



MULTIDISCIPLINARY EVALUATION AND TREATMENT POST-CONCUSSION

DES MOINES UNIVERSITY

GRAND ROUNDS

FEBRUARY 6, 2020

OBJECTIVES

1. Discuss the pathophysiology and natural clinical course of concussion.
2. Discuss strategies to address common symptoms and concerns.
3. Screen for patients who are at risk for a longer recovery post-concussion.
4. Explain the role of physical therapy in post-concussion treatment.
5. Identify subjective and objective findings which indicate the patient would benefit from physical therapy.

Concussion Management

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Where I Come From:



Objectives

- Discuss the pathophysiology and natural clinical course of concussion
 - Discuss optimal individualized multidisciplinary treatment of concussion
 - Discuss strategy's to address common symptoms and concerns
-
- Disclosures: Nothing to disclose

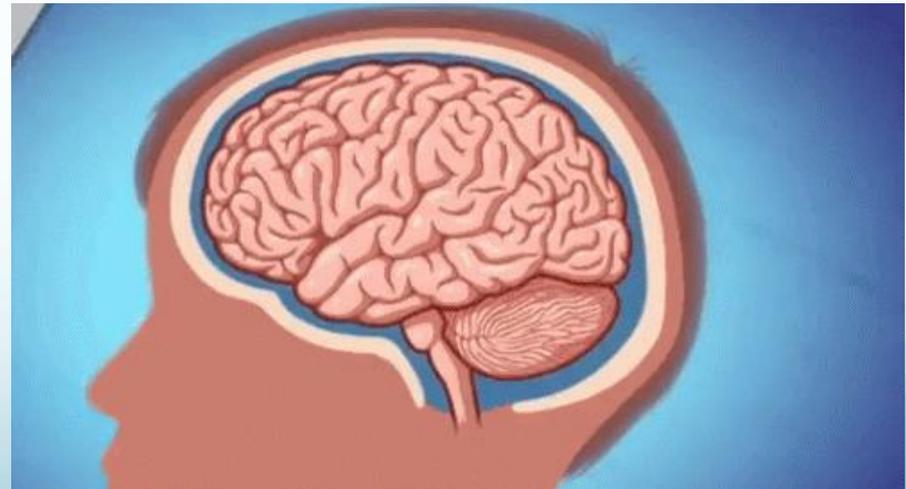
What is a concussion?

Traumatically induced transient disturbance of brain function, involving a complex pathophysiological process:

- **A subset of mild traumatic brain injury**
- **Generally self-limited**
- **Less severe end of brain injury spectrum**

How does a concussion happen?

- **Direct/indirect head impact**
- **Head does not have experience impact**
- **whiplash alone is sufficient (many other ways)**
- **Head is moving object and comes to an abrupt stop**



How often does a concussion occur?

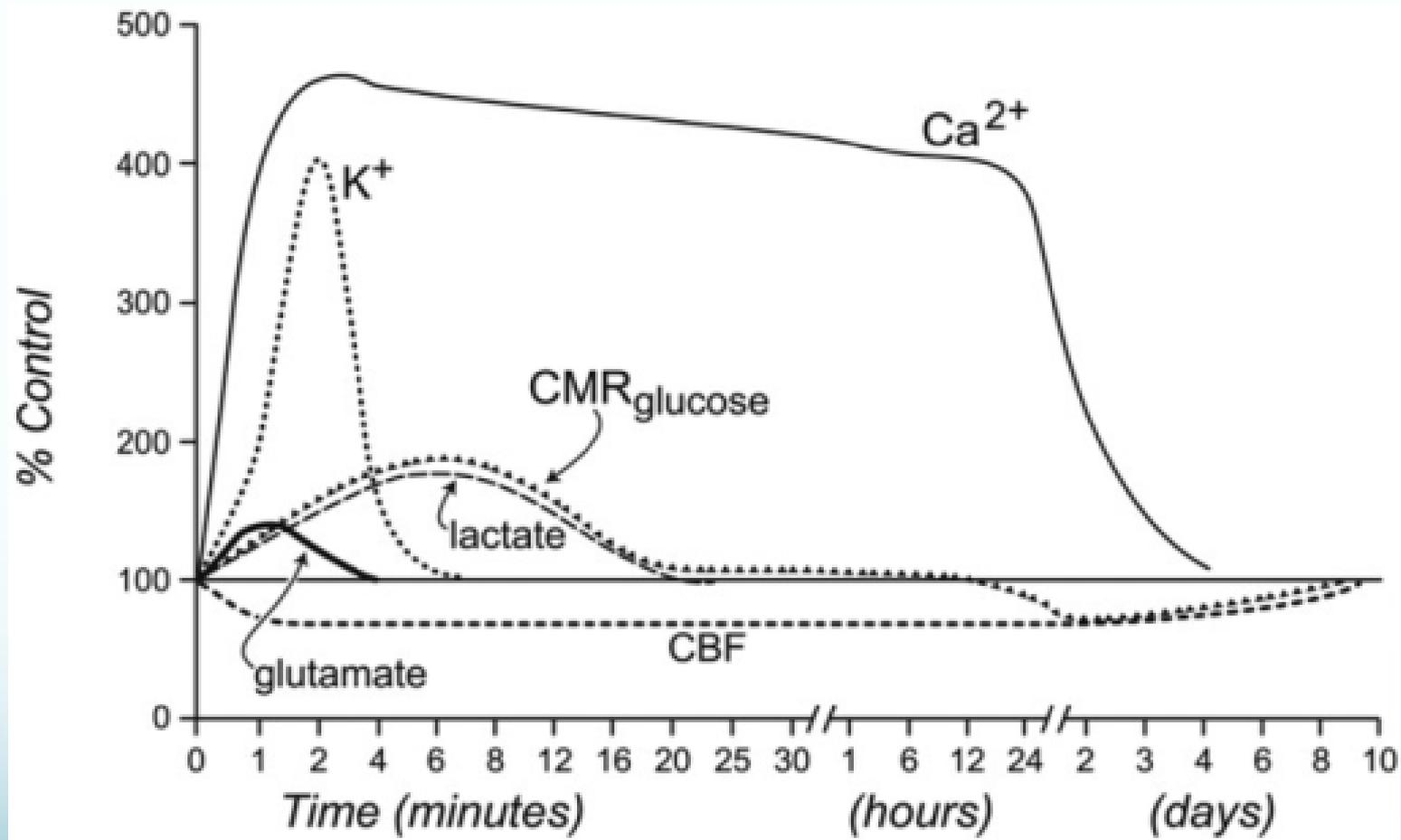
- 1 in 4 young people will have at least one concussion before the finish/leave high school.
- Twice as likely among boys
- Most often from sports (teenagers) or falls (children)
 - Contact sports more frequently but not exclusively
- 1.5-2 million/yr. in US.



Pathophysiology of Concussion:

- **Damaged neurons (Diffuse axonal injury) produce neurotoxins and a cascade of metabolic changes**
- **Acute mismatch of metabolism and energy requirements**
- **Brain enters period of decreased metabolic activity.**
 - **Decreased cerebral blood flow**
 - **Increased glucose requirement**
 - **Period of vulnerability = symptoms**
 - **Altered Consciousness**
 - **Physical symptoms**
 - **Vestibulo-ocular dysfunction**
 - **Sleep/Cognitive/Mood disturbance**
 - **Not a “Brain Bruise”**

Metabolic Cascade after Concussion



Most resolve in 7-10 days

10% with prolonged symptoms

“Post-Concussion Syndrome”:

- Multi-factorial
 - Metabolic
 - Genetic
 - Diffuse axonal injury
 - Co-morbidities
- Mixed
 - Physical/Physiologic
 - Psychosomatic

Persistent Symptoms:

- Headache
- Persistent dizziness
- Fatigue/Insomnia
- Irritability
- Emotional lability
- Cognitive Impairment
- Light/Sound sensitivity
- Other

Initial Evaluation (ACE)

A. Injury Characteristics Date/Time of Injury _____ Reporter: Patient Parent Spouse Other _____

1. Injury Description _____

1a. Is there evidence of a forcible blow to the head (direct or indirect)? Yes No Unknown

1b. Is there evidence of intracranial injury or skull fracture? Yes No Unknown

1c. Location of Impact: Frontal Lft Temporal Rt Temporal Lft Parietal Rt Parietal Occipital Neck Indirect Force

2. **Cause:** MVC Pedestrian-MVC Fall Assault Sports (*specify*) _____ Other _____

3. **Amnesia Before (Retrograde)** Are there any events just BEFORE the injury that you/ person has no memory of (even brief)? Yes No Duration _____

4. **Amnesia After (Anterograde)** Are there any events just AFTER the injury that you/ person has no memory of (even brief)? Yes No Duration _____

5. **Loss of Consciousness:** Did you/ person lose consciousness? Yes No Duration _____

6. **EARLY SIGNS:** Appears dazed or stunned Is confused about events Answers questions slowly Repeats Questions Forgetful (recent info)

7. **Seizures:** Were seizures observed? No Yes Detail _____

C. Risk Factors for Protracted Recovery (*check all that apply*)

Concussion History? Y ___ N ___	√	Headache History? Y ___ N ___	√	Developmental History	√	Psychiatric History
Previous # 1 2 3 4 5 6+		Prior treatment for headache		Learning disabilities		Anxiety
Longest symptom duration Days ___ Weeks ___ Months ___ Years ___		History of migraine headache ___ Personal ___ Family _____		Attention-Deficit/ Hyperactivity Disorder		Depression
If multiple concussions, less force caused reinjury? Yes ___ No ___		_____		Other developmental disorder _____		Sleep disorder
						Other psychiatric disorder _____

List other comorbid medical disorders or medication usage (e.g., hypothyroid, seizures) _____

Symptoms		none	mild		moderate		severe	
			1	2	3	4	5	6
Physical	Headache	0	1	2	3	4	5	6
	Nausea	0	1	2	3	4	5	6
	Vomiting	0	1	2	3	4	5	6
	Balance Problem	0	1	2	3	4	5	6
	Dizziness	0	1	2	3	4	5	6
	Visual Problems	0	1	2	3	4	5	6
	Fatigue	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
	Numbness/Tingling	0	1	2	3	4	5	6
	Pain other than Headache	0	1	2	3	4	5	6
Thinking	Feeling Mentally Foggy	0	1	2	3	4	5	6
	Feeling Slowed Down	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
Sleep	Drowsiness	0	1	2	3	4	5	6
	Sleeping Less than Usual	0	1	2	3	4	5	6
	Sleeping More than Usual	0	1	2	3	4	5	6
	Trouble Falling Asleep	0	1	2	3	4	5	6
Emotional	Irritability	0	1	2	3	4	5	6
	Sadness	0	1	2	3	4	5	6
	Nervousness	0	1	2	3	4	5	6
	Feeling More Emotional	0	1	2	3	4	5	6

Exam

- **Neurologic exam**
- **Ocular exam**
 - **Acuity, smooth pursuit, convergence/accommodation, saccades, VOR**
- **Cervical spine, including cervical proprioception**
- **Vestibular / Balance testing**
- **Neurocognitive testing**



VOMS

Vestibular/Ocular Motor Test:	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fogginess 0-10	Comments
BASELINE SYMPTOMS:	N/A					
Smooth Pursuits						
Saccades – Horizontal						
Saccades – Vertical						
Convergence (Near Point)						(Near Point in cm): Measure 1: _____ Measure 2: _____ Measure 3: _____
VOR – Horizontal						
VOR – Vertical						
Visual Motion Sensitivity Test						

Cognitive Exam (initial)

ORIENTATION

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	

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.

Dec - Nov - Oct - Sept - Aug - Jul - Jun - May - Apr - Mar - Feb - Jan	0	1
Months Score	of 1	
Concentration Total Score (Digits + Months)	of 5	

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing⁸

Which foot was tested (i.e. which is the non-dominant foot) Left Right

Testing surface (hard floor, field, etc.) _____

Footwear (shoes, barefoot, braces, tape, etc.) _____

Condition	Errors
Double leg stance	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot at the back)	of 10
Total Errors	of 30

IMMEDIATE MEMORY

List	Alternate 5 word lists					Score (of 5)		
						Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
Immediate Memory Score						of 15		
Time that last trial was completed								

List	Alternate 10 word lists					Score (of 10)		
						Trial 1	Trial 2	Trial 3
G	Finger	Penny	Blanket	Lemon	Insect			
	Candle	Paper	Sugar	Sandwich	Wagon			
H	Baby	Monkey	Perfume	Sunset	Iron			
	Elbow	Apple	Carpet	Saddle	Bubble			
I	Jacket	Arrow	Pepper	Cotton	Movie			
	Dollar	Honey	Mirror	Saddle	Anchor			
Immediate Memory Score						of 30		
Time that last trial was completed								

CONCENTRATION

DIGITS BACKWARDS

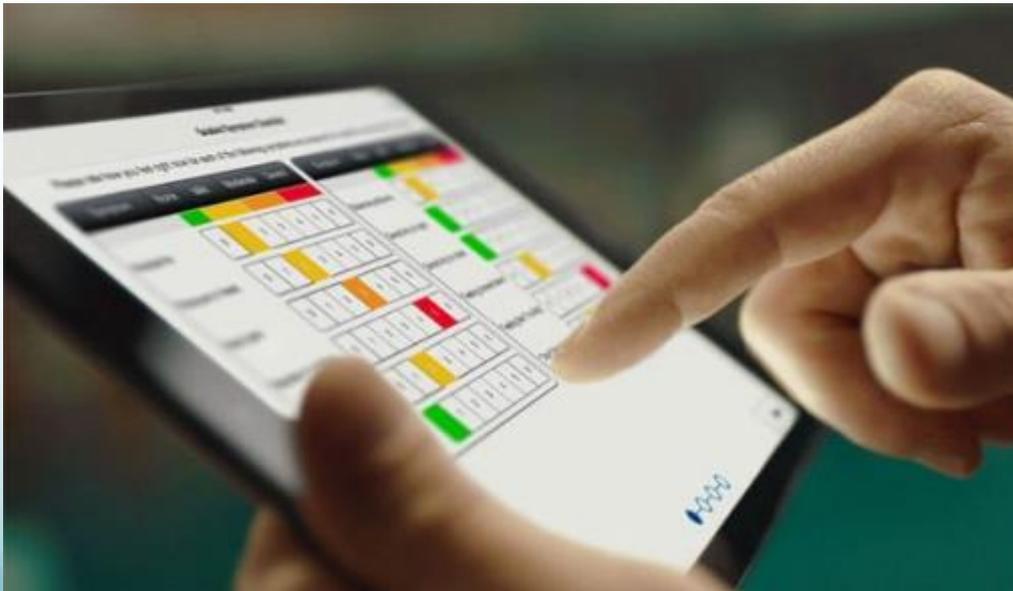
Concentration Number Lists (circle one)					
List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1
List D	List E	List F			
7-8-2	3-8-2	2-7-1	Y	N	0
9-2-6	5-1-8	4-7-9	Y	N	1
4-1-8-3	2-7-9-3	1-6-9-3	Y	N	0
9-7-2-3	2-1-6-9	3-9-2-4	Y	N	1
1-7-9-2-6	4-1-8-6-9	2-4-7-5-8	Y	N	0
4-1-7-5-2	9-4-1-7-5	8-3-9-6-4	Y	N	1
2-6-4-8-1-7	6-9-7-3-8-2	5-8-6-2-4-9	Y	N	0
8-4-1-9-3-5	4-2-7-9-3-8	3-1-7-8-2-6	Y	N	1
Digits Score:					of 4

DELAYED RECALL: Total number of words recalled accurately: **of 5** or **of 10**

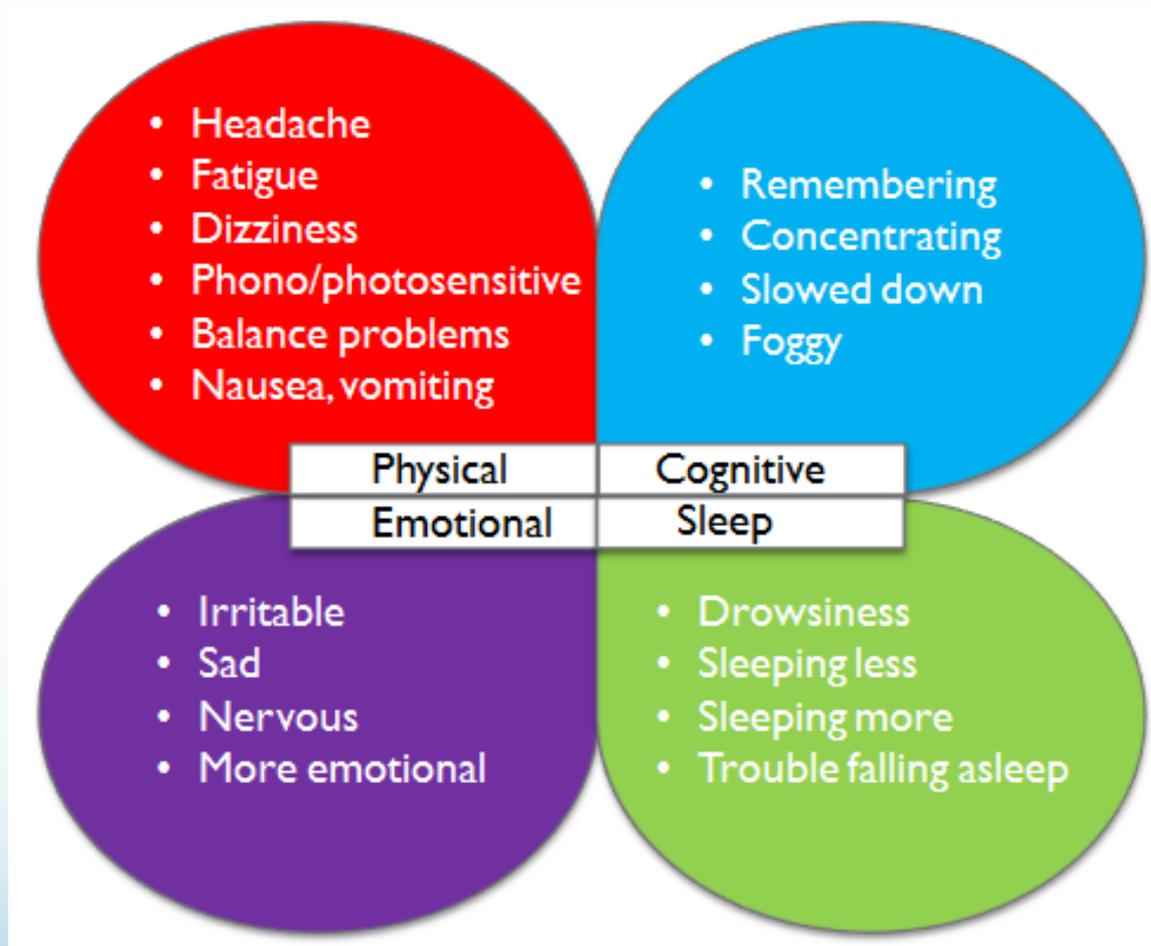
Total Score: _____

Neurocognitive Exam

- Neuropsych, paper-based, computerized ???
 - Provides supplemental objective information
 - Unclear benefit of baseline testing
 - Use as a component of RTP determination
- **SCAT 5 (Child)**
- **Impact**
- **C3 Logix**
- **Others**



Common Acute Symptoms of Concussion



Factors impacting Youth/Students:

- **Academics**
- **Sports/Activities**
- **Developmental changes**
- **Social factors**
- **Co-morbidities**



Factors impacting Adults:

- **Occupational stressors**
- **Pre-existing conditions**
- **Natural age-related changes**
- **Financial factors**
- **Co-morbidities**



Initial Visit Summary

- Review of evaluation
- Education
- Initial Plan of care
- Determination of needs
- Coordination of care
- Follow-up planning

Recovery Stages of Concussion

Each stage must be separated by at least 24 hours.
If symptoms occur at any one stage, athlete must return to previous stage.



Education (ACE)

Returning to Daily Activities

1. Get lots of rest. Be sure to get enough sleep at night- no late nights. Keep the same bedtime weekdays and weekends.
2. Take daytime naps or rest breaks when you feel tired or fatigued.
3. **Limit physical activity as well as activities that require a lot of thinking or concentration. These activities can make symptoms worse.**
 - Physical activity includes PE, sports practices, weight-training, running, exercising, heavy lifting, etc.
 - Thinking and concentration activities (e.g., homework, classwork load, job-related activity).
4. Drink lots of fluids and eat carbohydrates or protein to main appropriate blood sugar levels.
5. **As symptoms decrease, you may begin to gradually return to your daily activities. If symptoms worsen or return, lessen your activities, then try again to increase your activities gradually.**
6. During recovery, it is normal to feel frustrated and sad when you do not feel right and you can't be as active as usual.
7. Repeated evaluation of your symptoms is recommended to help guide recovery.

Returning to School

1. If you (or your child) are still having symptoms of concussion you may need extra help to perform school-related activities. As your (or your child's) symptoms decrease during recovery, the extra help or supports can be removed gradually.
2. Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your (or your child's) injury and symptoms. School personnel should be instructed to watch for:
 - Increased problems paying attention or concentrating
 - Increased problems remembering or learning new information
 - Longer time needed to complete tasks or assignments
 - Greater irritability, less able to cope with stress
 - Symptoms worsen (e.g., headache, tiredness) when doing schoolwork

~Continued on back page~

Returning to School (Continued)

Until you (or your child) have fully recovered, the following supports are recommended: (check all that apply)

- No return to school. Return on (date) _____
- Return to school with following supports. Review on (date) _____
- Shortened day. Recommend ___ hours per day until (date) _____
- Shortened classes (i.e., rest breaks during classes). Maximum class length: _____ minutes.
- Allow extra time to complete coursework/assignments and tests.
- Lessen homework load by _____%. Maximum length of nightly homework: _____ minutes.
- No significant classroom or standardized testing at this time.
- Check for the return of symptoms (use symptom table on front page of this form) when doing activities that require a lot of attention or concentration.
- Take rest breaks during the day as needed.
- Request meeting of 504 or School Management Team to discuss this plan and needed supports.

Returning to Sports

1. **You should NEVER return to play if you still have ANY symptoms** – (Be sure that you do not have any symptoms at rest and while doing any physical activity and/or activities that require a lot of thinking or concentration.)
2. Be sure that the PE teacher, coach, and/or athletic trainer are aware of your injury and symptoms.
3. It is normal to feel frustrated, sad and even angry because you cannot return to sports right away. With any injury, a full recovery will reduce the chances of getting hurt again. It is better to miss one or two games than the whole season.

The following are recommended at the present time:

- Do not return to PE class at this time
- Return to PE class
- Do not return to sports practices/games at this time
- Gradual** return to sports practices under the supervision of an appropriate health care provider.
 - Return to play should occur in gradual steps beginning with aerobic exercise only to increase your heart rate (e.g., stationary cycle); 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 of activity. Move to the next level of activity only if you do not experience any symptoms at the each level. If your symptoms return, stop these activities and let your health care professional know. Once you have not experienced symptoms for a minimum of 24 hours and you receive permission from your health care professional, you should start again at the previous step of the return to play plan.

Gradual Return to Play Plan

1. No physical activity
2. Low levels of physical activity (i.e.,). This includes walking, light jogging, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat).
3. Moderate levels of physical activity with body/head movement. This includes moderate jogging, brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (reduced time and/or reduced weight from your typical routine).
4. Heavy non-contact physical activity. This includes sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills (in 3 planes of movement).
5. Full contact in controlled practice.
6. Full contact in game play.

*Neuropsychological testing can provide valuable information to assist physicians with treatment planning, such as return to play decisions.

This referral plan is based on today's evaluation:

- Return to this office. Date/Time _____
- Refer to: Neurosurgery _____ Neurology _____ Sports Medicine _____ Physiatrist _____ Psychiatrist _____ Other _____
- Refer for neuropsychological testing
- Other _____

ACE Care Plan Completed by: _____ MD RN NP PhD ATC

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Concussion Management

Cornerstone of current concussion management is relative physical rest and cognitive rest until symptoms resolve, and then a **graded** program of physical/cognitive exertion prior to full clearance to return to work/school or return to play.

- **Active Facilitated Recovery**
 - Early return to adjusted activity
- **Reassurance**
- **Symptom Normalization (manage the anxiety)**
- **Frequent Follow-up as needed**
- **Multidisciplinary & Interdisciplinary approach**

Old model of treatment

- **Complete** physical and cognitive rest
- **Don't** let people sleep (wake them up)
- Dark room, **no** stimulation
- **No** school, **No** work



Old model of treatment

- Complete physical and cognitive rest
 - Don't let people sleep (wake them up)
 - Dark room, no stimulation
 - No school, No work
- = Worsened and prolonged symptoms**
- = Worsening depression and anxiety**
- = Poor long term outcomes**

Concussion Management

- **In most cases:**
 - Relative Rest
 - Graduated return to function
 - Return to Learn
 - Return to Work
 - Return to Play



Return to Learn

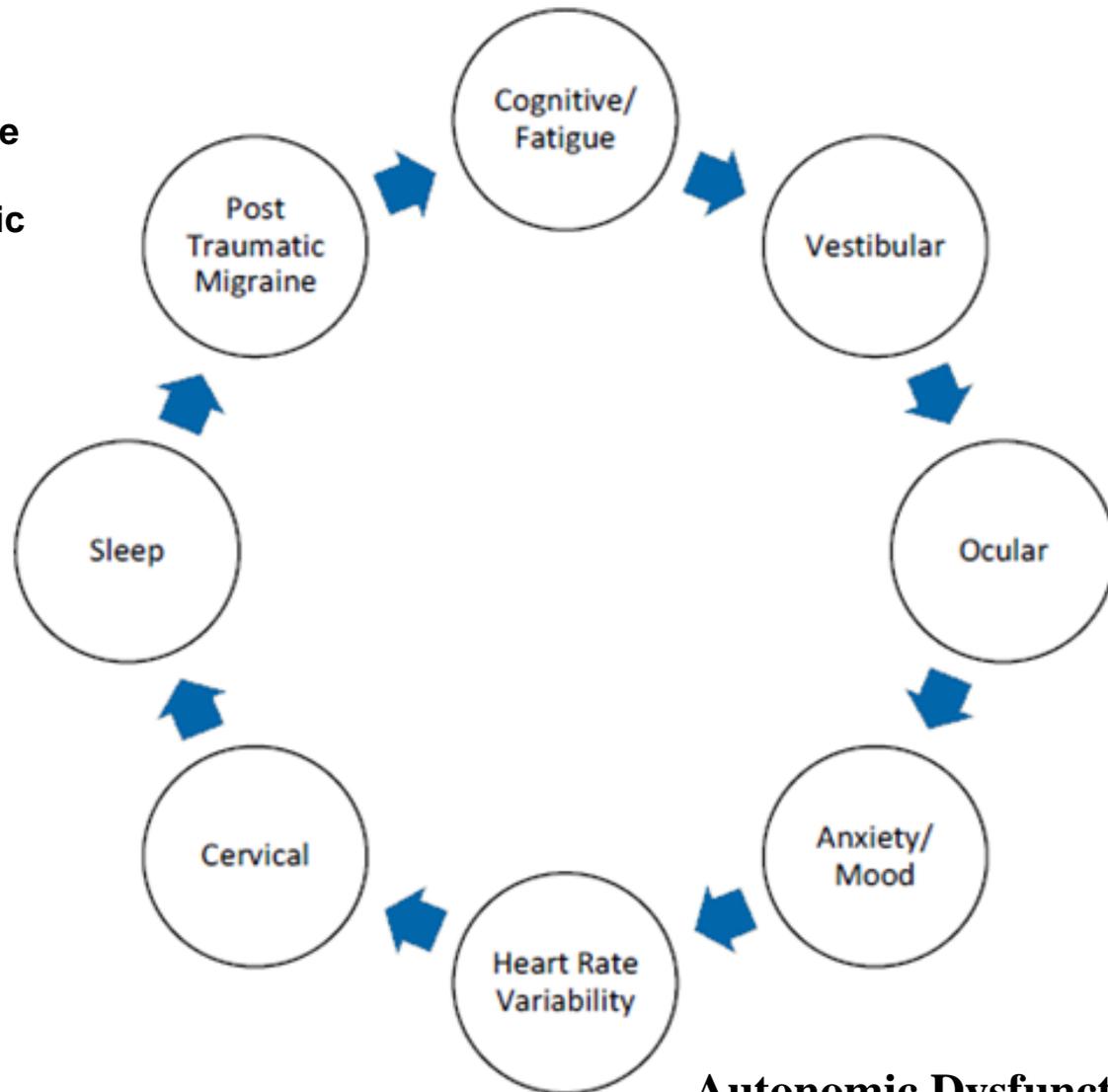
Stage	Description	Activity Level	Criteria to Move to Next Stage
0	No return, at home	Day 1 - Maintain low level cognitive and physical activity. No prolonged concentration. Cognitive Readiness Challenge: As symptoms improve, try reading or math challenge task for 10-30 minutes; assess for symptom increase.	To Move To Stage 1: (1) Student can sustain concentration for 30 minutes before significant symptom exacerbation, AND (2) Symptoms reduce or disappear with cognitive rest breaks* allowing return to activity.
1	Return to School, Partial Day (1-3 hours)	Attend 1-3 classes, intersperse rest breaks. No tests or homework. Minimal expectations for productivity.	To Move To Stage 2: Symptom status improving, tolerates 4-5 hours of activity-rest cycles; 2-3 cognitive rest breaks built into school day.
2	Full Day, Maximal Supports (required throughout day)	Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW ($\leq 60'$). Minimal-moderate expectations for productivity.	To Move To Stage 3: Symptom number & severity improving, needs 1-2 cognitive rest breaks built into school day.
3	Return to Full Day, Moderate Supports (provided in response to symptoms during day)	Attend all classes with 1-2 rest breaks (20-30'); begin quizzes. Moderate HW (60-90') Moderate expectations for productivity. Design schedule for make-up work.	To Move To Stage 4: Continued symptom improvement, needs no more than 1 cognitive rest break per day
4	Return to Full Day, Minimal Supports (Monitor final recovery)	Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time). HW (90+) Moderate- maximum expectations for productivity.	To Move To Stage 5: No active symptoms, no exertional effects across the full school day.
5	Full Return, No Supports Needed	Full class schedule, no rest breaks. Max. expectations for productivity.	N/A

Return to Play

Rehabilitation stage	Functional exercise at each stage of rehabilitation	Objective of each stage
1. No activity	Symptom limited physical and cognitive rest	Recovery
2. Light aerobic exercise	Walking, swimming or stationary cycling keeping intensity <70% maximum permitted heart rate No resistance training	Increase HR
3. Sport-specific exercise	Skating drills in ice hockey, running drills in soccer. No head impact activities	Add movement
4. Non-contact training drills	Progression to more complex training drills, eg, passing drills in football and ice hockey May start progressive resistance training	Exercise, coordination and cognitive load
5. Full-contact practice	Following medical clearance participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6. Return to play	Normal game play	

Components of Concussion / Integrated Systems of injury & recovery:

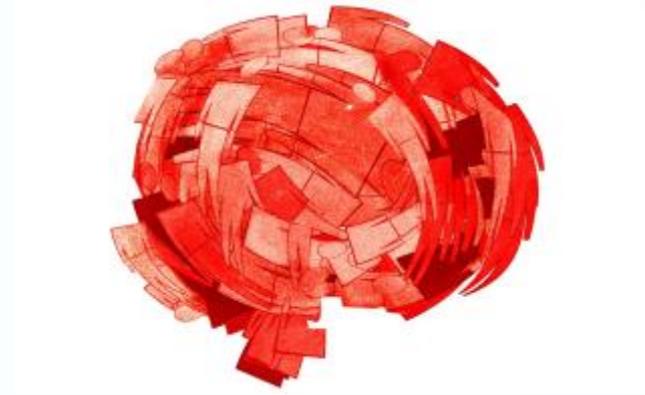
- * Headache
 - Migraine-like
 - Tension
 - Cervicogenic
 - Ocular



Autonomic Dysfunction

Headache

- **Mixed type of headache**
 - Migrainous
 - Cervicogenic
 - Ocular Tension
 - Medication misuse
- **Considerable overlap with migraine-type headache**
 - Activation of trigeminal nociception



- **Pharmacotherapy**
 - Abortive / Prophylactic
- **Physical Therapy**
- **Neuro-Optometry**
- **Combination approach**

Vestibular

- **Postural Instability**
 - Impaired balance/gait
 - Abnormal vestibular-ocular function
 - Visual motion sensitivity
- **Multiple functional systems**
 - Inner ear
 - Visual/Ocular system
 - Upper cervical spine
 - Neuro-musculoskeletal
- **Any (or multiple) of these systems may need to be addressed to improve balance/dizziness.**



Ocular

- Ocular dysfunction:
 - Convergence Dysfunction
 - Impaired accommodation
 - Abnormal pursuits
 - Abnormal Saccades
 - Symptom provocation
- Photophobia
 - “Blue Light”?
 - Sun-glasses in bright environments.
 - Adjust computer screen brightness.
 - Take “eye breaks” and focus on something further away to help relieve eye stress.
 - Consider colored lenses (yellow/orange/amber/rose), especially with electronics and artificial lighted areas.
 - Consider Neuro-optometry
- Upwards of 75% of the brain is involved in vision.
- Trouble focusing vision and/or tracking vision effectively.
- Eye strain (while reading) or tolerating busy environments.
- Certain types of light are more irritating.

Anxiety - Mood

- **Acute Emotional Lability**
 - Depressed/anxious mood
- **Consider pre-existing status**
- **Provide Reassurance**
- **Serotonin/Dopamine dysfunction:**
 - Emotional lability
 - Psychosomatic
 - Cognition
 - Balance
 - Pain perception
- **Maintain Social Engagement**
- **Mental Health counseling**
- **Cognitive behavioral therapy**
- **Regular light exercise**
- **Reassurance**
- **Relaxation techniques**
- **Pharmacotherapy**
 - **SSRI**
 - **Others**

Fatigue

- **Persistent sleep/wake disturbance**
 - **Sleep hygiene**
 - **Cognitive behavioral therapy**
 - **Medications**
 - **Melatonin**
 - **Trazadone**
 - **Tricyclic antidepressants**
 - **Environmental adjustments**
 - **Work/School**
 - **Exercise**
 - **Mental health consideration**
- **Post-traumatic narcolepsy**
 - **Sleep medicine consult**
- **Acupuncture/Message/etc.**
- **Post-Traumatic Endocrinopathy**

Cognitive Dysfunction

- **Concussion affects how our brain metabolizes energy.**
 - Cognitive tasks may seem harder to perform,
 - Take longer than normal, become frustrating, fatigue
 - It's like trying to operate a "slow computer" or work on "slow Wi-Fi".
 - Take frequent breaks, expect to perform less work than usual.
Relative rest
- Work-place / School accommodations
- Support & Reassurance!
- Coping strategies
 - Keep lists, a notebook
 - Ask family, friends to remind
- Consider mental health component
- Speech/Cognitive therapy
- Occupational therapy
- Neuropsychology evaluation/treatment

Autonomic Dysfunction

- After concussion, dysfunction of the autonomic nervous system often occurs. This can contribute to dysfunction of multiple systems.
 - Blood pressure and heart rate response to activity, which can contribute to dizziness, imbalance, and an overall sense of “not feeling right”.
 - Impact the ability of the visual system to respond appropriately, affecting vision. (Pupillary response and eye pressure)
 - Affect our endocrine system and impact the way our body responds to hormones. (Thyroid, pituitary hormones)
 - Up-regulates our “fight-flight” system releasing increased catecholamine (adrenaline) contributing to anxiety and mood/emotional dysfunction.

Cervical Spine

- **Whiplash**

- 4-10 G's of force

- Neck pain

- Headache

- Dizziness

- Cognitive dysfunction

- **Concussion**

- 96 G's of force

- Headache

- Dizziness

- Cognitive dysfunction

- Fatigue

Initial Recommendations

Rest/Sleeping:

- Brain needs time to recover.
- Adequate amounts of sleep

Driving:

- Do not drive or operate machinery until you feel much better and can concentrate and balance properly.

Drinking/Drugs:

- Do not drink alcohol or use recreational drugs until you are fully recovered.

Medications:

- Do not take new medication unless advised by your provider. *Review current medications.*

Work/Study:

- How much time you need off work or study will depend on the type of job you do and your symptoms/recovery.
- Let your employer or teachers know if you are having problems at work or with study. You may need to return to study or work gradually.

Sport/Lifestyle:

- It is dangerous for the brain to be injured again if it has not recovered from the first injury.

Relationships:

- Sometimes your symptoms will affect your relationship with family and friends. You may suffer irritability and mood swings.

Sub-Threshold Aerobic Exercise

Early Subthreshold Aerobic Exercise for Sport-Related Concussion

A Randomized Clinical Trial

John J. Leddy, MD¹; Mohammad N. Haider, MD^{1,2}; Michael J. Ellis, MD^{3,4,5}; [et al](#)

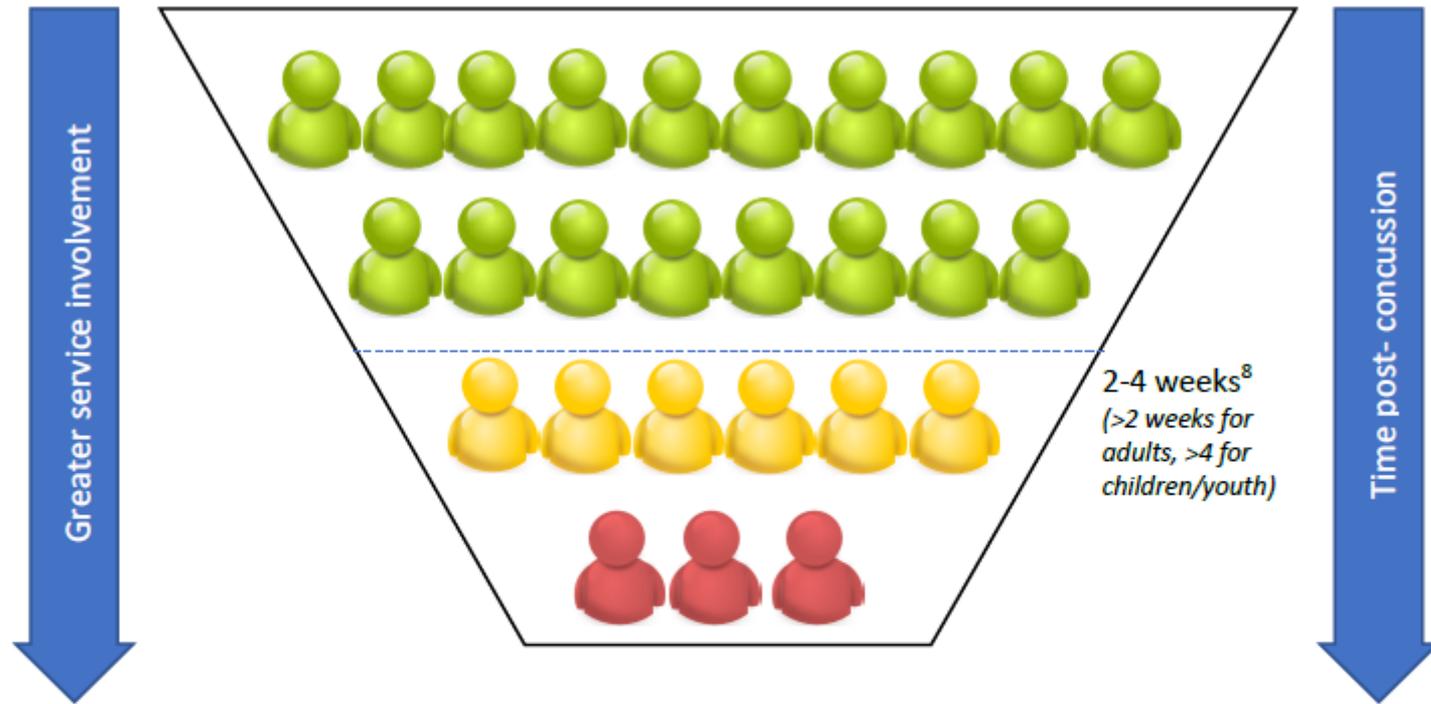
» [Author Affiliations](#)

JAMA Pediatr. Published online February 4, 2019. doi:10.1001/jamapediatrics.2018.4397

- Individualized sub-symptom threshold aerobic exercise treatment prescribed to adolescents with concussion symptoms during the first week after SRC speeds recovery and may reduce the incidence of delayed recovery.

Risk Factors for Delayed Recovery

- **History of three or more prior concussions?**
- **Female gender**
- **Younger age and older age**
- **Prior history of cognitive dysfunction**
- **Affective disorders such as depression/Anxiety**
- **Migraine Headaches**
- **Too much physical and/or cognitive activity too early**
- **Social Support Structure / coping skill**



Follow-up with primary care provider – majority will recover over a few days to weeks, with education about symptom management.

Follow-up required, further assessment may be required if symptoms are not resolving fully or considered as higher risk for a prolonged recovery.

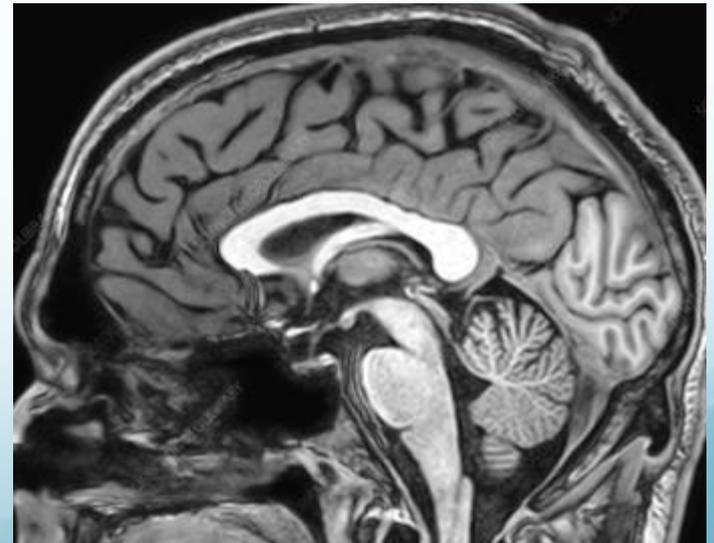
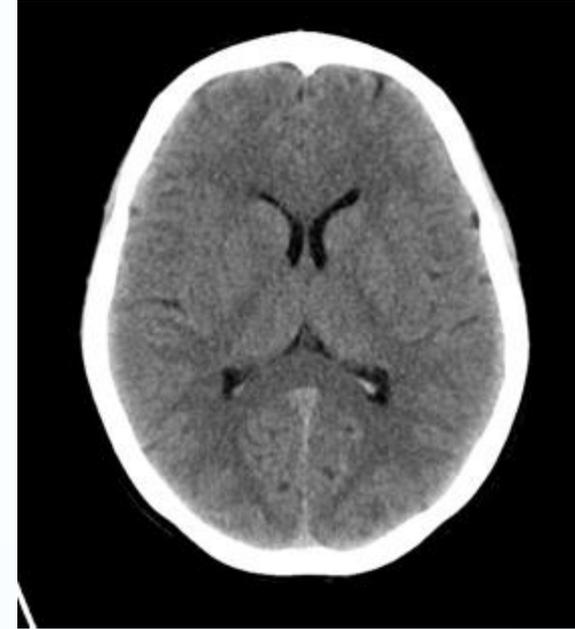
Persistent symptoms, interdisciplinary care required

Multidisciplinary Approach

- **Physician/Provider:** Dx/Tx plan, Rx management
- **PT/OT:** MSK/Balance/Vestib/RTP-RTD/Drive eval
- **Speech Tx:** Cognitive rehab, RTL/RTW, Occupational rehab
- **Optometry:** Specialty eval for functional vision changes
- **Neuropsychology:** Cognitive Behavioral eval and management, etc.
- **Mental/Behavioral health:** Mental Health support
- **Neurology:** Consult for atypical features
- **Other:** Acupuncture, dry needling, modalities, etc.

Neuro Imaging

- **Brain CT (or, when/where available, MRI) contributes little to concussion evaluation**
 - If suspicion of an intra-cranial structural lesion exists.
- **Prolonged disturbance of conscious state**
- **Focal neurological deficit**
- **Acutely worsening symptoms.**



Important

- Just because a therapist does “**vestibular therapy**”, doesn’t mean they have much ability to treat complex Concussion.
- Don’t under-recognize concussion
- Don’t over-pathologize concussion
- Consider interdisciplinary management for prolonged symptoms.

UNITYPOINT CLINIC CONCUSSION MANAGEMENT PROGRAM

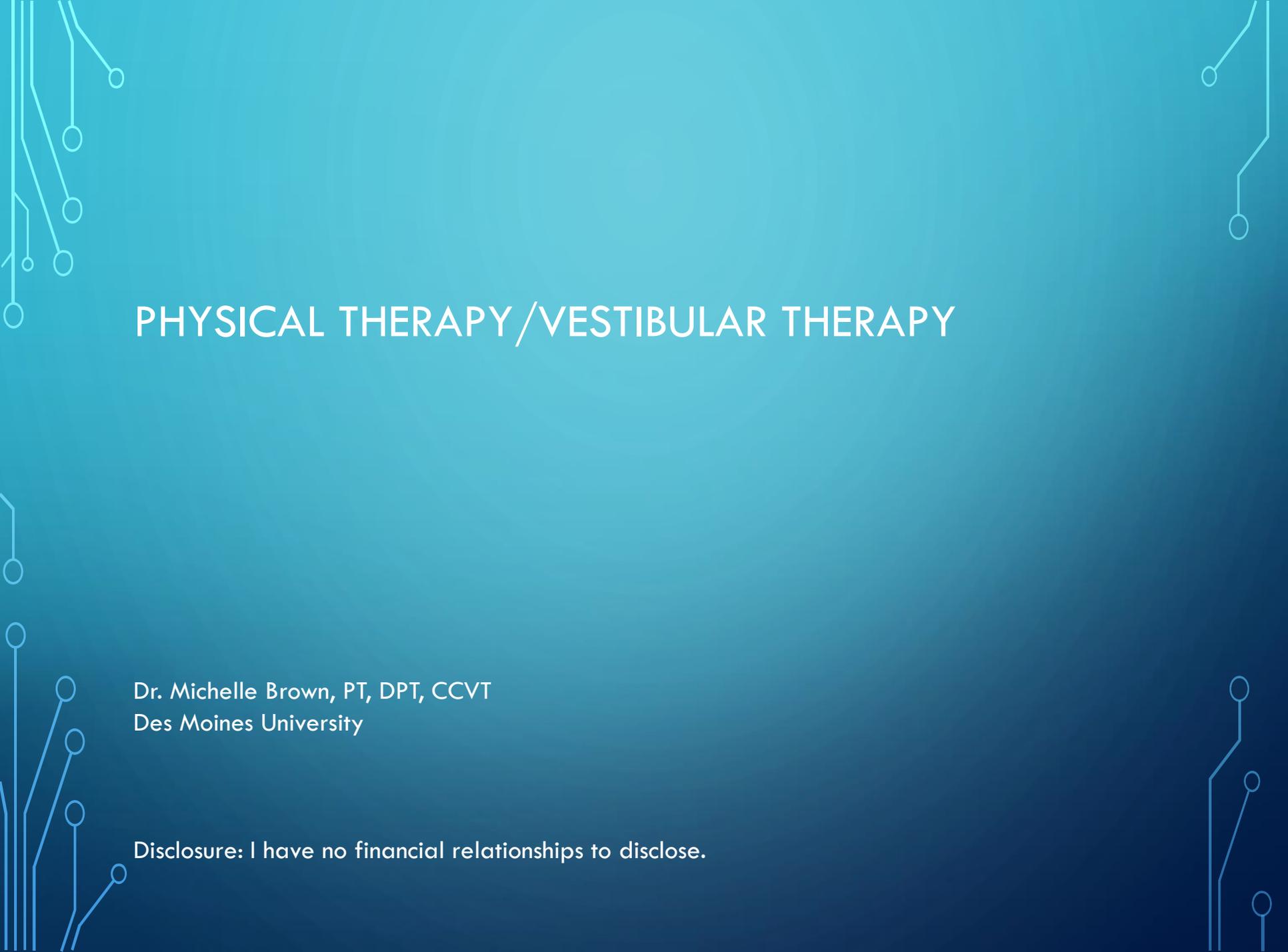
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<https://www.unitypoint.org/desmoines/concussion-management-program.aspx>

The background is a solid teal color. In the four corners, there are decorative white line-art elements that resemble circuit traces or neural pathways, with small circles at the end of the lines.

PHYSICAL THERAPY/VESTIBULAR THERAPY

Dr. Michelle Brown, PT, DPT, CCVT
Des Moines University

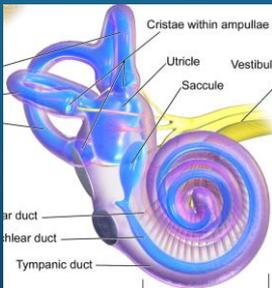
Disclosure: I have no financial relationships to disclose.

ROLE OF PHYSICAL THERAPY POST CONCUSSION

- Musculoskeletal evaluation and treatment
- Balance training
- Vestibular and oculomotor assessment and treatment
- Exertional tolerance testing- Buffalo Concussion Treadmill test¹



BALANCE



- Visual system
 - Vision is more than just acuity
 - Central/focal vision
 - Peripheral/ambient vision-gives us orientation, and likely affected with concussion
- Somatosensory system- orientation sense we get through our feet in contact with the ground.
- Vestibular system- inner ear-(semicircular canals and otolith organs) provides information regarding orientation in space
 - Gaze stabilization
 - Postural stabilization

PHYSIOLOGY²

- VOR- vestibulo-ocular reflex- gaze stabilization during head movement.
 - VOR gain 1:1
- VSR- vestibulospinal reflex- stabilizes the body during head movement

COMMON TERMINOLOGY³

- Nystagmus- involuntary eye movements
- Adaptation- ability to modify VOR gain with repeated stimuli, i.e. head movements
- Habituation- “An acquired tolerance gained by repeated exposure to a particular stimulus.”
- Dynamic Visual Acuity (DVA)- test of VOR. Compares static vision acuity to dynamic vision acuity. A positive test is > 2 lines difference.

SUBJECTIVE

Onset

Rate symptoms VAS

Quality

Duration

Frequency

Aggravating and Alleviating factors

Precipitating factors, PMH, psychosocial

SYMPTOMS SUGGESTING PROLONGED RECOVERY

- **Dizziness 6.7x more likely** to have > recovery time.⁴
- **Dizziness with concussion “greatest predictor” for > 21 days for recovery.**⁵
- **> number of symptoms, severity and duration of symptoms** post injury suggest longer recovery.⁵
- Post-traumatic migraines after concussion predictive of > recovery time⁶

SUBJECTIVE REPORTS WHICH INDICATE REFERRAL TO PHYSICAL AND VESTIBULAR THERAPY

- Headaches
- Neck pain
- Visual Motion sensitivity
- “off-balance”
- Blurred or bouncing vision with head movement
- Dizziness



COMMON SUBJECTIVE DESCRIPTIONS OF DIZZINESS

- Spinning
- Floating
- Foggy
- Off balance
- Blurred vision
- Imbalance
- Rocking
- Nausea
- Loss of equilibrium
- Head pressure



POSSIBLE VESTIBULAR DYSFUNCTION POST CONCUSSION

- BPPV
- Labyrinthine concussion
- Perilymphatic fistula, superior canal dehiscence
- VOR deficits

OBJECTIVE

- Oculomotor: smooth pursuit, saccades, converge/diverge, spontaneous nystagmus, gaze holding nystagmus
- Neuro screen: coordination, reflexes, Cranial nerve tests, gait
- Musculoskeletal screen
- Balance: Romberg EO/EC, Foam EO/EC*
- Vitals
- VBI screen
- Head thrust and VOR sitting and standing
- VOR cancellation
- Optokinetic Reflex
- Static and Dynamic Visual Acuity
- Positional testing if BPPV suspected

TREATMENT

- Multidisciplinary approach ^{6,7}
- Targeted ^{6,7}
- Manual therapy
 - If they don't have good C1 /2 mobility or mm activation they will have trouble with VOR
- Vestibular rehabilitation
 - 5 minute rule
- Balance-Sensory Organization Training
- Symptom limited aerobic exercise- increase cerebral perfusion, improve mood

TREATMENT ⁷

- Oculomotor: Saccades, smooth pursuit, convergence
- Adaptation/gaze stabilization
 - VOR x 1 (needs to be outside of convergence zone. < 120 bpm is smooth pursuit)
 - VOR x 2
 - VORc
- Progression: VOR
 - Sitting, standing, change foot position
 - Plain background, busy background
 - Different surfaces
 - Walking
 - Sport specific drills
- Optokinetic reflex training- Visually induced dizziness: OPK and VOR, try VOR to side of impairment
- Peripheral/central integration
- Balance: Romberg EO, EC
- Habituation exercises

CASE STUDY: SUBJECTIVE

- **Chief complaint:** headache, R sided neck pain
- **Mechanism of Injury:** 2 wks ago, moving washing machine up flight of stairs, washer fell on her and her head hit the wall behind her. Possible LOC. Went to ER
- **Pain:** 2/10; worst pain in past two weeks 5-6/10; lowest pain in past two weeks 1-2/10
- **Quality:** dull (headache-constant); aching (posterior neck); intermittent
- **Decrease symptoms:** sitting; pain medications & muscle relaxers; lying down; darkness, quiet, better in a.m.
- **Increase symptoms:** > as day goes on, TV, changing positions, riding in car, increase noise/lights - increased HA

SUBJECTIVE

- Impaired sleep due to pain
- Prior History: no similar problems in the past
- Imaging: CT scan (2 scans - frontal and full -both normal)
- Associated Symptoms: nausea; confusion; forgetfulness; dizziness
- IADL: limited to engage in previous recreational activities, driving: dependent upon others
- Employment: Computer - program planner-off work due to injury
- Patient goals: Return to work and normal activities.

CASE STUDY: OBJECTIVE

- Cervical AROM: side bending: limited B, rotation: Limited R > L, Flexion: limited, extension: limited w/pain frontal region.
- Palpation: tenderness of B trapezius, levator scapulae; Suboccipitals R > L.
- Flexibility Right: upper trapezius and Levator scapulae decreased.

OBJECTIVE

- Saccades: slow/labored with c/o dizziness
- Smooth pursuit: nystagmus with pursuit to L, c/o dizziness.
- Dizziness Handicap Inventory: (DHI): 40, where 100 = maximum perception of disability.

CASE STUDY: TREATMENT

- **Impairments:** HA, neck pain, dizziness, visual motion sensitivity, mental foginess, memory trouble
- **Manual therapy:** STM, MET cervical
- **Therapeutic Exercise:** CROM, deep neck flexor strengthening
- **Vestibular:** saccades, VOR x 1 progression, VOR x2, gait with head turns, nods
- **Balance:** Romberg floor, foam EO, EC, head turns, nods, progressed prn
- **s/p 11 wks concussion patient c/o spinning: + L Dix Hallpike BPPV**
 - Canalith repositioning maneuver L posterior canal 2x
- Next treatment (-) L Dix Hallpike, + R Dix Hallpike
 - Canalith repositioning maneuver R posterior 1x
- 4 months s/p concussion: playing with dog and hit R posterior head, increased symptoms
 - + L Dix Hallpike, + L supine canal roll test.
 - CRM L horizontal and post. canal

DISCHARGE

- Reported improvement: Neck: 90%, vestibular: 90-95%; Since last canalith repositioning maneuver dizziness much better. No spinning or feeling like still moving at the stop light.
- DHI: 4 (improved from 40), where 100 = maximum disability
- Reports more endurance physically and mentally. Able to work onsite 7 -7.5 hrs.
- Patient reports able to manage symptoms and things are getting better with time.

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IMAGES: CREATIVE COMMONS

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