



MICHIGAN MEDICINE
UNIVERSITY OF MICHIGAN

Recognition, Evaluation and Management of Concussions

A Case-based Learning Series

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Disclosures & COI

Neither of the presenters have any disclosures or conflicts of interest to report.

Objectives

- Review concussion assessment tools for assistance in evaluation and diagnosis
- Identify signs and symptoms necessitating advanced imaging
- Recognize factors that contribute to an increased symptom burden and prolong concussion recovery, and incorporate screening for them into your clinical practice
- Prescribe a return to play and return to learn/work protocol for patients in your clinical practice

Outline

1. Define Concussion
2. Brief Pathophysiology of Concussion
3. Notable Concussion Statistics
4. Evaluating a Potential Concussion
5. Diagnosing Concussion
6. Managing Concussion

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Concussion

“A traumatically induced transient disturbance of brain function that involves a complex pathophysiological process.¹”

American Medical Society for Sports Medicine Position Statement

Concussion

A traumatically induced transient disturbance of brain function that involves a complex pathophysiological process.

- **What Does this Mean?**
 - Subset of mild traumatic brain injury
 - Majority resolve in 1-4 weeks
 - Classified based on injury characteristics and functional deficits
 - Signs & symptoms cannot otherwise be explained by drug, alcohol, medication use or alternative injuries or co-morbidities

Outline

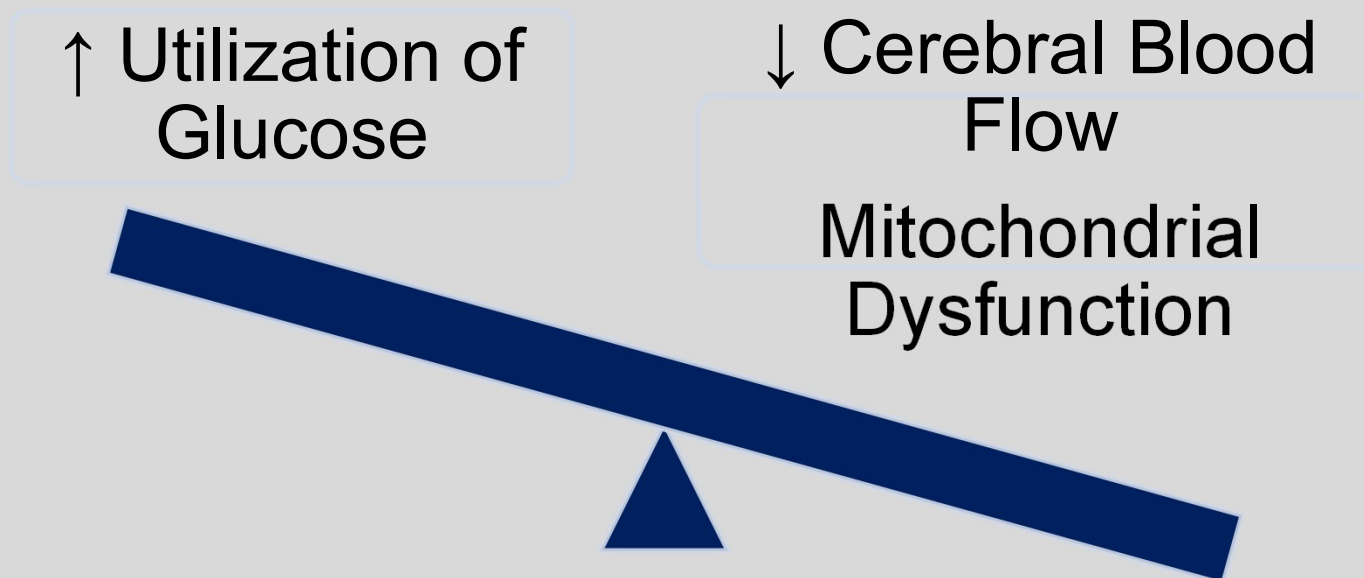
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Brief Pathophysiology of Concussion¹

- Not completely understood
- Primarily based on animal models
- Force on the brain \Rightarrow neuronal cell membrane and axon stretching =
 - change in intracellular ion concentrations
 - \uparrow utilization of glucose to restore sodium and potassium balance
 - decrease in resting cerebral blood flow
 - indiscriminate release of neurotransmitters
 - mitochondrial dysfunction \Rightarrow reactive oxygen species

Brief Pathophysiology of Concussion

Energy imbalance develops given \uparrow uptake of glucose in the face of \downarrow cerebral blood flow & mitochondrial dysfunction



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Notable Concussion Statistics

- ~3.8 million concussions in the USA per year during competitive sports and recreational activities²
 - Up to 50% of these concussions are likely unreported²
- Concussion can occur in any sport, with the highest incidence in football, hockey, rugby, soccer and basketball^{3,4,5,6}
- When you group sports and recreation:
 - Men: bicycling, football and basketball
 - Women: bicycling, playground activities and horseback riding
- ↑ incidence in females compared to males competing in the same sport⁷

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Evaluating a Potential Concussion

- All athletes with a suspected concussion should be **removed from play** and assessed by a licensed healthcare provider trained in the evaluation and management of concussions. (Michigan Law)
 - Obtain HPI (particularly if mechanism is not visualized)
- Assess Symptoms
- Perform Cognitive Evaluation (including orientation, past and immediate memory, new learning and concentration)
- Balance testing
- Physical examination

Evaluating a Potential Concussion

Sideline Evaluation

Standardized Assessment of Concussion⁸ (SAC)

- Best when compared to a known baseline

Modified Balanced Error Scoring System (M-BESS) Test

Physical Exam

The Standardized Assessment of Concussion
Obtain Pre-Season Baseline Score; Compare with Post-Concussion Score

NAME OF ATHLETE:			
Age:	Sex:	Examiner:	
Nature of Injury:			
Date of Exam:		Time:	

I. ORIENTATION			
Month	0	1	
Date	0	1	
Day of Week	0	1	
Year	0	1	
Time	0	1	
Orientation Total Score:			/5

III. NEUROLOGICAL SCREENING			
Recollection of injury (pre- or post-traumatic amnesia):			
Strength:			
Sensation:			
Coordination:			

IV. CONCENTRATION			
Digits Backwards: If correct, go to the next string length. If incorrect, read second trail. Stop after incorrect on both trails.			
4-9-3	6-2-9	0	1
3-8-1-4	3-2-7-9	0	1
6-2-9-7-1	1-5-2-8-6	0	1
7-1-8-4-6-2	5-3-9-1-4-8	0	1
Months of the Year in Reverse Order: Athlete must recite entire reverse sequence correct.			
Dec-Nov-Oct-Sep-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan		0	1
Total Concentration Score:			/5

V. EXERTIONAL MANEUVERS				
5	5	5	5	
Jumping Jacks	Sit-ups	Push-ups	Knee- bends	

II. IMMEDIATE MEMORY				
All 3 trials are completed regardless of score on trial 1 & 2; score equals sum across all 3 trials.				
List	Trial 1	Trial 2	Trial 3	
Elbow	0 1	0 1	0 1	
Apple	0 1	0 1	0 1	
Carpet	0 1	0 1	0 1	
Saddle	0 1	0 1	0 1	
Bubble	0 1	0 1	0 1	
Total Immediate Memory Recall:				/15
<i>Note: Do not inform the subject that delayed recall will be tested.</i>				

VI. DELAYED MEMORY RECALL				
List	Trial 1	Trial 2	Trial 3	
Elbow	0 1	0 1	0 1	
Apple	0 1	0 1	0 1	
Carpet	0 1	0 1	0 1	
Saddle	0 1	0 1	0 1	
Bubble	0 1	0 1	0 1	
Total Delayed Memory Recall:				/15

SUMMARY OF TOTAL SCORES	
Orientation	/5
Immediate Memory	/15
Concentration	/5
Delayed Memory Recall	/15
Overall Total Score	/40
<i>If score is below baseline, DO NOT return to play.</i>	

©Brain Injury Association of America, 1997

Evaluating a Potential Concussion

Sideline Evaluation

Rule out Red Flags¹⁰
- if present, head and/or neck imaging should be obtained immediately

Monitor for deteriorating physical or mental status

Table 5. Red Flags in Patients with Head Injury

Altered consciousness	Pupillary asymmetry
Behaves unusually or seems confused and irritable	Repeated vomiting
Cannot recognize persons that the patient should be able to recognize, or is disoriented to place	Seizures
Double vision	Slurred speech
Progressively declining neurologic examination	Unsteady on feet
	Weakness or numbness in arms or legs
	Worsening headache

Adapted from U.S. Department of Veterans Affairs. VA/DoD clinical practice guideline for management of concussion/mild traumatic brain injury. Washington, DC: U.S. Department of Defense; April 2009. http://www.healthquality.va.gov/mtbi/concussion_mtbi_full_1_0.pdf. Accessed August 21, 2011.

Evaluating a Potential Concussion

Office-Based Evaluation Sport Concussion Assessment Tool– 5th Edition (SCAT 5)

- Child and Adult versions
- On-field (immediate) and Off-field (office-based) sections

Physical Exam

- Emphasis on Neuro Exam

Downloaded from <http://bjsm.bmj.com/> on November 3, 2017 - Published by group.bmj.com

OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport/team/school: _____

Date/time of injury: _____

Years of education completed: _____

Age: _____

Gender: M / F / Other _____

Dominant hand: left / neither / right _____

How many diagnosed concussions has the athlete had in the past? _____

When was the most recent concussion? _____

How long was the recovery (time to being cleared to play) from the most recent concussion? _____ (days)

_____ (days)

Has the athlete ever been:

Hospitalized for a head injury?

Yes	No
-----	----

Diagnosed/treated for headache disorder or migraines?

Yes	No
-----	----

Diagnosed with a learning disability/dyslexia?

Yes	No
-----	----

Diagnosed with ADD/ADHD?

Yes	No
-----	----

Diagnosed with depression, anxiety or other psychiatric disorder?

Yes	No
-----	----

Current medications? If yes, please list: _____

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

2

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read the instructions carefully and then complete the symptom scale. For the baseline assessment, the athlete should rate their symptoms based on how they typically feel and for the post-injury assessment of 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
Balancing 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 is normal do you feel?							
If not 100%, why?							

Please hand form back to examiner

© Concussion in Sport Group 2017
 Davis GA, et al. Br J Sports Med 2017;0:1-8. doi:10.1136/bjsports-2017-097506/SCAT5

Evaluating a Potential Concussion

Office-Based Evaluation – Physical Exam

Head Examination

- Facial and skull bony tenderness
- Lacerations/swelling
- TM rupture

Neck Examination

- Bony tenderness (spinous process, mastoid process)
- Full ACTIVE ROM without pain (flexion, extension, rotation)
- Isometric strength testing of neck
- Spurling's maneuver (only if passive ROM is not painful)
- Strength of upper and lower extremities
- Pronator Drift

Evaluating a Potential Concussion

Office-Based Evaluation – Physical Exam

Neurologic Examination

- Cognition/ Mental Status: Orientation (day, time, date, month, year)
- Immediate memory (5 item immediate recall)
- Delayed recall (recall prior 5 items approximately 5 minutes after immediate recall)
- Concentration (digits backwards, months backwards, serial sevens, WORLD backwards)
- Affect
- CN testing: EOM evaluation (nystagmus), speech
- Balance assessment (Modified BESS, tandem gait, Rhomberg test)
- Coordination (finger-nose-finger, heel-to-shin, rapid finger movements)
- Vestibular-Oculomotor Screen (smooth pursuit, saccades, convergence, vestibular-ocular reflex, vestibular motion sensitivity)

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CASE #2 – Diagnosing Concussion

- 16 yo F soccer player, struck in the head by another player while going for a header
- Removed from play by her coach
- Presents to your office 2 days later for evaluation of Head Injury

CASE #2 – Diagnosing Concussion

What Do You Do?

- Obtain a History
- Symptom Checklist
 - symptoms are the most sensitive indicator of concussion¹¹
 - heterogeneous
- Standardized Concussion Assessment Tool
 - SCAT5 and Child SCAT5 are recommended by the Concussion in Sport Group¹
- Physical Examination – emphasis on Neuro exam

CASE #2 – Diagnosing Concussion – HPI

- Injury Mechanism: head to head impact
- Recall/memory of injury: full memory
- Past concussions or head injuries: 1 prior concussion, recovered in 2 weeks, no residual symptoms, 1 year ago.
- Sports, positions and individual playing style: forward
- Pre-injury mood disorders, learning disorders, attention deficit disorders (ADD/ADHD) and migraines: ADHD

CASE #2 – Diagnosing Concussion – Assessment

- Symptom Checklist completed
- Standardized Tool for assessment of concussion utilized (ex. SAC or SCAT5)
- Physical Exam with emphasis on performing a comprehensive Neurological Exam

How do you feel?
"You should score yourself on the following symptoms, based on how you feel now".

	none	1	2	3	4	5	6	
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	
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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	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)							14	
Symptom severity score (Maximum possible 132)							32	

Case #2 – Diagnosing Concussion

Is This a Concussion?

- Clinical Judgement
- Based on Symptoms, Standardized Assessment Tools and Neurological Examination
 - Graded symptom checklists
 - Objective tool for assessing a variety of concussive symptoms
 - Track the severity of symptoms over serial evaluations
 - Standardized assessment tools (ex. SCAT5) & Objective examination
 - Provides a helpful structure for evaluation

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Case #3 – Managing Concussion

- 14 yo Freshman running back on the HS football team. You evaluated him following the game on Friday night and diagnosed a concussion.
- He presents to your office for Saturday clinic and symptom score is 28 on SCAT5.
- No significant neurological deficits are observed but he reports difficulty concentrating and minimal increase in headache while completing the SCAT5.
- He is visibly bothered by the light in the examination room.

Case #3 – Managing Concussion

- Provide School/Work Accommodations
 - Return to school is preferred
 - Avoid social isolation
- Manage with serial examinations, typically weekly, until symptoms resolve
 - Concussion-related signs and symptoms should be resolved before returning to sport
 - Athlete should be off all analgesics for 24 hours without symptoms before returning to sport
- Return to Work/School/Athletics should be progressive

Managing Concussion

Managing Symptom Burden

- Nausea→ avoid reading or looking at phone in the car
- Photophobia→ sun glasses, adjust seating away from windows in class, turn out lights when possible
- Blurry vision→ limit reading to small amounts. Listen in class. Limit computer/ gaming
- Vestibular Ocular Motor Impairment, nystagmus→ Vestibular PT, Limit reading homework until improves, provide class notes to avoid looking up/down in class
- Drowsy→ allow naps as needed if not affecting sleep overnight.
- Neck spasms→ Physical Therapy, neck stretching
- Impaired Concentration/Memory→ No testing/exams in school, may need accommodations to repeat assignments/instructions, may need repetition/assistance
- Impaired Balance→ Balance training, avoid bike riding, elevated surfaces

Managing Concussion

- **Risk Factors for Prolonged Recovery**
 - Premorbid concussion
 - Delayed removal from activity
 - Symptom severity
 - Youth
 - Migraines
 - Mood disorders (depression, anxiety, etc.)
 - Learning disorders (ADD, ADHD)
 - Neurological or Psychiatric disorders
 - Pre-injury symptoms
 - Family and/or Social stressors

Managing Concussion

Return to Learn¹

Facilitate communication and transition back to school.

- Notify school personnel after injury to prepare for return to school.
 - Obtain consent for communication between medical and school teams.
- Designate point person to monitor the student's status related to academics, recovery and coping with injury, and communicate with medical team.
 - School health professional, guidance counsellor, administrator, athletic trainer.
- Develop plan for missed assignments and exams.
- Adjust schedule to accommodate reduced or modified attendance if needed.

Managing Concussion

Return to Learn¹

Classroom adjustments

- Breaks as needed during school day.
- Reduce inclass assignments and homework.
- Allow increased time for completion of assignments and testing.
- Delay exams until student is adequately prepared and symptoms do not interfere with testing.
- Allow testing in a separate, distraction-free environment.
- Modify due dates or requirements for major projects.
- Provide preprinted notes or allow peer notetaker.
- Avoid high-risk or strenuous physical activity.

School environment adjustments

- Allow use of headphones/ear plugs to reduce noise sensitivity.
- Allow use of sunglasses/hat to reduce light sensitivity.
- Limit use of electronic screens or adjust screen settings, including font size, as needed.
- Allow student to leave class early to avoid crowded hallways.
- Avoid busy, crowded or noisy environments—music room, hallways, lunch room, vocational classes, assemblies.

Managing Concussion

- Return to Play¹

Stage	Description	Objective
1	Symptom-limited activity	Reintroduction of normal activities of daily living. Symptoms should not worsen with activity.
2	Light aerobic exercise	Walking, stationary biking, controlled activities that increase heart rate.
3	Sport-specific exercise	Running, skating or other sport-specific aerobic exercise avoiding risk of head impact.
4	Non-contact training drills	Sport-specific, non-contact training drills that involve increased coordination and thinking. Progressive introduction of resistance training.
5	Full contact practice	Return to normal training activities. Assess psychological readiness.
6	Return to sport	

Managing Concussion

- Consensus guidelines endorse 24–48 hours of symptom-limited cognitive and physical rest followed by a gradual increase in activity, staying below symptom-exacerbation thresholds¹².
- There is no human evidence that nutraceuticals prevent or ameliorate concussion in athletes¹³⁻¹⁵.
- Most consistent predictor of recovery is the number and severity of acute and subacute concussive symptoms¹⁶.
- There are no evidence-based guidelines for disqualifying or retiring an athlete from sport after concussion.

Resources

- Link to Adult SCAT5 (Ages 13 and up)
 - <https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097506SCAT5.full.pdf>
- Link to Child SCAT5 (Ages 5-12)
 - <https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097492childscat5.full.pdf>
- Link to SAC
 - <http://concussioncorps.org/wp-content/uploads/2013/04/SAC.pdf>
- CDC's Heads Up Concussion Education
 - <https://www.cdc.gov/headsup/index.html>
- VOMS
 - <https://www.bamc.org/media/1393/voms-exam.pdf>

Resources

Sample School Accommodations Letter

To whom it may concern:

This patient is currently under my medical care for treatment of a concussion. Please make school accommodations to assist with his/her recovery process. These may include, but are not limited to, rest breaks during class, homework, and examination as dictated by symptoms exacerbation; repetition and written instructions for assignments/instructions; extended time for assignments and examinations and/or forgiveness of projects or assignments; providing class notes; allow to wear sunglasses and provide seating away from bright lights and noisy environments; lighter workload; and/or shortened school day as necessary. Please forgive any non-essential homework/assignments. He/She should not return to gym class or sports at this time and should not have additional coursework to make up for missed gym class.

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