Concussion for the Primary Care Provider

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Created by: Steven M. Erickson, MD
Medical Director, Sports Medicine and Concussion Specialists, Chief of Sports Medicine, Banner University Medical Center –PHX
Adapted by: Jazmyn Ledford
Arizona Soccer Association

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Definition of MTBI

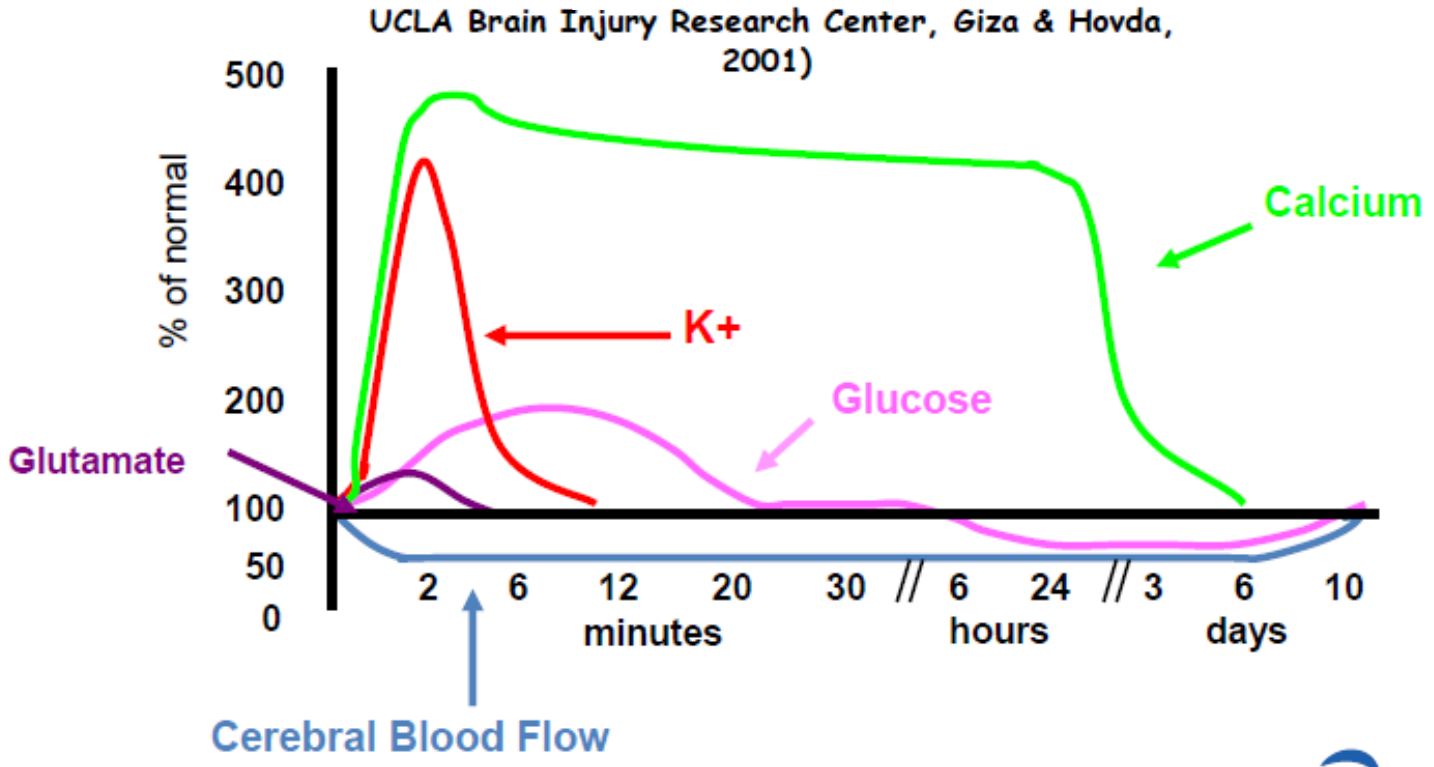
- A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces including:
  - Direct blow to body or head
  - Rapid onset of short-lived impairment of neurological function that usually resolves spontaneously
  - Traditional imaging (CT and MRI 1.5-3T) tests usually normal
  - May or may not involve LOC

Criteria	Mild	Moderate	Severe
Structural imaging	Normal	Normal or abnormal	Normal or abnormal
Loss of Consciousness (LOC)	0-30 min	> 30 min and < 24 hrs	> 24 hrs
Alteration of consciousness/ mental state (AOC)	Transient up to 24 hours	>24 hours. Severity based on other criteria	
Post-traumatic amnesia (PTA)	0-1 day	> 1 and < 7 days	> 7 days
Glascow Coma Scale (best available score in first 24 hours)	13-15	9-12	< 9

Concussion Myths

- **Myth:** It's not a concussion if you are not knocked out.
- **Truth:** You do not have to be knocked out to have a concussion.
  - 90-95% of concussions do not result in loss of consciousness

Neurometabolic Cascade Following Cerebral Concussion



Incidence of Sports Related MTBI

- Estimated 3.8 million sports and recreational related concussions per year
- Collegiate football players
  - 34% with one concussion, 20% with multiple concussions
  - Individual Risk 19%/year of play in contact sports
  - One concussion per team per three games
- High risk with soccer, hockey and cheerleading

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Incidence of Sports Related MTBI

- According to the American College of Sports Medicine in 2010, approximately 85% of concussions go undiagnosed, which means that too many athletes go back to play too soon, risking greater injuries that could result in more serious injury or long-term cognitive impairments.

Symptoms of MTBI

- Headache, pressure in head
- Neck pain
- Nausea, Vomiting
- Dizziness
- Balance problems
- Vision changes, double, blurry
- Photosensitivity
- Phonosensitivity
- Feeling slowed down or in just “not right”
- Feeling sluggish or fatigued
- Confusion
- Feeling foggy
- Difficulty remembering
- Difficulty concentrating
- Irritability
- More emotional, nervous or sadness than usual
- Tinnitus
- Neck Pain

Initial History

- Essential to perform a complete history and physical which identifies ALL of the deficits
- Don’t just ask the concussed individual if they are OK and trust that the information is truthful and accurate
- Important past medical history:
  - Prior TBI, migraines, ADHD/LD, seizure disorder, anxiety / depression
- Important family history:
  - Migraines, psychiatric disease, neurodegenerative disease

Initial Physical Exam

- Neurologic Examination to include:
  - Mini Mental Status
  - Cranial Nerves
  - Motor and Sensory Exam
  - Cerebellar Exam
- Neurofunctional exam aimed at identifying cognitive, vestibular, visual or fine motor deficits

- Cervical Exam to include:
  - ROM
  - Motor and Sensory Exam
  - Spurling's maneuver

Mini Mental Status Exam

- 3 item recall
  - Complex items
- Blue car, chili dog, red balloon
- Immediate and at 5, 10, 15, 20, 30 minutes
- Count back by 7's from 100
  - Alternative count back by 3's from 50

- Serial numbers
  - Example: 1,4,7,8,2
  - Forwards and backwards
  - Phone number
- Month of the year backwards
- Days of the week backwards

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097506SCAT5
To download a clean version of the SCAT tools please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097506SCAT5)

SCAT5©

SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION
DEVELOPED BY THE CONCUSSION IN SPORT GROUP
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Patient details

Name: _____
DOB: _____
Address: _____
ID number: _____
Examiner: _____
Date of Injury: _____ Time: _____

WHAT IS THE SCAT5?

The SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals[1]. The SCAT5 cannot be performed correctly in less than 10 minutes.

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The SCAT5 is to be used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCAT5.

Preseason SCAT5 baseline testing can be useful for interpreting post-injury test scores, but is not required for that purpose.Detailed instructions for use of the SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.

Key points

- Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned to play on the day of injury.
- If an athlete is suspected of having a concussion and medical personnel are not immediately available, the athlete should be referred to a medical facility for urgent assessment.
- Athletes with suspected concussion should not drink alcohol, use recreational drugs and should not drive a motor vehicle until cleared to do so by a medical professional.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The SCAT5 should NOT be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a concussion even if their SCAT5 is "normal".

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.

IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The Maddocks questions and cervical spine exam are critical steps of the immediate assessment; however, these do not need to be done serially.

Name: _____
DOB: _____
Address: _____
ID number: _____
Examiner: _____
Date: _____

STEP 1: RED FLAGS

RED FLAGS:

- Neck pain or tenderness
- Double vision
- Weakness or tingling/ burning in arms or legs
- Severe or increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

STEP 2: OBSERVABLE SIGNS

Witnessed ☐ Observed on Video ☐

Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS[2]

"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

_____
_____

Mark Y for correct answer / N for incorrect

What venue are we at today?	Y	N
Which half is it now?	Y	N
Who scored last in this match?	Y	N
What team did you play last week / game?	Y	N
Did your team win the last game?	Y	N

Note: Appropriate sport-specific questions may be substituted.

STEP 4: EXAMINATION GLASGOW COMA SCALE (GCS)[3]

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best verbal response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best motor response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion / Withdrawal to pain	4	4	4
Localises to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ **Baseline** ☐ **Post-Injury**

Please hand the form to the athlete

	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
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
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6
Total number of symptoms:							of 22
Symptom severity score:							of 132
Do your symptoms get worse with physical activity?						Y	N
Do your symptoms get worse with mental activity?						Y	N
If 100% is feeling perfectly normal, what percent of normal do you feel?							

If not 100%, why?

_____
_____
_____

Please hand form back to examiner

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Indications for imaging in MTBI?

- CT Scan to rule out bleed?
- MRI (3T) may reveal subtle abnormalities and is indicated with prolonged recovery
- Generally imaging is not indicated and will not assist in the management except to rule out other pathology

Myths about Concussion

- **Myth:** Concussion can be diagnosed with a CT scan or MRI.
- **Truth:** Concussions can not be diagnosed by CT or MRI scan and are not useful in making return to play decisions following

Indications for CT

- Age < 2 or >65
- LOC or Amnesia with
- Severe Headache
- Nausea, Vomiting
- Progressing symptoms
- On anticoagulants
- Post Traumatic Seizure
- Dangerous mechanism of injury
- Drug / Alcohol Intoxication
- Memory Deficits
- Physical evidence of trauma above the clavicle
- GCS less than 15
- Focal neurologic deficit
- Coagulopathy

Initial Management of MTBI

- Based on magnitude of reported symptoms and presence of visual, vestibular or cognitive deficits initial recommendations should include to be off work or school
- No sports participation, including non-contact sports, until symptoms resolve

Management Guidelines

- 15+ sets of guidelines in the literature
- None are based on scientific evidence
- All overestimate the importance of loss of consciousness

Return to School

- Every student diagnosed with concussion should be given recommendations with regard to attending school
- When cleared to return to school, consideration should be given to recommending temporary academic accommodations.

Cornerstone of Initial MTBI Management (Phase I)

- Brain rest
- No class
- No physical exertion
- No reading
- No internet
- No texting
- No video games
- Increase fluids / increase rest
- TV?

Initial Treatment of MTBI

- Treatment of Headaches
- Treatment of Sleep Disturbance
- Treatment of Nausea
- Treatment of Dizziness

Normal Recovery Curves for Uncomplicated MTBI

- High School Students average recovery curve 14-21 days due to immaturity of the neurologic system (plasticity)
- College and Professional Athletes average recovery curve 7-10 days due to more mature neurologic system
- 20-30% go on to have post concussion syndrome lasting over 1 month

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Which Symptoms During Recovery Predict Prolonged Recovery?

- Persistence of fogginess and difficulty concentrating are the most predictive of prolonged symptoms and delayed recovery as measured by neurocognitive testing
- Greater deficits in reaction time are predictive of protracted recovery

Factors Predicting Prolonged Recovery

- History of previous mTBI
- History of learning disability / ADHD
- History of previous visual or vestibular dysfunction
- History of Psychiatric / Psychological Disease
- Substance use at time of injury
- Not LOC
- Anterograde / Retrograde Amnesia
- Dizziness as major initial symptom
- Prolonged reaction time

Myths about Concussion

- **Myth:** Concussion is strictly a physical injury .
- **Truth:** Concussion is a complex diagnosis with physical, intellectual, emotional and psychological manifestations.

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Post Concussion Syndrome

- Decreased Processing Speed
- Short-term Memory Impairment
- Concentration Deficit
- Irritability/Depression
- Fatigue/Sleep Disturbances
- General feeling of “fogginess”
- Persistent Symptoms >4 weeks after MTBI

Post Concussion Syndrome

- Post Traumatic Stress Disorder (PTSD)
- Anxiety
- Depression
- Adjustment Disorder

Post Concussion Syndrome

- Physical Therapy
- Occupational Therapy
- Vestibular Therapy
- Visual Therapy
- Cognitive Therapy
- Psychological Counseling

Myths about Concussion

- **Myth:** Equipment like the right helmet can prevent concussions.
- **Truth:** Equipment cannot prevent concussions. No football, hockey, baseball, bicycle or other helmet or head gear can prevent concussion.

Return to School

- Initially complete brain rest
- Gradual increase in activities as limited by symptoms
- Return to school depends on resolution of symptoms and neurocognitive testing
- Individualized return to school plan
- Coordination with school counselors and disability resource specialists

Return to Play Protocol

- Stepwise Protocol:
  1. No activity, complete rest. Once asymptomatic, proceed to next level.
  2. Light aerobic exercise such as walking or stationary cycling, no resistance training.
  3. Sport specific exercise
  4. Non-contact training drills
  5. Full contact training after medical clearance.
  6. Game play.

Multiple Concussions

- Following first episode of MTBI athlete is 4X more likely to experience another MTBI and 3X more likely to experience MTBI in the same season
- Concept of “Concussion Threshold”

Chronic Traumatic Encephalopathy

- First published case 1954, dementia pugilistica
- Associated with ApoE genotype but most cases have e3/e3 genotype found in 58% of normal population
- Many cases associated with substance abuse
- Only 153 cases reported in literature
- Irregular, multifocal and generally perivascular tau-immunoreactive neurofibrillary tangles
- Overlap with Alzheimer's disease, Parkinson Disease, Lewy body dementia and cerebrovascular disease