

Concussions: Basics of Recognition and Management 8th Annual LIFESTAR Symposium

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Disclosures

- None

What is Primary Care Sports Medicine?



Primary Care Sports Medicine

- Physicians specializing in the non-operative medical treatment of musculoskeletal sports conditions
 - Acute injuries
 - Overuse injuries



Taken from American Medical Society of Sports Medicine



Primary Care Sports Medicine

- Sports Medicine Physicians have received additional training in the non-musculoskeletal aspects of sports medicine
 - Mild traumatic brain injury (Concussions)
 - Athletes with chronic or acute illnesses (mono)
 - Nutrition, supplements, ergogenic aids and performance issues
 - Exercise prescription for patients who want to increase their fitness
 - Injury prevention
 - “Return to play” decisions in the sick or injured athlete
 - Strength training and conditioning
 - Healthy lifestyle promotion



Goals

- Recognition of Concussion
 - What is a Concussion?
 - Common Signs/Symptoms
- Possible Complications of Concussions
- Evaluation of Suspected Concussions
- Treatment of Concussions

Concussion in the Media

Concussions Lawsuit

Timeline

011



Duerson,
suicide

GAME CHANGER



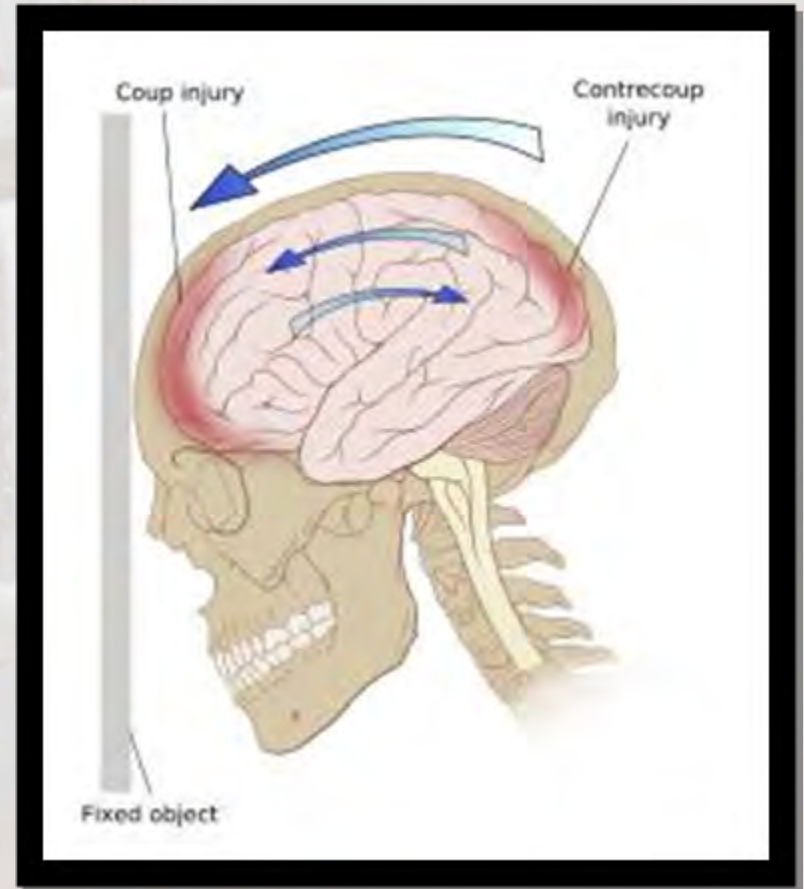
What is a Concussion

- Aka: Mild Traumatic Brain Injury (MTBI)
- “a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces”
 - McCroy, P, et al. *Clin J Sport Med.* 2009; 19(3): 185-200
- “Bruised Brain”
- CDC estimates 1.6-3.8 million concussions per year



Mechanism of Injury

- Coup-Contrecoup
 - Acceleration-deceleration
 - Linear
- Brain moves forward in the skull
- Frontal lobes strike inside of skull (coup)
- Rebound (contrecoup) injury to occipital lobe



Mechanism of Injury

- Rotational
- Brain rotates on axis causing stretching/tearing of axons
- Stretching/tearing of blood vessels results in hematoma
- Brain strikes skull causing contusion



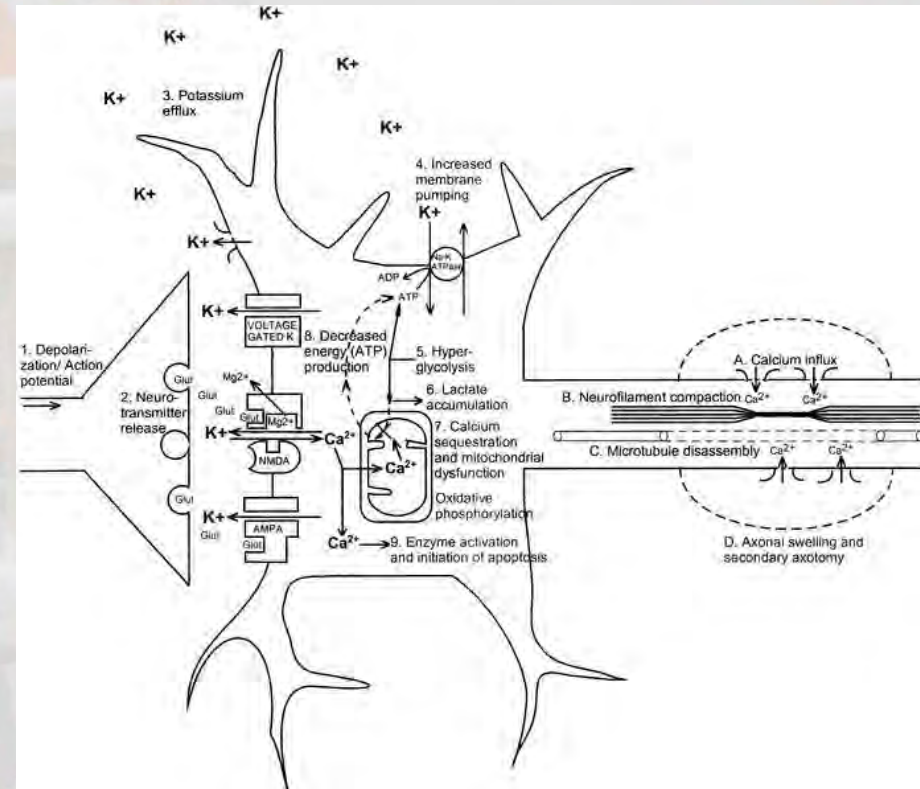
WARNING



May cause **DROWSINESS**.
ALCOHOL may intensify this effect.
USE CARE when operating a car
or dangerous machinery.

Pathophysiology: Energy Crisis!

- Injury disrupts neuronal membrane
- Efflux of extracellular **Potassium** AND excitatory neurotransmitter **Glutamate**
 - Worsens efflux of Potassium
- Increase activity of Na^+/K^+ pump to restore homeostasis
 - Requires increase **Glucose** utilization via **glycolysis**
- Increase Glucose utilization via glycolysis leads to increase **Lactate** production
 - Results in neuronal dysfunction by inducing acidosis, membrane damage, altered BBB permeability and cerebral edema
- Cellular influx of **Calcium**
 - Vascular constriction
- Decrease in **Cerebral Blood Flow**
 - Uncoupling of cerebral glucose metabolism



Signs and Symptoms of Concussion

Signs

- Dazed
- Confused
- Moves clumsily
- Answers questions slowly
- Personality changes
- Retrograde amnesia (forgets play prior to hit)
- Anterograde amnesia (forgets play after hit)
- Loses consciousness

Symptoms

- Headache
- Nausea
- Balance problems
- Double vision
- Photosensitivity
- Feeling sluggish
- Feeling foggy
- Change in sleep
- Cognitive changes

Signs and Symptoms of Concussions

Frontal Lobe

- Amnesia
- Multitasking
- Fogginess
- **usually means longer recovery



Occipital Lobe

- Visual
- Balance
- Dizziness
- Attention
- Occipital lobe
- Arousal (fatigue)



Frequency of Reported Symptoms

- Headache—71%
- Feeling slowed down—58%
- Difficulty concentrating—57%
- Dizziness—55%
- Fogginess—53%
- Fatigue—50%
- Visual Blurring/double vision—49%
- Light sensitivity—47%
- Memory dysfunction—43%
- Balance problems—43%

Concussion Grading Systems

- Many described in the literature
 - American Academy of Neurology
 - Colorado Medical Society
 - Cantu
- 2004 Prague Statement abandoned grading systems
 - Simple vs. Complex categorization
- 2008 Zurich Statement abandoned 2004 categorization
 - Symptom-based approach (subjective)
 - Postural and cognitive testing (objective)

Concussion Grading Systems

- Do not work
- Concussion evaluation and treatment must be **INDIVIDUALIZED**



Gender and Age Differences

- Female athletes typically have more severe symptoms and longer recovery than male counterparts
- Young athletes typically have more symptoms and longer recovery
 - Neurochemical processes appear to differ in developing brains (? Higher metabolic demands)

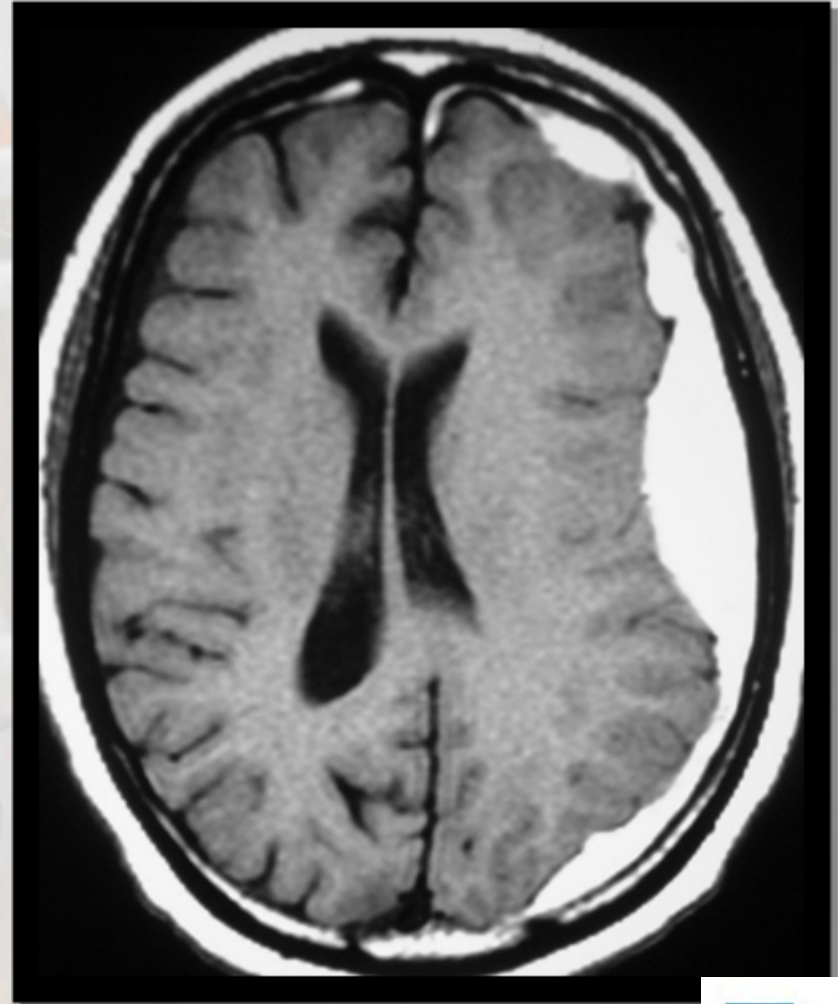


Complications of Concussion

- Immediate Complications:
 - Subdural Hematoma
 - Epidural Hematoma
 - Second Impact Syndrome
- Delayed Complications:
 - Post-Concussion Syndrome
 - Chronic Traumatic Encephalopathy

Complications of Concussions

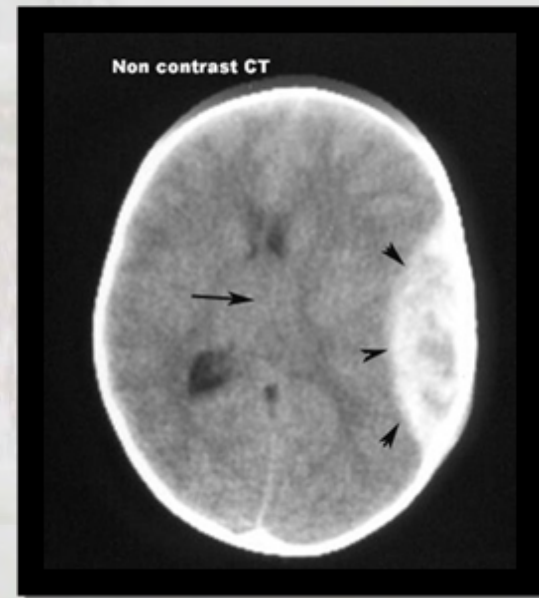
- Subdural Hematoma
 - Collection of blood between the brain and the brain's outer lining
 - Usually involves tearing of small veins
 - Low pressure
 - May be more likely to have LOC
 - Diagnosed on CT scan



Complications of Concussions

■ Epidural Hematoma

- Collection of blood between the outer lining of the brain (dura) and bone
- Usually involves temporal skull fracture and tear of arteries
 - High pressure
- Classically see brief LOC followed by lucid period then rapid decompensation
- Diagnosed by CT scan



Second Impact Syndrome

- Occurs when a second head injury occurs while the individual is still recovering from the first concussion
 - Second injury may be very minor
- Disparity between supply and demand during hyperglycolysis leads to an energy crisis
- Dysautoregulation of cerebral blood flow
 - Vascular engorgement
 - Diffuse cerebral swelling
 - Increased ICP
 - Brain herniation

Post Concussion Syndrome

- DSM-IV definition: 3 months duration of ≥ 3 of the following symptoms after head injury:
 - Fatigue
 - Disordered sleep
 - Headache
 - Vertigo/dizziness
 - Irritability or aggressiveness
 - Anxiety or depression
 - Personality changes
 - Apathy

Post Concussion Syndrome

- Increased risk of PCS if return to play too quickly
- Better concussion management lead to decreased risk of PCS

Concussion Legislation

- TSSAA Concussion Policy and Return to Play Form (July 2010)
- NCAA Concussion Policy (April 2010)
- NFL Concussion Policy (2009)
- Congress considering nation-wide policy for all school districts (Sep 2010)
 - *Protecting Student Athletes from Concussions Act H.R. 6172*
 - Many states are developing formal guidelines

TSSAA Policy

- **Effective July 2010**
- “Any player who exhibits signs, symptoms, or behaviors consistent with a concussion (such as loss of consciousness, headache, dizziness, confusion or balance problems) shall be immediately removed from the game and shall not return to play until cleared by an appropriate health-care professional.”
- **Adapted from the Acute Concussion Evaluation (ACE) by the Center for Disease Control (CDC)**
- **TSSAA Concussion Return to Play Form**
 - Must be used for games and practice
 - Must be completed by MD or DO

TSSAA Policy



TSSAA Concussion Return to Play Form

This form is adapted from the 4thth Concussion Evaluation (ACE) tool plus to the CDC web site (www.cdc.gov/concussion). All medical providers are encouraged to review this site if they have questions regarding the latest information on the evaluation and care of the athlete's injury following a concussion injury. **Please initial any recommendations that you select.**

Athlete's Name: _____ Date of Birth: _____
 Date of Injury: _____

This return to play plan is based on today's evaluation. Date of Evaluation: _____

Care plan completed by: _____ Return to the office, Date/Time: _____
 Return to school or (SMR) _____

- RETURN TO SPORTS**
1. Athletes should not return to practice or play the same day that their head injury occurred.
 2. Athletes should never return to play or practice if they still have **ANY** symptoms.
 3. Athletes be sure that your coach and/or athletic trainer are aware of your injury, symptoms, and has the contact information for the treating physician.

The following are the return to sports recommendations of the present time:

- PHYSICAL EDUCATION:** Do not return to PE class at this time. May return to PE class.
- SPORTS:**
- Do not return to sports practice or competition at this time.
 - May gradually return to sports practice under the supervision of the health care provider for your school or team.
 - May be advised back to competition after a show consultation with attending physician.
 - Must return to Physician for final clearance to return to competition.
- OR:** Cleared for full participation in all activities without restriction.

Medical Office Information (Please Print Stamp)

Physician's Name: _____ Physician's Office phone: _____
 Physician's Signature: _____ Office Address: _____

Gradual Return to Play Plan

Return to play should occur in gradual steps beginning with light aerobic exercise only to increase your heart rate (e.g. stationary bike); moving to increasing your heart rate with movement (e.g. running); then adding controlled contact (if appropriate); and finally return to sports competition.

Pay careful attention to your symptoms and your thinking and concentration skills at each stage or activity. After completion of each step without recurrence of symptoms, you can move to the next level of activity the next day. Move to the next level of activity only if you do not experience any symptoms at the present level. If your symptoms return, let your health care provider know, return to the first level and restart the program gradually.

- Day 1: Low level of physical activity (i.e. symptoms do not come back during or after the activity). This includes walking, light jogging, light stationary biking, and light weightlifting (low weight—moderate reps, no bench, no squats).
- Day 2: Moderate levels of physical activity with body-based movement. This includes moderate jogging, light running, moderate intensity on the stationary cycle, moderate intensity weightlifting (moderate time and/or reduced weight from your typical routine).
- Day 3: Heavy non-contact physical activity. This includes sprinting/running, high intensity stationary cycling, completing the regular (flat) (no hills, over contact) sport specific drills (agility— with 3 planes of movement).
- Day 4: Sport Specific practice.
- Day 5: Full contact in a controlled drill or practice.
- Day 6: Return to competition.



Concussion Management

- GOALS:
 - Acute Management
 - Rule out serious intracranial pathology
 - Rule out serious neck/spine injury
 - Post-injury Management
 - Prevent Second Impact Syndrome
 - Prevent Post-Concussion Syndrome

Acute Management

- Primary Survey
 - ABC's, Level of Consciousness, C-spine evaluation
 - Always assume C-spine injury if unconscious
- If student/athlete unconscious:
 - Stabilize head and neck
 - Activate EMS
 - Transport to Emergency Room
 - Monitor airway and circulation

Acute Management

- If student/athlete is conscious:
 - Determine level of consciousness
 - Reassure athlete
 - Do exam:
 - Evaluate neck
 - Neurological exam
 - If neck is tender or exam is abnormal, transport to Emergency Room

Acute Management

- History and Cognitive Evaluation:
 - Symptoms
 - Oriented to Person, Place, Time
 - Memory of events
- SCAT 2

Sport Concussion Assessment Tool 2 (SCAT 2)

SCAT2

Sport Concussion Assessment Tool 2

Name: _____

Age: _____

Sex: _____

Team: _____

Position: _____

Level of education: _____

Year of education completed: _____

Language: _____

Symptom Evaluation

How do you feel?
You should mark yourself on the following symptoms. Select either you feel none or you feel some.

Symptom	None (0)	Some (1)	Severe (2)
Headache	0	1	2
Pressure in head	0	1	2
Nausea	0	1	2
Balance problems	0	1	2
Dizziness	0	1	2
Blurred vision	0	1	2
Sensitivity to light	0	1	2
Sensitivity to sound	0	1	2
Feeling slowed down	0	1	2
Feeling like in a fog	0	1	2
"Foggy" thoughts	0	1	2
Difficulty concentrating	0	1	2
Memory impairment	0	1	2
Feeling unsteady	0	1	2
Loss of consciousness	0	1	2
Loss of consciousness > 5 minutes	0	1	2
Amnesia	0	1	2
Seizure	0	1	2
Other symptoms	0	1	2

Total number of symptoms (Maximum of 22) _____

Symptom severity score (0-10) _____

0 = No symptoms at all
1 = Mild symptoms
2 = Moderate to severe symptoms

Overall rating
If you have the above and you are feeling none of the above, you should be rated as follows:
0 = No symptoms at all
1 = Mild symptoms
2 = Moderate to severe symptoms

What is the SCAT2?
This tool represents a standardized method of evaluating injured athletes for concussions and can be used in athletes aged from 10 years and older. It supersedes the original SCAT published in 2001. This tool also enables the calculation of the Standardized Assessment of Concussion (SAC)¹ score and the Maddocks questions² for sideline concussion assessment.

Instructions for using the SCAT2
The SCAT2 is designed for the use of medical and health professionals. Concussion further testing with the SCAT2 can be helpful for determining post-injury test scores. Watch the video throughout the SCAT2 as the instructions given in the video 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 blow or object to the head. It results in a variety of non-specific symptoms (like those listed below) and often does not involve loss of consciousness. Concussions should be suspected in the presence of **any one or more** of the following:

- Symptoms such as headache, or
- Physical signs such as vomiting, or
- Impaired brain function (eg. confusion or
- Altered 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

Cognitive & Physical Evaluation

1 Symptom score (Percentage of 11 items) _____

2 Physical signs score
What level of consciousness? _____
Eye opening? _____
Best verbal response? _____
Physical signs score (1 point for each sign observed) _____

3 Glasgow coma scale (GCS)
Best eye response (E) _____
Best verbal response (V) _____
Best motor response (M) _____
Glasgow Coma score (E + V + M) _____

4 Sideline Assessment – Maddocks Score
Modified Maddocks questions (1 point for each correct answer) _____
Maddocks score _____

5 Cognitive assessment
Standardized Assessment of Concussion (SAC)
Orientation (1 point for each correct answer)
Immediate memory (1 point for each correct answer)
Digit Span Backward (1 point for each correct answer)

SCAT2 (Sport Concussion Assessment Tool 2) | PAGE 2



Sport Concussion Assessment Tool 2 (SCAT 2)

4 Balance examination
 Balance examination is a modified version of the clinical examination of the vestibular system. It is a modified version of the clinical examination of the vestibular system.

Balance testing
 "I am now going to test your balance. Please take your shoes off, roll up your pant leg above ankle (if applicable), and remove any ankle taping (if applicable). The test will consist of three twenty-second tests with different stances."

4a Double leg stance
 "The first stance is standing with your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of that position. I will start timing when you are set and have closed your eyes."

4b Single leg stance
 "If you were to take a fall, which foot would you use? This will be the dominant foot. Your stand on your non-dominant foot. The dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

4c Tandem stance
 "Now stand heel-to-heel with your non-dominant foot in back. Your weight should be evenly distributed across both feet. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Balance testing - types of errors

1. Arms lifted off the feet
2. Feet slumped, or flat
3. The clinician, or test
4. Moving the eyes (Protagonist deviation)
5. Using tandem or heel
6. Stepping out of the stance/stance

Scoring of the balance tests is based on counting the number of movements that the patient makes. A patient is given one point for each error. The maximum total number of errors for any single condition is 6. A patient receives a score of 0-6. A score of 0-2 is considered a green result, a score of 3-4 is considered a yellow result, and a score of 5-6 is considered a red result. The patient's score is the sum of the errors for a maximum of 60 seconds. The patient's score is the sum of the errors for a maximum of 60 seconds.

Balance examination score **of 60**

5 Coordination examination
 Upper limb coordination
 "I am going to test your coordination. Please sit comfortably on the chair with your eyes open and your arm (either right or left) extended. I should hold it at 90 degrees and allow and fingers extended. When I give a start signal, I would like you to perform five successive finger-to-nose movements using your index finger to touch the tip of the nose as quickly and as accurately as possible."

Coordination score **of 10**

6 Cognitive assessment
 Standardized Assessment of Concussion (SAC)
 "Do you remember that list of words I read a few times earlier? Tell me or write down from the list as you can remember the words."

Delayed recall score **of 10**

Overall scores

Balance score	00/60
Coordination score	00/10
Delayed Recall score	00/10
SAC total	00/30
SCAT2 total	00/100
Return to play	00/1

Scoring data from the SCAT2 or SAC should not be used as a stand alone method to diagnose concussion, measure recovery or make decisions about an athlete's readiness to return to competition after concussion.

SCAT2 (2008) (CONCUSSION ASSESSMENT TOOL) - PAGE 3

Athlete Information
 Any athlete suspected of having a concussion should be removed from play, and then seek medical evaluation.

Signs to watch for
 Signs to watch for are listed below. The doctor will also ask you to watch for the following signs:

- Loss of consciousness
- Loss of memory of the event
- Loss of orientation (person, place, time)
- Loss of balance
- Loss of coordination
- Loss of consciousness
- Loss of memory of the event
- Loss of orientation (person, place, time)
- Loss of balance
- Loss of coordination
- Loss of consciousness

Return to play
 The patient should not be allowed to play the same sport until they have been medically cleared by a physician. The patient should not be allowed to play the same sport until they have been medically cleared by a physician. The patient should not be allowed to play the same sport until they have been medically cleared by a physician.

Remember, it is better to be safe. Consult your doctor after a suspected concussion.

SCAT2	SCAT2	SCAT2	SCAT2	SCAT2
SCAT2	SCAT2	SCAT2	SCAT2	SCAT2
SAC	SAC	SAC	SAC	SAC
Total	SCAT2			

Concussion injury advice (To be given to concussed athlete)

The patient has received an injury to the head. A careful medical examination has been carried out and no sign of any serious complications has been found. It is expected that recovery will be rapid, but the patient will need monitoring for a further period by a responsible adult. Your healing physician will provide guidance as to the time frame.

If you notice any change in behaviour, vomiting, dizziness, worsening headache, double vision or excessive drowsiness, please telephone the clinic or the nearest hospital emergency department immediately.

Other important points:

- Rest and avoid strenuous activity for at least 24 hours
- No alcohol
- No sleeping tablets
- Use paracetamol or codeine for headache. Do not use aspirin or anti-inflammatory medication
- Do not drive until medically cleared
- Do not train or play sport until medically cleared

Clinic phone number

SCAT2 (2008) (CONCUSSION ASSESSMENT TOOL) - PAGE 4



Acute Management

- Physical Exam:
 - Appearance
 - Cervical spine exam
 - Tenderness to palpation
 - Motion
 - Head/face
 - Orbital/Skull fractures
 - Mental Status
 - Orientation
 - Memory
 - Judgement
 - Intellect
- Neurologic
 - Pupils
 - Cranial nerves
 - Sensation/motor
 - Coordination
 - Gait
- Evaluate every 5 minutes for next 15-30 minutes and then frequently thereafter

Balance Testing

- Romberg testing
- Cerebellar function
- Balance Error Scoring System (BESS)



BESS

- Developed at UNC Sports Medicine Research Laboratory
- Portable, cost-effective
- Takes about 10 minutes to conduct
- Requires limited materials
 - Level surface
 - Foam pad (Airex Pad)
 - Stop watch
 - Protocol / Script / Score Card

BESS

- Composed of six 20-second sections
- Balance Error Scoring System
- Each done on firm ground, repeated on foam
 - Double leg stance
 - Single leg stance
 - Tandem stance
 - Points given for errors
- Types of Errors
 - 1. Hands lifted off iliac crest
 - 2. Opening eyes
 - 3. Step, stumble, or fall
 - 4. Moving hip into > 30 degrees abduction
 - 5. Lifting forefoot or heel
 - 6. Remaining out of test position >5 sec
 - The BESS is calculated by adding one error point for each error during the time

BESS



Reasons to Transport to ER

- Potential C-spine injury
- Recurrent emesis
- Severe or progressively worsening headache
- Deterioration in mental status
- Seizure activity
- Focal neurological symptoms (Unsteady gait, slurred speech, weakness or numbness in the extremities)
- Signs of a basilar skull fracture or skull fracture
- Altered mental status resulting in a GCS <15
- Unusual or very irritable behavior

Acute Treatment

- Rest
 - Cool environment
 - Quiet environment
 - Dark environment
- Hold out of class--Return to class may make symptoms worse
 - Level of concentration
 - Use of Computer
 - Use of Video
- Medication
 - Only Acetaminophen in the first 24 hours

Follow Up

Evaluation/Management

- Refer to Physician who is trained in concussion management

- Evaluation
- Exertional Testing
- Neurocognitive testing

- ImPACT
- HeadMinder
- Axon Sports
- Concussion Vital Signs

- Return to Play Decision



Return To Play Decision

- Rest until asymptomatic
 - May include staying home from school
- Physical exertion once symptoms have resolved at rest
 - Cardiovascular challenge
 - Sport-specific drills
- Neurocognitive evaluation
 - Computerized testing
 - Formal Neurocognitive testing

Limitations of Evaluation

- Concussions are subjective
 - Rely on patient's report of symptoms
 - No objective study to determine if patient sustained a concussion or if it is resolved
 - MRI's and CT scans DO NOT diagnosis concussions
- Emerging technologies
 - Functional MRI, PET scans
 - Blood tests looking for proteins c/w brain injury

Return To Play Decision

- Anyone suspected of having a concussion, should NEVER be returned to play the same day of injury
 - on average, concussion resolution takes 7-10 days
- Anyone suspected of having a concussion should be referred to a physician trained in concussion management
- Per TSSAA policy, student cannot participate in sports unless evaluated and cleared by a physician

Resources

- CDC Concussion Tool Kit
 - <http://www.cdc.gov/concussion/HeadsUp/youth.html>
- SCAT2 form
 - <http://www.cces.ca/files/pdfs/SCAT2%5B1%5D.pdf>
- TSSAA concussion policy
 - <http://www.kocortho.com/pdfs/tssaa-concussion.pdf>
- Online course for parents and coaches
 - <http://www.nfhslearn.com>

Resources

- Dick's Sporting Goods PACE program
 - www.dsgpace.org
- Project B.R.A.I.N (TN Disability Coalition)
 - http://tndisability.org/coalition_programs/project_brain/concussion_within_our_sports_community

Resources

- Knoxville Orthopedic Clinic
 - Concussion Management Program
 - 3 primary care sports medicine physicians trained in concussion management
 - Dr. Amber Luhn
 - Dr. Benson Scott
 - Dr. Chris Klenck
 - Recognized as Certified ImPACT Consultants
 - Only clinic in Knoxville and surrounding area

“Shout Out”

- Jeff Gregory
- Andrew Slemp
- J.R. Gore
- Walter Idol



Questions???

