury

Rates of TBI-related ED Visits by Age Group- USA 2001-2010



More data...

- Highest number of TBI ED visits in children and adolescents were related to bicycling, football, playground activities, basketball and soccer
- Numbers and rates are the highest for football and girl's soccer
- Fewer than 10% of sports-related concussions have associated loss of consciousness & 25% have some degree of amnesia.
- 71% of sport & recreation-related TBI ED visits were in males
- 70.5% of all sport & recreation-related TBI ED visits were among 10-19 years old
- *Children and teens are more likely to get a TBI, including concussion, and generally take longer to recover than adults*

Most Current Concussion Guidelines

1. Consensus Statement on Concussion in Sport- The 4th International Conference on concussion in Sport held in Zurich, November 2012
2. Summary of Evidence-based Guideline Update: Evaluation and management of concussion in sports: Report of the Guideline Development Subcommittee of the American Academy of Neurology, March 2013
3. American Medical Society for Sports Medicine position statement: concussion in sport, October 2012
4. CDC, Heads Up to Concussion program, 2003- present

Source	American Medical Society for Sports Medicine[3]	American Academy of Neurology[4]	Zurich Consensus Working Group[5]
Diagnosis/Evaluation Recommendations	<ul style="list-style-type: none"> ● Remains a clinical diagnosis to be made by licensed health care providers ● Graded symptoms checklist ● Cognitive evaluation (including orientation, past and present memory, new learning, and concentration tests) ● Balance testing ● Neurological physical exam ● Standardized assessment tools ● Baseline testing (effects are currently unclear but is becoming common practice among experts) 	<ul style="list-style-type: none"> ● Graded symptoms checklist ● Use of the Standardized Assessment of Concussion (standardized sideline evaluation tool that assesses orientation, immediate memory, delayed recall, and concentration) - can be used by non physicians ● Balance Error Scoring System (assesses balance) ● Neuropsychological assessments ● Combining the diagnostic tests mentioned above will likely increase diagnostic accuracy 	<ul style="list-style-type: none"> ● Initial assessment of symptoms + continued serial assessments ● Immediate evaluation of cognition through brief neuropsychological (NP) tests, like SCAT3 or SAC. ● Detailed history of event and past concussion history ● Gait and balance testing ● Comprehensive neuropsychological testing performed by a neuropsychologist (not part of immediate sideline evaluation, in which abbreviated NP testing is recommended) ● Baseline assessments are recommended although research in this area is limited
Recommendations Based Upon:	Uses a strength of recommendation taxonomy (SORT) to grade recommendations based upon a review of the literature.	Systematic literature review from 1955 to 2012. Assessed the evidence level in coming up with recommendations.	4th International Conference on Concussion in Sport held in Zurich, November 2012. A consensus statement was formulated that incorporated data from a systematic literature review, in conjunction, with expert opinions.

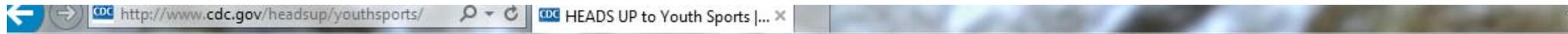
What does this mean? Why so many guidelines?

- Inadequate consensus and too little evidence-based data to support a specific approach
- Research is being done on *athletic* concussions, but management for all concussion is based on the same principles
- Concussion remains a clinical diagnosis based more on clinical judgment than results on any currently available concussion-related tools
- No current concussion tools that are universally accepted to measure presence or severity of concussion or to predict recovery time
- Imaging can only rule out hemorrhage

So what can be done for these kids??

- Understand the risks for children and when those risks are most concerning
- Know the rules in your state that schools are required to operate by concerning concussion and utilize resources in the school to help children with concussion return to full functioning
- Know your local and internet resources for support in providing good concussion care
- Use these resources to find a fair balance between safety and risk in getting children back to full participation at school & sport

Helpful online resource



- HEADS UP
- Brain Injury Basics +
- Helmet Safety
- HEADS UP to Parents
- HEADS UP to Youth Sports -**
- Online Concussion Training
- Coaches
- Parents
- Athletes
- Sports Officials
- Atención: Conmoción Cerebral en el Deporte Juvenil
- HEADS UP to High School Sports +
- HEADS UP to Schools +
- HEADS UP to Health Care Providers +
- Sports Concussion Policies and Laws

[CDC](#) > [HEADS UP](#)

HEADS UP to Youth Sports



To help ensure the health and safety of young athletes, CDC developed the HEADS UP Concussion in Youth Sports initiative to offer information about concussions to coaches, parents, and athletes involved in youth sports. The HEADS UP initiative provides important information on preventing, recognizing, and responding to a concussion.

Specific Concussion Information for...

Coaches



Concussion resources for youth sports coaches

[More >](#)

Parents



Concussion resources for parents of youth athletes

[More >](#)

Sports Officials



Concussion resources for youth sports officials

[More >](#)

Young Athletes



Concussion resources for youth athletes

[More >](#)

Another resource available on line:

Guidelines for Concussion Management in the School Setting



The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Office of Student Support Services
Albany, New York 12234
June 2012

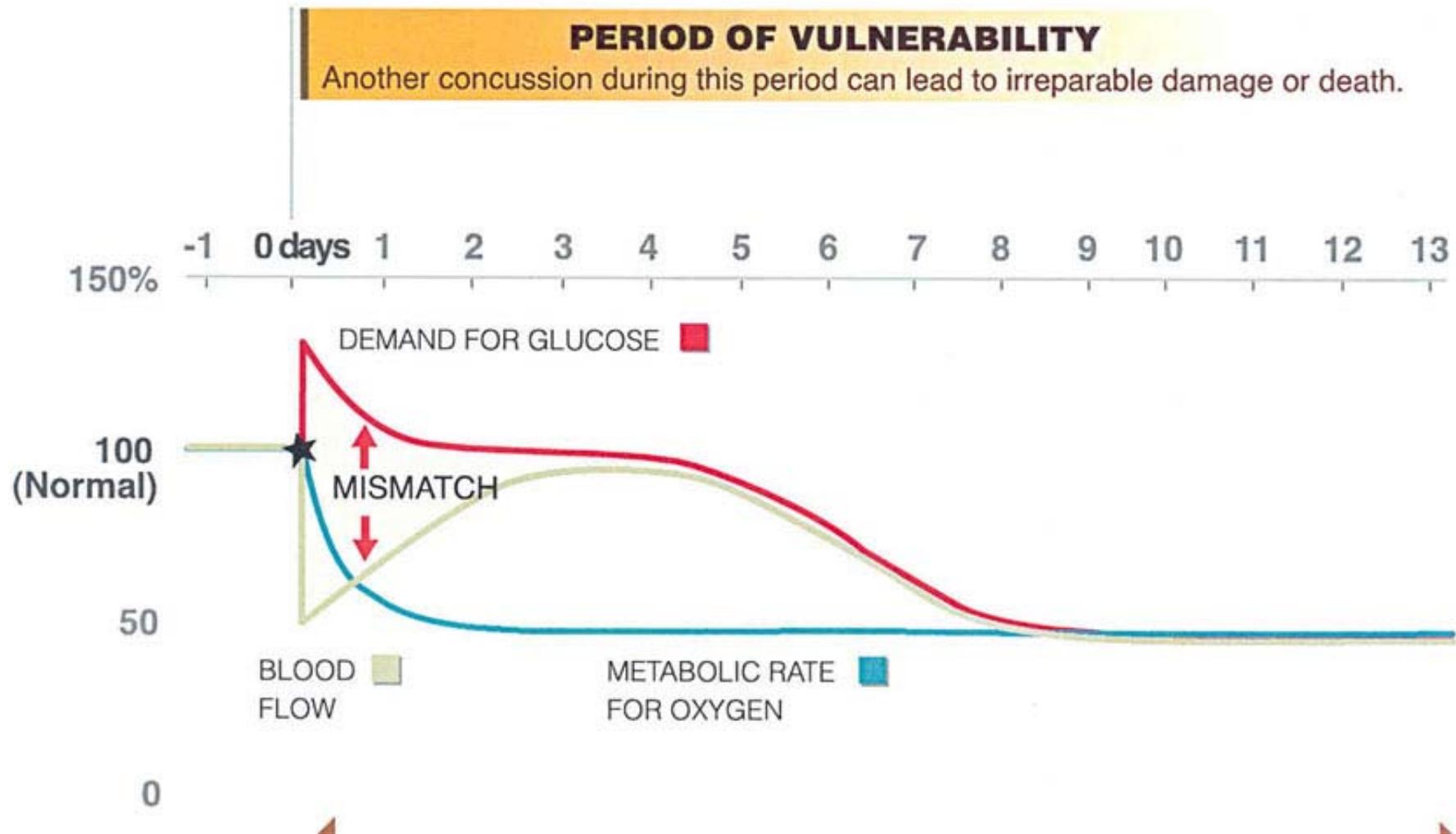
Leading Causes of MTBI (seen in Emergency Depts)

- ✓ Falls
- ✓ Motor Vehicle trauma
- ✓ Unintentionally struck by/ against events
- ✓ Sports
- ✓ Assaults

Clinical Timeline for Recovery

- Most concussions (80-90% in adult athletes) resolve without interventions by 7 days post-injury
- In children and adolescents, most symptoms resolve within 3 weeks
- Physical symptom resolution may not always mean full cognitive recovery
- In sports concussion research, risk of a second concussion is particularly increased in the 10 days after the concussive injury (80-92% of repeat injuries occur in the 7-10 days post-initial injury)
- Post-concussion syndrome is characterized by prolonged symptoms of concussion beyond 3 months in children and adolescents

Period of Vulnerability; especially in teens



Post Concussion Syndrome

- Diagnostic criteria: presence of at least 3 post-concussive symptoms that persist at least 3 months after concussive injury (DSM-IV)
- “Minimal, and at times contradictory, evidence exists to associate clinically available factors with eventual development of PCS in children” . Babcock, et al., JAMA PEDIATR/VOL 167 (NO. 2), FEB 2013
- Believed to be interplay of contributing physical, psychological and interpersonal factors in post-concussion syndrome including:
 - Injury severity
 - Parental anxiety/fear
 - Depression/PTSD
 - Pre-existing conditions
 - Child’s anxiety
 - Unresolved lawsuits
 - Initial treatment
 - Re-habitation

So what's everyone so afraid of?

✓ **Second Impact Syndrome**

- Sudden, *catastrophic* brain swelling occurring rapidly after second concussive injury (particularly during the period of vulnerability)
- Disproportionally affects young people (all reported cases have occurred <20yr olds except in boxing)
- 1.5 people die after concussion annually in USA
- Those who do not die are severely disabled

✓ **Chronic Traumatic Encephalopathy**

- Chronic, progressive, degenerative encephalopathy only definitively diagnosed on autopsy
- Occurs in individuals who have sustained recurrent concussion and is associated with accumulation of tau proteins.
- Believed to be a “cumulative” result of previous traumatic brain injuries

23

Overarching Goals of Concussion Management

- Early identification & evaluation of concussive injury
- Prevent secondary concussive injury
- Expedite recovery
- Safe return to full activities
 - ✓Academics, then activity/sport participation
- Prevent permanent neuropathic changes associated with repeated concussion

Acute Symptoms of Concussion

- Dazed, Confused, Disorientation, LOC
- Poor balance and/or coordination
- Slow or slurred speech. Delayed response to questions
- Amnesia, usually retrograde, but may also be antegrade
- Vacant stare
- Poor concentration or recall
- Unusual emotions or behavior
- Irritability
- Headache, Dizziness
- Tinnitus or sensitivity to noise
- Visual changes and/or Sensitivity to light
- Vomiting
- Tiredness; general and/or “brain feels tired”
- Deterioration in Performance

Early identification & evaluation of concussive injury

- Concussion remains a *clinical diagnosis*. Widespread understanding of concussion risk, early symptoms in educational, sport & community settings is essential
- In sport, any player suspected of having sustained concussion or shows ANY concussion symptom must be pulled from play for evaluation by athletic trainer or licensed provider
- Sideline assessment tools can assist the layperson or athletic trainer determine likelihood of concussion in individual cases
 - ✓ SCAT & Child SCAT3 (Sport Concussion Assessment Tool 3)
 - ✓ SAC (Standardized Assessment of Concussion)
- Further evaluation and monitoring in an Emergency Dept or office setting with HCP should be recommended; for early neuro assessment, injury details, to determine need for imaging to r/o serious brain injury

26

SCAT example:

SCAT2

Sport Concussion Assessment Tool 2



Name _____

Sport/team _____

Date/time of injury _____

Date/time of assessment _____

Age _____ Gender M F

Years of education completed _____

Examiner _____

What is the SCAT2?*

This tool represents a standardized method of evaluating injured athletes for concussion and can be used in athletes aged from 10 years and older. It supersedes the original SCAT published in 2005¹. This tool also enables the calculation of the Standardized Assessment of Concussion (SAC)^{2,4} score and the Maddocks questions⁵ for sideline concussion assessment.

Instructions for using the SCAT2

The SCAT2 is designed for the use of medical and health professionals. Preseason baseline testing with the SCAT2 can be helpful for interpreting post-injury test scores. Words in italics throughout the SCAT2 are the instructions given to the athlete by the tester.

This tool may be freely copied for distribution to individuals, teams, groups and organizations.

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 symptoms (like those listed below) and often does not involve loss of consciousness. Concussion should be suspected in the presence of **any one or more** of the following:

- Symptoms (such as headache), or
- Physical signs (such as unsteadiness), or
- Impaired brain function (e.g. confusion) or
- Abnormal behaviour.

Any athlete with a suspected concussion should be REMOVED FROM PLAY, medically assessed, monitored for deterioration (i.e., should not be left alone) and should not drive a motor vehicle.

SCAT2 SPORT CONCUSSION ASSESSMENT TOOL 2 | PAGE 1

Symptom Evaluation

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 (if applicable)	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
(Add all scores in table, maximum possible: 22 x 6 = 132)

Do the symptoms get worse with physical activity? Y N
Do the symptoms get worse with mental activity? Y N

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

Cognitive & Physical Evaluation

1 Symptom score (from page 1)
22 minus number of symptoms of 22

2 Physical signs score
Was there loss of consciousness or unresponsiveness? Y N
If yes, how long? _____ minutes
Was there a balance problem/unsteadiness? Y N
Physical signs score (1 point for each negative response) of 2

3 Glasgow coma scale (GCS)
Best eye response (E)
No eye opening _____ 1
Eye opening in response to pain _____ 2
Eye opening to speech _____ 3
Eyes opening spontaneously _____ 4
Best verbal response (V)
No verbal response _____ 1
Incomprehensible sounds _____ 2
Inappropriate words _____ 3
Confused _____ 4
Oriented _____ 5
Best motor response (M)
No motor response _____ 1
Extension to pain _____ 2
Abnormal flexion to pain _____ 3
Flexion/Withdrawal to pain _____ 4
Localizes to pain _____ 5
Obeys commands _____ 6
Glasgow Coma score (E + V + M) of 15
GCS should be recorded for all athletes in case of subsequent deterioration.

4 Sideline Assessment – Maddocks Questions
I am going to ask you a few questions, please listen carefully and give your best effort.
Modified Maddocks questions (1 point for each correct answer)
At what venue are we at today? 0 1
Which half is it now? 0 1
Who scored last in this match? 0 1
What team did you play last week/game? 0 1
Did your team win the last game? 0 1
Maddocks score of 5
Maddocks score is validated for sideline diagnosis of concussion only and is not included in SCAT 2 summary score for serial testing.

5 Cognitive assessment
Standardized Assessment of Concussion (SAC)
Orientation (1 point for each correct answer)
What month is it? 0 1
What is the date today? 0 1
What is the day of the week? 0 1
What year is it? 0 1
What time is it right now? (within 1 hour) 0 1
Orientation score of 5

Immediate memory
I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order.

Trials 2 & 3:
I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

Complete all 3 trials regardless of score on trial 1 & 2. Read the words at a rate of one per second. Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do not inform the athlete that delayed recall will be tested.

List	Trial 1	Trial 2	Trial 3	Alternative word list					
elbow	0	1	0	1	0	1	candle	baby	finger
apple	0	1	0	1	0	1	paper	monkey	penny
carpet	0	1	0	1	0	1	sugar	perfume	blanket
saddle	0	1	0	1	0	1	sandwich	sunset	lemon
bubble	0	1	0	1	0	1	wagon	iron	insect
Total									

Immediate memory score of 15

Concentration
Digits Backward:
I am going to read you a string of numbers and when I am done, you repeat them back to me backwards, in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.
If correct, go to next string length. If incorrect, read trial 2. One point possible for each string length. Stop after incorrect on both trials. The digits should be read at the rate of one per second.

	0	1	Alternative digit lists
4-9-3	0	1	6-2-9 5-2-6 4-1-5
3-8-1-4	0	1	3-2-7-9 1-7-9-5 4-9-6-8
6-2-9-7-1	0	1	1-5-2-8-6 3-8-5-2-7 6-1-8-4-3
7-1-8-4-6-2	0	1	5-3-9-1-4-8 8-3-1-9-6-4 7-2-4-8-5-6

Months In Reverse Order:
Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November ... Go ahead

1 pt. for entire sequence correct
Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan 0 1
Concentration score of 5

¹ This tool has been developed by a group of international experts at the 3rd International Consensus Meeting on Concussion in Sport held in Zurich, Switzerland in November 2008. The full details of the conference outcomes and the authors of the tool are published in British Journal of Sports Medicine, 2009, volume 43, supplement 1.

The outcome paper will also be simultaneously co-published in the May 2009 issues of Clinical Journal of Sports Medicine, Physical Medicine & Rehabilitation, Journal of Athletic Training, Journal of Clinical Neuroscience, Journal of Science & Medicine in Sport, Neurosurgery, Scandinavian Journal of Science & Medicine in Sport and the Journal of Clinical Sports Medicine.

² McCrory P et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. British Journal of Sports Medicine, 2005; 39: 196-204.

³ McCrea M. Standardized mental status testing of acute concussion. Clinical Journal of Sports Medicine, 2001; 11: 176-181.

⁴ McCrea M, Randolph C, Kelly J. Standardized Assessment of Concussion: Manual for administration, scoring and interpretation. Waukegan, Wisconsin, USA.

⁵ Maddocks, DJ, Dickler, GD, Saling, MM. The assessment of orientation following concussion in athletes. Clin J Sport Med, 1995;9(1):32-3

⁶ Guzikiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports, 2003; 2: 24-30



SAC example:

Standardized Assessment of Concussion (SAC)

ORIENTATION Score: ____ / 5

What month is it?	0	<input type="checkbox"/>	1	<input type="checkbox"/>
What is the date?	0	<input type="checkbox"/>	1	<input type="checkbox"/>
What day of the week is it?	0	<input type="checkbox"/>	1	<input type="checkbox"/>
What year is it?	0	<input type="checkbox"/>	1	<input type="checkbox"/>
What time of day is it? (<i>w/in 1 hour</i>)	0	<input type="checkbox"/>	1	<input type="checkbox"/>

IMMEDIATE MEMORY Score: ____ / 15

<u>Form A</u>	<u>Form B</u>	<u>Form C</u>	<u>Form D</u>
Elbow	Candle	Baby	Monkey
Apple	Paper	Monkey	Penny
Carpet	Sugar	Perfume	Blanket
Saddle	Sandwich	Sunset	Lemon
Bubble	Wagon	Iron	Insect

	<u>Trial 1</u>	<u>Trial 2</u>	<u>Trial 3</u>
Word 1	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>
Word 2	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>
Word 3	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>
Word 4	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>
Word 5	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>	0 <input type="checkbox"/> 1 <input type="checkbox"/>

NEUROLOGIC SCREENING

Loss of Consciousness: (occurrence, duration)

Retrograde Amnesia

Antegrade Amnesia

Strength

Sensation

Coordination

CONCENTRATION: *Digits Backwards* Score: ____ / 5

<u>Form A</u>			
4-9-3	6-2-9	0	<input type="checkbox"/> 1 <input type="checkbox"/>
3-8-1-4	3-2-7-9	0	<input type="checkbox"/> 1 <input type="checkbox"/>
6-2-9-7-1	1-5-2-8-5	0	<input type="checkbox"/> 1 <input type="checkbox"/>
7-1-8-4-6-2	5-3-9-1-4-8	0	<input type="checkbox"/> 1 <input type="checkbox"/>

<u>Form B</u>			
5-2-6	4-1-5	0	<input type="checkbox"/> 1 <input type="checkbox"/>
1-7-9-5	4-9-6-8	0	<input type="checkbox"/> 1 <input type="checkbox"/>
4-8-5-2-7	6-1-8-4-3	0	<input type="checkbox"/> 1 <input type="checkbox"/>
8-3-1-9-6-4	7-2-4-8-6-5	0	<input type="checkbox"/> 1 <input type="checkbox"/>

<u>Form C</u>			
1-4-2	6-5-8	0	<input type="checkbox"/> 1 <input type="checkbox"/>
1-8-3-1	3-4-8-1	0	<input type="checkbox"/> 1 <input type="checkbox"/>
4-9-1-5-3	6-8-2-5-1	0	<input type="checkbox"/> 1 <input type="checkbox"/>
3-7-6-5-1-9	9-2-6-5-1-4	0	<input type="checkbox"/> 1 <input type="checkbox"/>

Months in Reverse Order

Dec_Nov_Oct_Sept_Aug_Jul_Jun_May_Apr_Mar_Feb_Jan

0 1

DELAYED RECALL Score: ____ / 5

Word 1	0	<input type="checkbox"/>	1	<input type="checkbox"/>
Word 2	0	<input type="checkbox"/>	1	<input type="checkbox"/>
Word 3	0	<input type="checkbox"/>	1	<input type="checkbox"/>
Word 4	0	<input type="checkbox"/>	1	<input type="checkbox"/>
Word 5	0	<input type="checkbox"/>	1	<input type="checkbox"/>

SCORE TOTALS

Orientation = ____ / 5

Immediate Memory = ____ / 15

Concentration = ____ / 5

Delayed Recall = ____ / 5

Overall Score

/ 30

Prevent secondary concussive injury

- If diagnosed with concussion they must be pulled from play and not allowed to return to play on day of injury
- “When in doubt, pull them out”
- Player must be evaluated by healthcare provider and followed for persistent symptoms or deterioration of neurological status
- Clearance for activity participation required by HCP AND successful completion of Return to Play criteria is meant to ensure adequate brain recovery before full contact sport is allowed

Expedite Recovery from Concussion

- Provide the nervous system with initial *cognitive and physical rest* to facilitate healing, but just for up to 1 week
- Avoid requiring “too much, too early ” of injured brain, but guide them to slowly return to their baseline
- Seek to prevent depression from inactivity or hyper-vigilance of symptomatology. Move to slowly increase academics, then activity
- May need periods of rest if symptoms reappear when pt tries to do more. Then they may return later that day or the next to try again. Notes to schools can help with rest periods or for extra time on tests/projects for a few weeks.
- Re-emergence of symptom is the current “boundary” of tolerance- convey you expect the boundary to improve day by day.
- Requires clinical judgment involving *both* reserve and encouragement

COGNITIVE

Feeling Mentally Foggy
Feeling Mentally Slowed Down
Difficulty Concentrating
Forgetful of Recent Information
Difficulty Remembering
Confused About Recent Events
Repeats Questions
Answers Questions Slowly

PHYSICAL

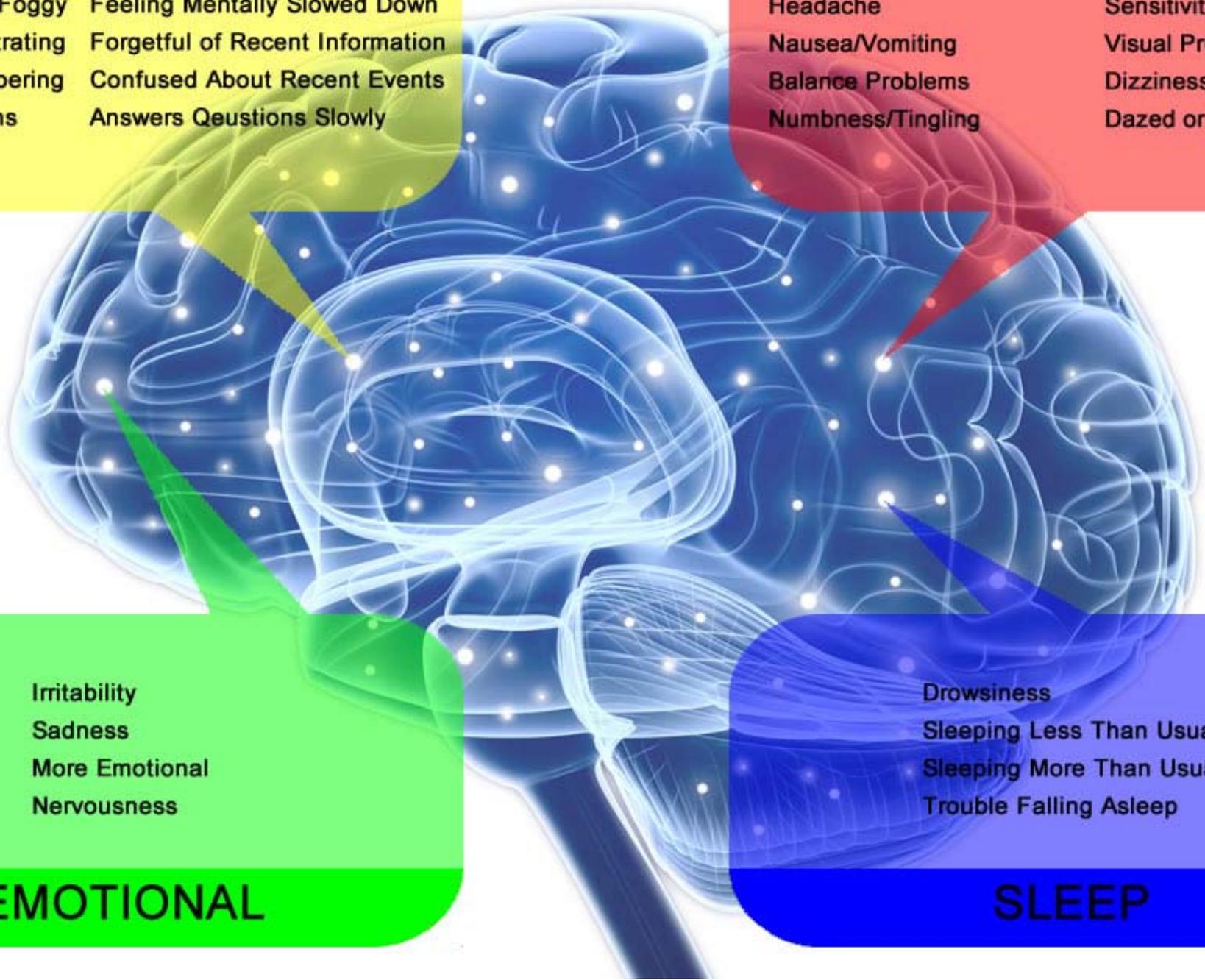
Headache
Nausea/Vomiting
Balance Problems
Numbness/Tingling
Sensitivity to Light/Noise
Visual Problems
Dizziness
Dazed or Stunned

Irritability
Sadness
More Emotional
Nervousness

EMOTIONAL

Drowsiness
Sleeping Less Than Usual
Sleeping More Than Usual
Trouble Falling Asleep

SLEEP



Return to Learn

- Recognition & accommodation for “invisible” injury of concussion
- Founded on evidence that using a concussed brain to learn may worsen concussion symptoms and perhaps prolong recovery
- **GOAL: Cognitive rest and paced return to full academic load BEFORE attempting Return to Play**
- Neuropsych Tests (Impact & Others) cannot determine when the child is “ready” for return to full academics but can identify where problems exist and strategies for overcoming them
- Minimize/Limit stressors that trigger symptom return;
 - Homework
 - Smartboards
 - Reading/Testing
 - Bright lights/Noisy environments
 - Texting/ video games/TV

TABLE 1 Signs and Symptoms of a Concussion and the Potential Problems They May Pose to the Student

Sign/Symptom	Potential Implications in School
Headache	<p>Most common symptom reported in concussions</p> <p>Can distract the student from concentration</p> <p>Can vary throughout the day and may be triggered by various exposures, such as fluorescent lighting, loud noises, and focusing on tasks</p>
Dizziness/lightheadedness	<p>May be an indication of injury to vestibular system</p> <p>May make standing quickly or walking in crowded environment challenging</p> <p>Often provoked by visual stimulus (rapid movements, videos, etc)</p>
Visual symptoms: light sensitivity, double vision, blurry vision	<p>Troubles with various aspects of the school building</p> <ul style="list-style-type: none"> Slide presentations Movies Smart boards Computers Handheld computers (tablets) Artificial lighting <p>Difficulty reading and copying</p> <p>Difficulty paying attention to visual tasks</p>
Noise sensitivity	<p>Troubles with various aspects of the school building</p> <ul style="list-style-type: none"> Lunchroom Shop classes Music classes (band/choir) Physical education classes Hallways Organized sports practices
Difficulty concentrating or remembering	<p>Challenges learning new tasks and comprehending new materials</p> <p>Difficulty with recalling and applying previously learned material</p> <p>Lack of focus in the classroom</p> <p>Troubles with test taking</p> <p>Troubles with standardized testing</p> <p>Reduced ability to take drivers education classes safely</p>
Sleep disturbances	<p>Excessive fatigue can hamper memory for new or past learning or ability to attend and focus</p> <p>Insufficient sleep can lead to tardiness or excessive absences</p> <p>Difficulty getting to sleep or frequent waking at night may lead to sleeping in class</p> <p>Excessive napping due to fatigue may lead to further disruptions of</p>

TABLE 4 Signs and Symptoms of a Concussion and the Strategies to Help in the School Setting

Sign/Symptom	Potential Adjustments in School Setting
Headache	Frequent breaks Identifying aggravators and reducing exposure to them
Dizziness	Rests, planned or as needed, in nurses office or quiet area Allow student to put head down if symptoms worsen Give student early dismissal from class and extra time to get from class to class to avoid crowded hallways
Visual symptoms: light sensitivity, double vision, blurry vision	Reduce exposure to computers, smart boards, videos Reduce brightness on the screens Allow the student to wear a hat or sunglasses in school Consider use of audiotapes of books Turn off fluorescent lights as needed Seat student closer to the center of classroom activities (blurry vision) Cover 1 eye with patch/tape 1 lens if glasses are worn (double vision)
Noise sensitivity	Allow the student to have lunch in quiet area with a classmate Limit or avoid band, choir, or shop classes Avoid noisy gyms and organized sports practices/games Consideration of the use of earplugs Give student early dismissal from class and extra time to get from class to class to avoid crowded hallways during pass time
Difficulty concentrating or remembering	Avoid testing or completion of major projects during recovery when possible Provide extra time to complete nonstandardized tests Postpone standardized testing (may require that 504 plan is in place) Consider 1 test per day during exam periods Consider the use of preprinted notes, notetaker, scribe, or reader for oral test taking
Sleep disturbances	Allow for late start or shortened school day to catch up on sleep Allow rest breaks

Return to Learn

- Individualized approach geared to support progressive return to full academic responsibilities
- Geared toward acknowledging child's specific symptoms and adjusting for symptoms, while expecting full recovery to occur
- Message should be to continue to try to push up to limit (symptom return) but not really beyond; expectation is that the limit will 'expand' with time as brain heals and habituation occurs

Safe Return to Full Physical Participation

- Physical rest includes (particularly in the first few days)
 - ✓ Adequate nightly sleep
 - ✓ Rest periods or (brief) naps
 - ✓ Avoiding physical exertion- both organized and recreational
- Incremental, progressive return to normal daily activities
- Clearance to participate in formal Return to Play criteria
 - ✓ Can occur when symptom-free at rest for at least 24 hours
 - ✓ Takes *at least* 5 days to accomplish RTP steps
 - ✓ May progress to the next RTP activity if no return of concussion symptoms (not typical of pre-concussion status) occurs
 - ✓ If symptoms do re-appear with physical exertion, then child must return to previous level of activity and re-attempt new level after another 24hr symptom-free period passes

Return to Play Criteria

- Step 1 / Baseline : Complete physical and cognitive rest for a minimum of 24 hours symptom free
- Step 2 / Light Aerobic Exercise: Increase heart rate for 5-10 min with exercise bike, walking, light jogging. No weight lifting, jumping or running
- Step 3 / Moderate Exercise: Increase muscle exertion and heart rate without significant trunk or head movement with moderate jogging, moderate intensity stationary bike, mild weight-lifting.
- Step 4 / Non-Contact Exercise: More intense workout but without risk of contact or collision with another individual
- Step 5 / Return to Full Practice: Full contact without full stress of competition
- Step 6 / Play ; Return to competition

STEPWISE RETURN TO PLAY

Step/Stage	Activity	Description	Time Frame	Objective
1	No Activity	Complete rest	Variable-as long as it takes	Individual recovery
2	Light Aerobic	Exercise Walking or stationary bike	~ 15 minutes of activity	Increase heart rate (HR)
3	Sport specific activity	NON-CONTACT drills or resistance training. (away from practice)	20-30 minutes	Add movement & increase HR
4	Practice-A	Full training drills, (Still NON CONTACT)	Full length practice	Increase physical and cognitive load
5	Practice-B	Full contact practice	Full length practice	Assessment of functional skills & restore confidence
Completion of stage/step 5 warrants re-evaluation by sports medicine specialist				
6	Full return to sport without restrictions	Full game play	n/a	n/a

Summary: Prevent permanent neuropathic changes

- Advocate for and adhere to rules & protective gear in sport that may minimize risk for concussive injury, most especially in the pre-pubescent athlete
- “When in doubt, sit them out”
- Understand & educate that greatest risk for re-injury is in the first 7-10 days post-concussion and that children commonly recover more slowly than adults.
- Provide balanced approach; initial caution followed by progressive return to academic, then physical activities while providing assurance and re-assurance that full recovery is expected

The End.

All concussions are serious.
If you think you have a

CONCUSSION:

- * Don't hide it.
- * Report it.
- * Take time to recover.

HEADACHE

PRESSURE IN HEAD

NAUSEA OR VOMITING

BALANCE PROBLEMS
OR DIZZINESS

DOUBLE OR
BLURRY VISION

SENSITIVITY TO
LIGHT OR NOISE

FEELING SLUGGISH, HAZY,
FOGGY, OR GROGGY

CONCENTRATION OR
MEMORY PROBLEMS

CONFUSION

JUST NOT "FEELING RIGHT"
OR "FEELING DOWN"

References

- Harmon, et al. American medical society for sports medicine position statement; concussion in sport. *Br J Sports Med* 2013, 47, 15-26
- Giza, et al., Summary of evidence-based guideline update: evaluation and management of concussion in sports: Report of the guideline development subcommittee of the American Academy of Neurology. *Neurology* 2013, 80, 2250-2257
- Halstead, et al., Returning to learning following concussion. *Pediatrics*, 132 (5), 948-957
- McCrory, et al. Consensus statement on concussion in sport – the 4th international conference on concussion in sport held in zurich, November 2012. *Br J Sports Med* 2013, 47, 250- 258
- University of the State of NY. Guidelines for concussion management in the school setting. *NYS Education Dept*, June 2012

Resources online

<http://www.knowconcussion.org/about-concussion/>

<http://www.youthsportssafetyalliance.org/sites/default/files/docs/Statistics-2013.pdf>

http://www.cdc.gov/traumaticbraininjury/get_the_facts.html

http://www.google.com/url?url=http://bianys.org/_literature_98853/Concussion_in_the_Classroom&rct=j&frm=1&q=&esrc=s&sa=U&ei=L_5GVMjIE-KasQTUsoKYAw&ved=0CBoQFjAB&usg=AFQjCNHWuZ8YXc73Au_I_Au8MsX6-A_4vg



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MEDICINE

MEDICINE *of* THE HIGHEST ORDER