

Concussion Diagnosis, Evaluation, Intervention & Prognosis

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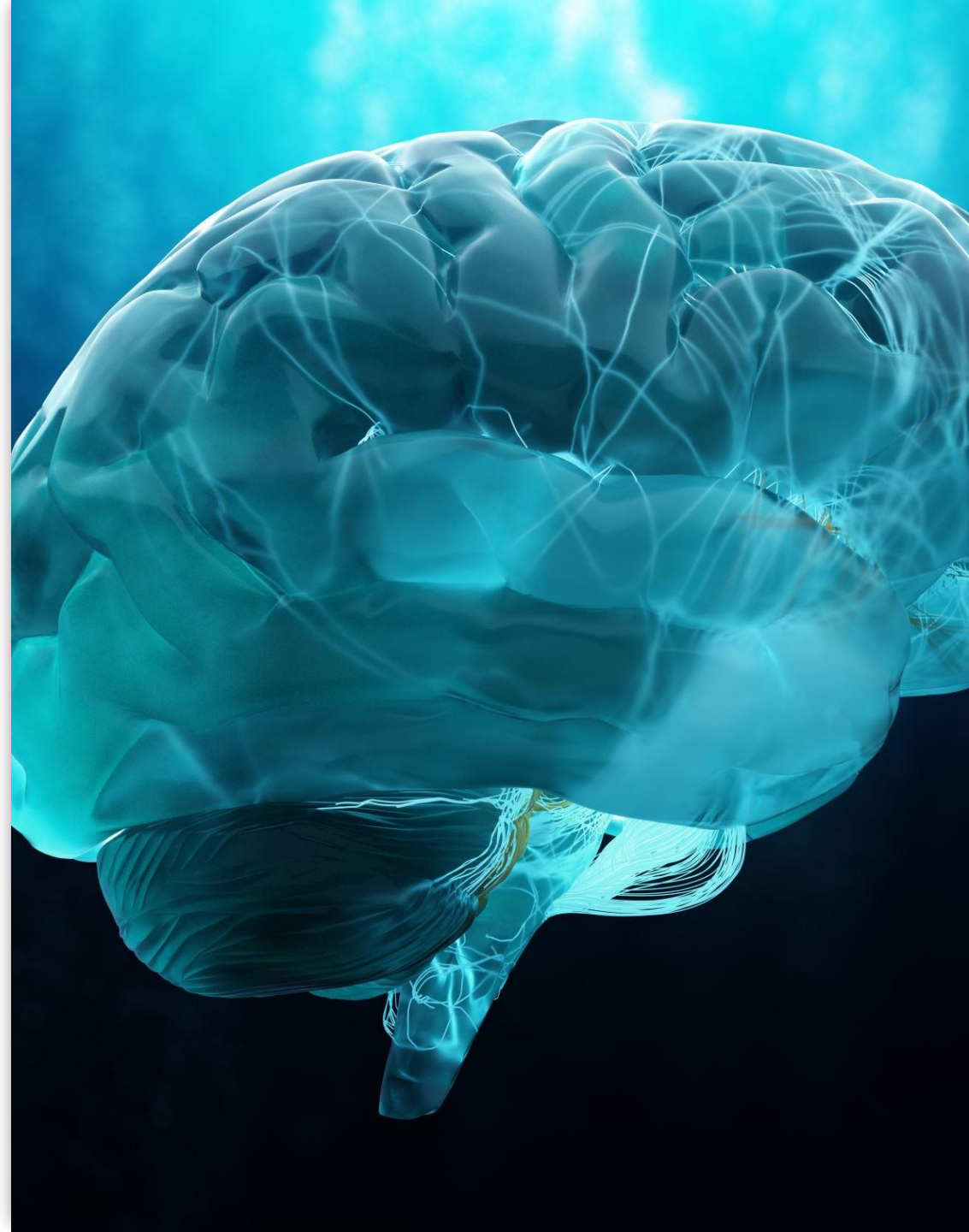
Objectives

- Describe the underlying pathophysiology of mTBI
- Identify key diagnosis criteria for mTBI
- Describe common symptoms related to mTBI
- Evaluate the role of physical therapy in diagnosing and treatment of mTBI
- Develop strategies and interventions for treatment of mTBI
- List the prognostic factors associated with mTBI

Introduction to Concussion

Definition

- National Institute of Neurological Disorders and Stroke
 - Concussion is a mild TBI which may take minutes to months to heal
 - Often result of a blow to the head, or a rapid movement of the brain within the skull



Pathophysiology of Concussion¹

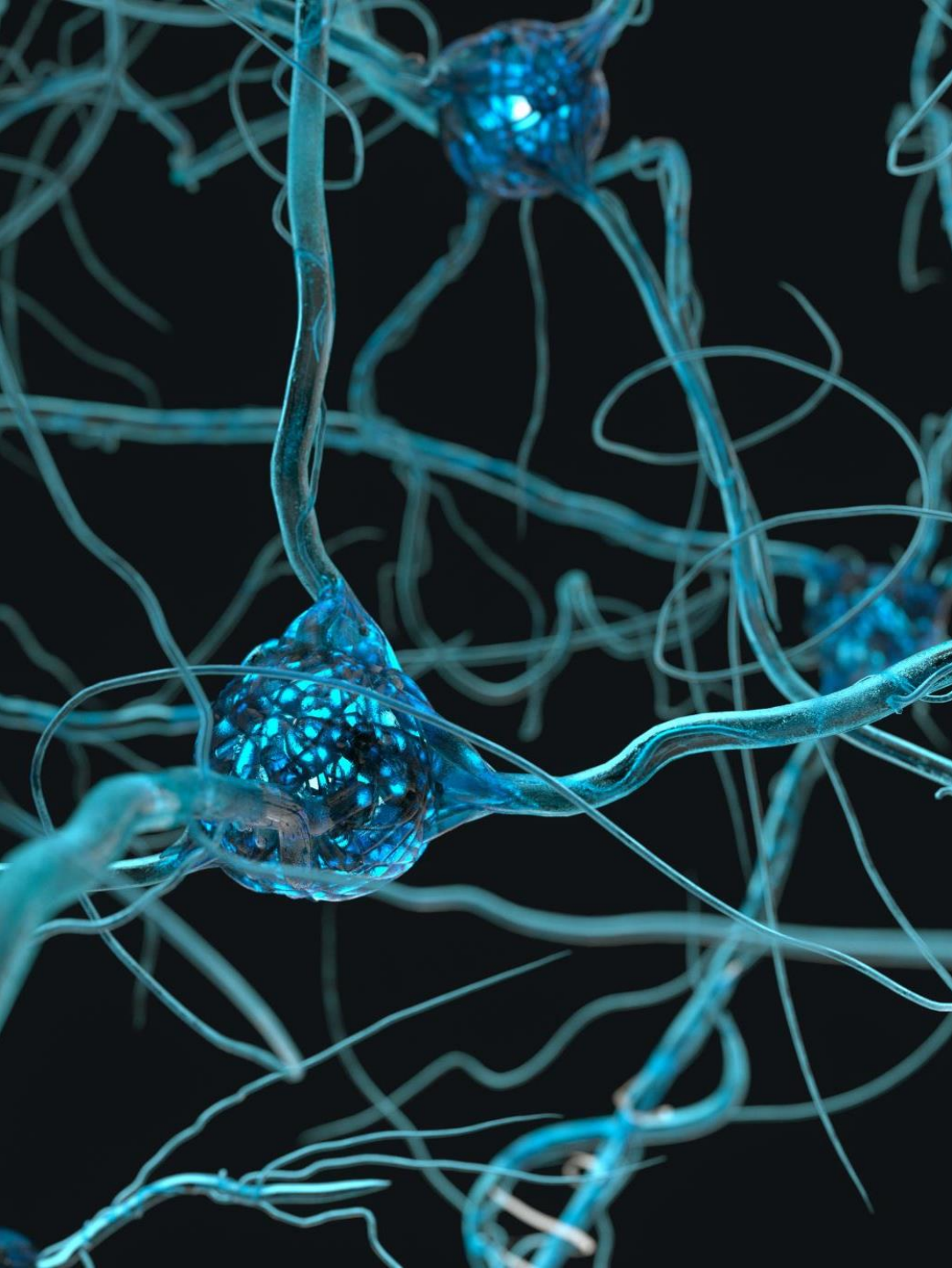
THE MOLECULAR PATHOPHYSIOLOGY OF CONCUSSION

[David R Howell](#)^{1,2}, [Julia Southard](#)^{1,3}

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- Neurometabolic Cascade
 - The rapid shift of the brain within the skull causes an abrupt neuronal depolarization, excitatory neurotransmitter release, altered cerebral blood flow, and disrupted axonal function



Continued

- The sudden release of potassium and influx of sodium and calcium is responsible for the sudden depolarization of neurons
- This triggers both voltage or ligand gated ion channels resulting in widespread depression and inability to clear inflammation/repair neuronal connections

Epidemiology^{2,3}

Annual Incidence Rate → 1.2%

1.4-3.8 Million Concussions per year

Higher incidence in males than females and increases to 4.9% and 6.9% in those aged 12-17 respectively

Concussion Diagnosis

Clinical Presentation

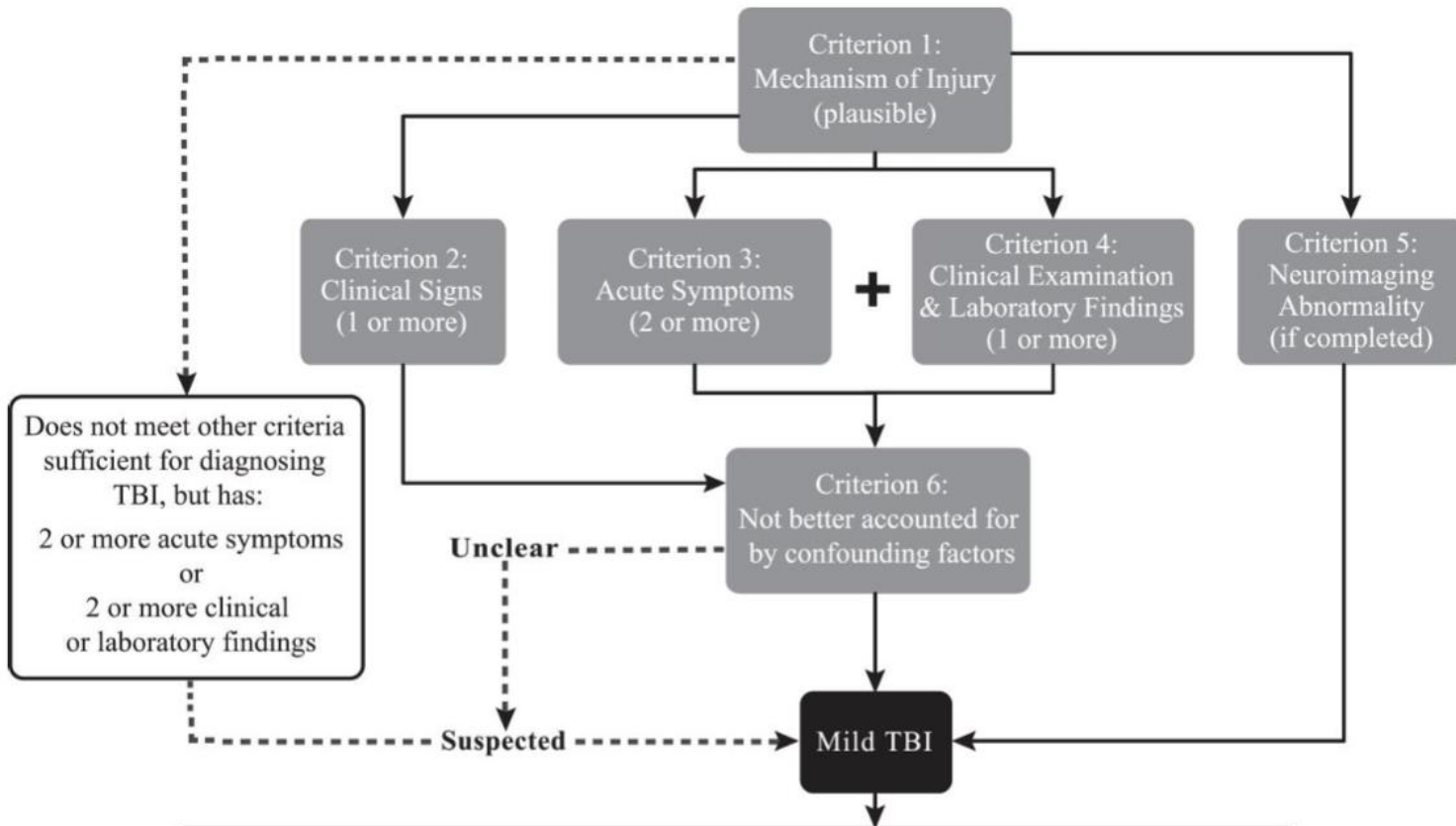
Acute Symptoms^{4,5}

- Headaches
- Neck Pain
- Balance Deficits
- Nausea, Vomiting
- Blurred Vision
- Confusion, drowsiness

Post-Concussion Syndrome⁶

- Similar symptoms as listed above but can last for years after initial neurological insult

Early Diagnosis⁷



The 'Mild' qualifier is not used if any of the injury severity indicators listed below are present.

- Loss of consciousness duration greater than 30 minutes.
- After 30 minutes, a Glasgow Coma Scale (GCS) score of less than 13.
- Post traumatic amnesia greater than 24 hours.

The American Congress of Rehabilitation Medicine Diagnostic Criteria for Mild Traumatic Brain Injury

Noah D. Silverberg, PhD ^{a,b,c} · Grant L. Iverson, PhD ^{d,e,f,g,h} ·

ACRM Brain Injury Special Interest Group Mild TBI Task Force members: · ... · Ross Zafonte, DO ^{d,f,n,b}

Nathan D. Zasler, MD ^{bf} · Roger Zemek, MD ^{bg,bh} ... Show more

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ACRM
Concussion
Guideline
Breakdown⁸



Concussion Evaluation

Subjective Questioning

What happened?

Current and Previous
Symptoms?

Aggs and Eases?

Past Medical History?

Concussion Red Flags

Generally, we will not have to determine if someone needs imaging following a head trauma

....but if working sidelines, it may be valuable to understand imaging rules to determine the emergence of the injury

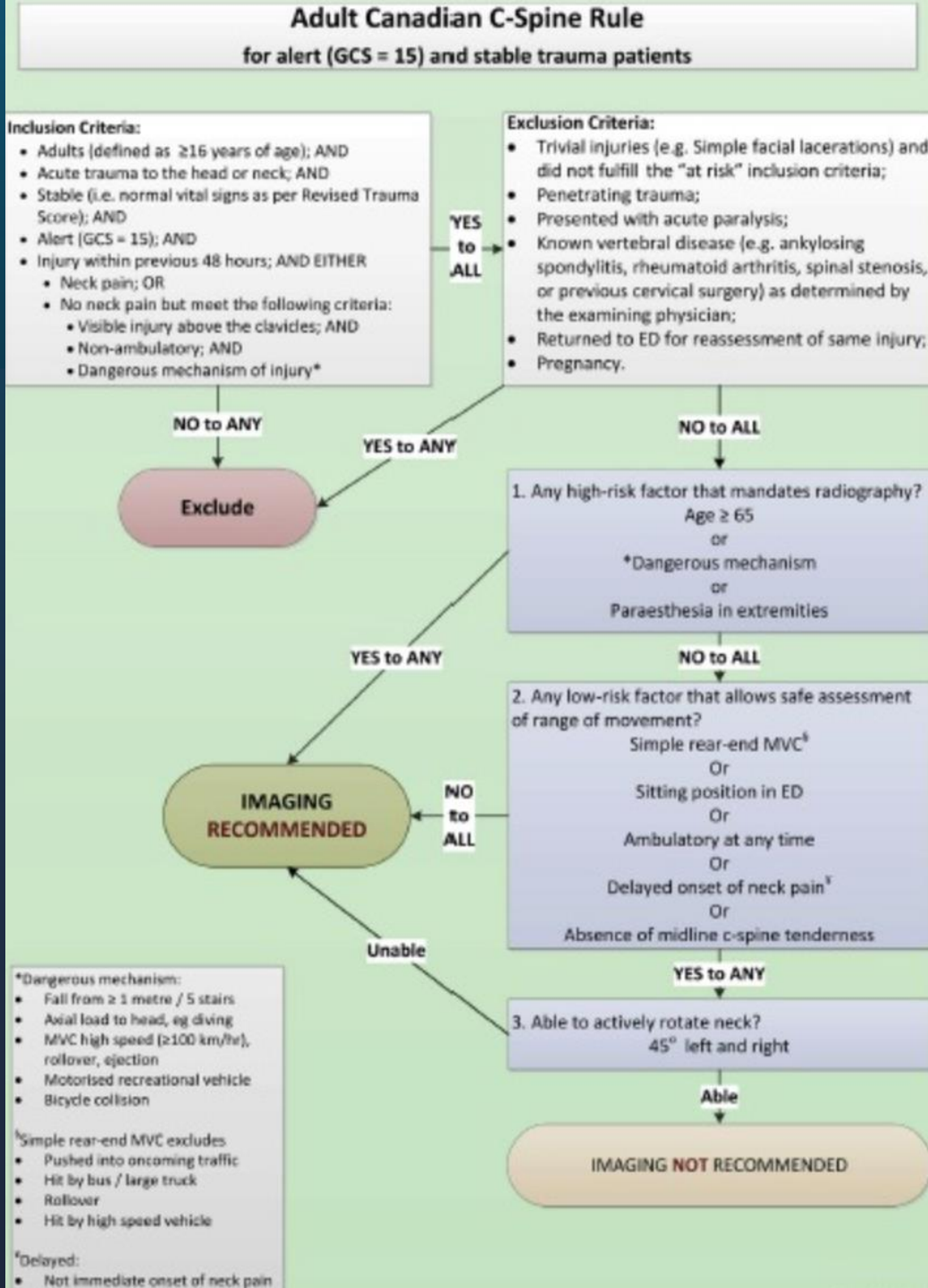
Concussion RED Flags

Canadian CT Head Rules

- Determine the need for neuroimaging due to possible lesions, hemorrhaging

Canadian C-Spine Rules

- Determine the need for imaging due to C-Spine injury



Concussive Events

Using the Evidence to Guide Physical Therapist Practice

J Orthop Sports Phys Ther 2020;50(4):176-177. doi:10.2519/jospt.2020.0502

Concussion Domains, Cervical MSK Impairments¹¹

- Cervical Musculoskeletal Impairments
 - Symptoms: neck pain, HA, dizziness, fatigue, balance problems, visual focus limitations
 - Assessment should include
 - ROM, MMT or dynamometry, Muscular Endurance, Palpation, Joint Position Error

Concussion Domains: Vestibulo-Ocular Impairments¹¹

- Symptoms: HA, Dizziness, Vertigo, Nausea, Fatigue, Balance Problems, Visual Motion Sensitivity, Blurred Vision, Difficulty Focusing
- Assessment Should Include
 - Vestibular and oculomotor function related to ocular alignment , smooth pursuits, saccades, vergence and accommodation, gaze stability, dynamic visual acuity, visual motion sensitivity, light-headedness, vertigo
 - Dix-Hallpike if suspected BPPV

Concussive Events

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Assessment Tools

- VOMS
 - Vestibular Ocular Motor Screening
 - Symptom score demonstrated significant increase in acute concussion timeline frame
 - Highest clinical utility within 72 hours¹³

VOMS

Test	Dizziness (0-10)	Headache (0-10)	Nausea (0-10)	Fogginess (0-10)	Comments
Smooth Pursuit					_____ reps in 10 sec
H. Saccades					_____ reps in 10 sec
V. Saccades					_____ reps in 10 sec
H. VORx1					_____ reps in 10 sec
V. VORx1					_____ reps in 10 sec
Convergence					Trial 1:_____cm Trial 2:_____ cm Trial 3:_____cm
VMS					

VOMS

- What to look for
 - Symptom Provocation
 - Difficulty Tracking
 - Slow movements
 - General difficulty throughout

Dizziness Handicap Inventory - DHI

PROM which has been found to have clinical utility in delineating Vestibular related issues related to dizziness, balance, etc.¹⁴

Allows us to separate from other impairments which may be in play such as cervicogenic HA

Autonomic/Exertional Intolerance Impairments^{11,18}

- Assessment should include
 - Orthostatics: BP in supine, seated and standing
 - Observe for a drop in systolic BP of 20 or greater or a diastolic BP 10 or greater
 - Observe HR for signs of autonomic dysfunction
 - A symptom guided, exertional test should be completed

Buffalo Concussion Treadmill Test

Standardized test used to determine individual's ability to tolerate physical activity following a concussion

Allows us to find the subsymptomatic threshold for exercise via heart rate or BORG rating¹⁶

Utilize a stationary bike if the patient presents with cervical, or vestibular symptoms¹¹

Buffalo Concussion Treadmill Test Cont.¹⁵

Age predicted Max HR: 220-age= _____

Speed: 3.2 mph = 5ft 5in or less, 3.6 mph = Taller than 5ft 5 in.

Time/stage	MPH	Grade	HR	BP	VAS (0-10)	RPE	Notes
Pre-test	-	-					
1	3.2 / 3.6	0	-	-			
2	3.2 / 3.6	1					
3	3.2 / 3.6	2	-	-			
4	3.2 / 3.6	3					
5	3.2 / 3.6	4	-	-			
6	3.2 / 3.6	5					
7	3.2 / 3.6	6	-	-			
8	3.2 / 3.6	7					
9	3.2 / 3.6	8	-	-			
10	3.2 / 3.6	9					
11	3.2 / 3.6	10	-	-			
12	3.2 / 3.6	11					
13	3.2 / 3.6	12	-	-			
14	3.2 / 3.6	13					
15	3.2 / 3.6	14	-	-			
16	3.2 / 3.6	15					
17	+ 0.4	15	-	-			
18	+ 0.4	15					
19	+ 0.4	15	-	-			
20	+ 0.4	15					
21	+ 0.4	15	-	-			
22	+ 0.4	15					

Threshold HR Range: _____ x .80 = Low Rx HR: _____

Threshold HR Range: _____ x .90 = High Rx HR: _____

Exclusion Criteria: Greater than or equal to Pre-test rating of 7 on VAS. Significant balance, visual, or orthopedic issues.

Test Termination criteria:

- 1) Stop test with greater than or equal 3 rating increase on VAS from pre-test rating. Use HR from last successfully completed stage for Rx HR. Exercise in Rx HR range for 20 min daily for 6-7 days a week. Stop daily exercise if symptoms increase 2 or more VAS rating from pre-exercise symptom level or at 20 min, whichever comes first.
- 2) Test is successfully completed when voluntary exhaustion is achieved and an RPE rating of 18-20 has also been reached with an increase of less than 3 VAS rating increase from the pre-test rating. Progress Return to Play Protocol after successfully completing test and being able to tolerate 20 min of aerobic exercise several days in a row to voluntary exhaustion at

Motor Function Impairments¹¹

Symptoms: impaired static, and dynamic balance, motor coordination, dual tasking

Evaluation/Assessment Tools: TUG, TUG COG, FGA, DGI

Assessment Tools

Post-Concussion Symptom Scale

Player's Name: _____ Team: _____ Position: _____

SYMPTOM	RATING						BASELINE Date:	TESTING 2 Date:	TESTING 3 Date:	TESTING 4 Date:	TESTING 5 Date:	
	None	1	2	3	4	5						6
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 problems	0	1	2	3	4	5	6					
Dizziness	0	1	2	3	4	5	6					
Fatigue	0	1	2	3	4	5	6					
Trouble falling asleep	0	1	2	3	4	5	6					
Sleeping more than usual	0	1	2	3	4	5	6					
Sleeping less than usual	0	1	2	3	4	5	6					
Drowsiness	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					
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					
Numbness or tingling	0	1	2	3	4	5	6					
Feeling slowed down	0	1	2	3	4	5	6					
Feeling mentally "foggy"	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					
TOTAL SCORE												

Concussion Intervention

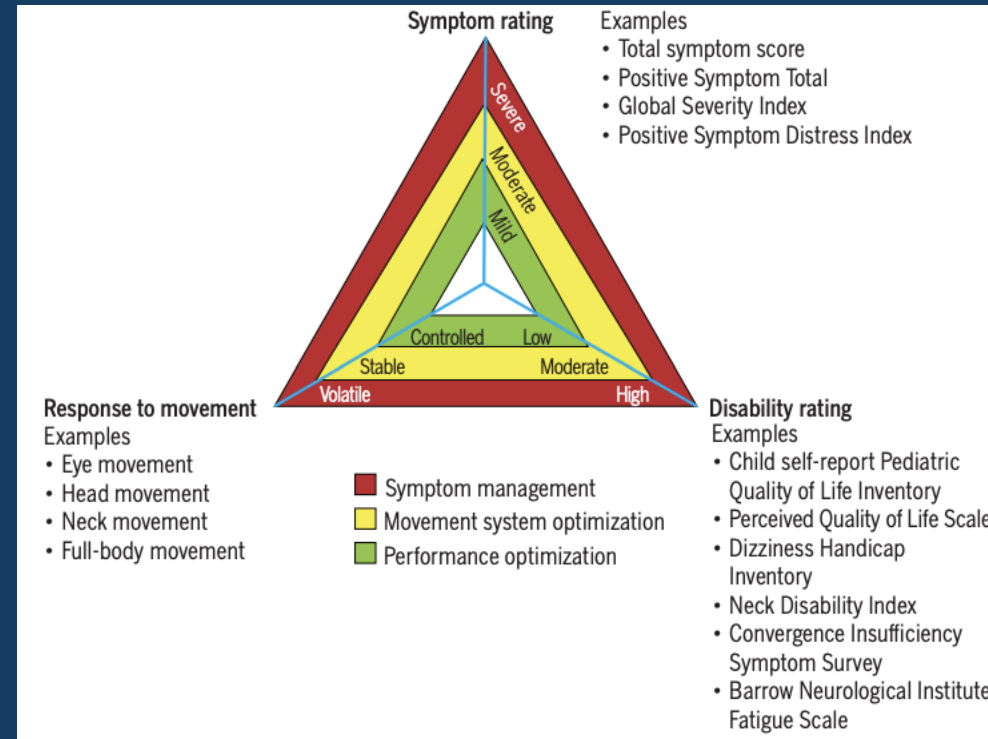
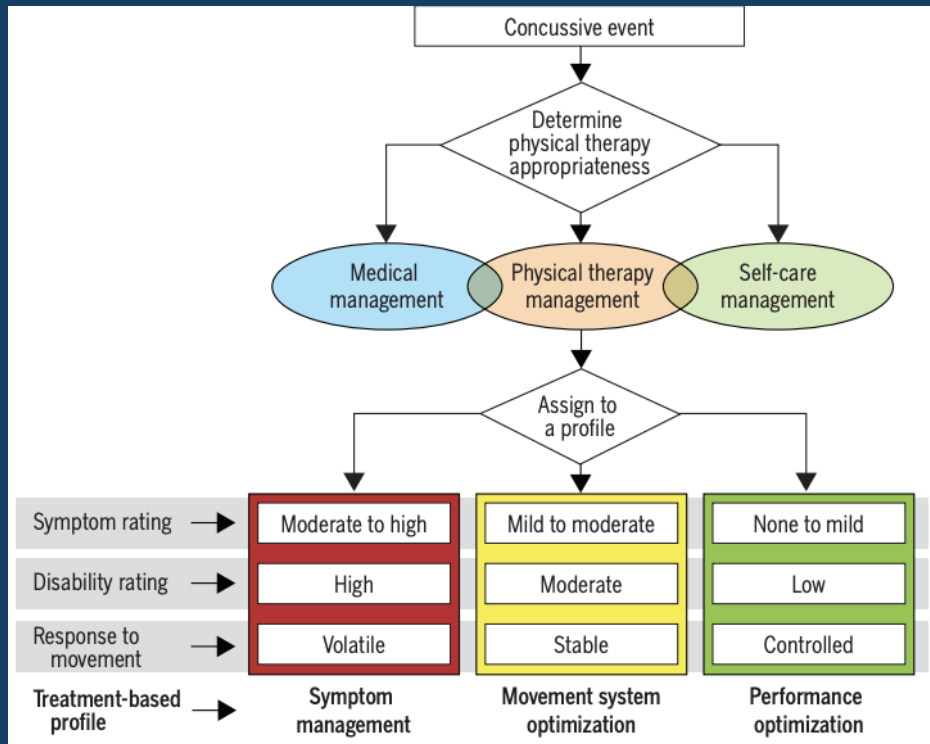
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A Treatment-Based Profiling Model for Physical Therapy Management of Patients Following a Concussive Event

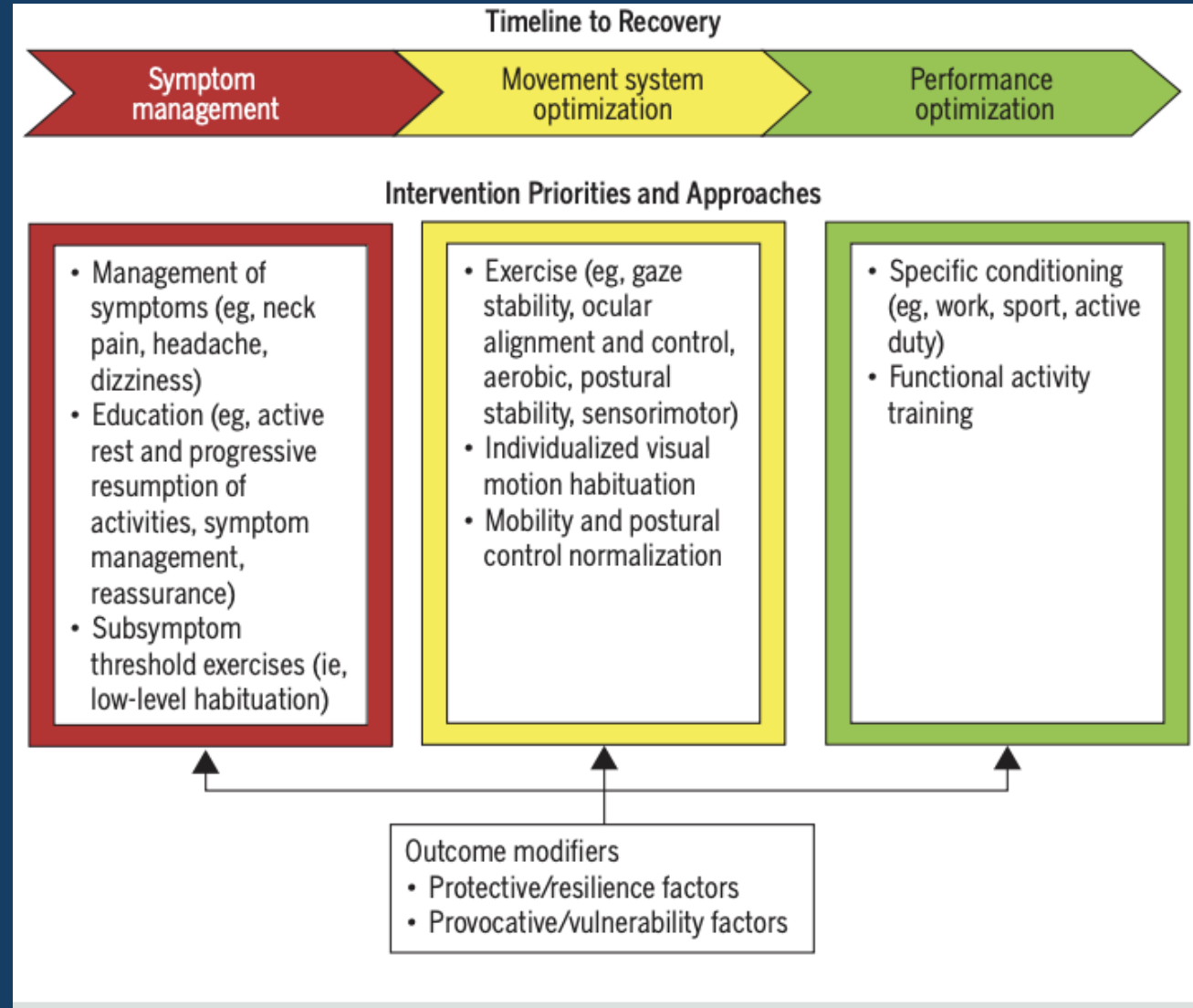
Treatment-Based Profiling Model¹⁷

- We must consider the multifaceted effects concussion may have on our patients
- While it may be easy to find and treat symptoms, we must consider other factors that may relate to symptoms and treatments

Treatment-Based Profiling Model¹⁷



Treatment-Based Profiling Model¹⁷



Acute Management

Early Rest

Most guidelines recommend a 24-48 hour physical and cognitive rest break following the initial insult

This serves to allow the metabolic cascade to return to homeostasis allowing for normal neuronal healing

Education

Early education on management, and reassurance

Acute Management

- Early Subsymptomatic Threshold Aerobic Training¹⁶
 - Found to reduce risk of persistent post-concussive symptoms
 - Decreased time to return to normal activity after concussion



Education¹⁸

Regardless of the stage,
education should
always be an initial
intervention

Symptoms,
impairments, functional
limitations, and
reassurance should
always be covered

Cervical Musculoskeletal Intervention¹¹

Intervention should be tailored to specific cervical deficits found in objective examination

ROM, Strength, Postural Control, Sensorimotor Function

Vestibulo-Oculomotor Intervention^{11,18}

If BPPV is suspected:

Utilize canalith-repositioning maneuvers

Depending on symptoms and contextual factors:

Gaze stability exercises, visual motion habituation

Autonomic/Exertional Tolerance Intervention^{11,16}

Utilize testing such as the Buffalo Treadmill Test to determine a subsymptomatic threshold, and provide a symptom guided progressive aerobic program

Consider the patient's comfort level, lifestyle, and access to equipment

Motor Function Impairment Intervention¹¹

Targeted exercise based on functional impairments

Static Balance

- Romberg stance, single leg stance

Dynamic Balance

- Perturbations, uneven surfaces, wobble board

Dual Task Interventions

Unilateral Vestibular Hypofunction

Symptoms: similar to other vestibular dysfunctions but include further issues with things such as motion sickness

Intervention: habituation exercises (walking with head turns), gaze stabilization (VOR x1&2)

Central Sensory Integration Dysfunction¹⁹

- Central sensory integration dysfunction rather than peripheral or oculomotor may explain issues with chronic PCSS such as ongoing balance complaints
- Delineation of central from peripheral can be seen in symptomology
 - Difficulty in situations where sensory input is unclear such as dark rooms, uneven surfaces etc.
- Treatment
 - Individualized balance and stability, habituation, gaze stabilization, anything to challenge the integration of vestibular information to the central system

Concussion Prognosis



Prognosis^{20,21}

Most patients are able to return to normal activity within 10 days to 2 months

Severity of initial symptoms seem to be the best prognostic indicator for recovery

Conclusion

- Concussion is best managed through a multi-faceted approach
- Early rest (24-48 hours), and early sub-symptomatic threshold aerobic exercise have a growing body of evidence which can be prescribed by a PT
- Other interventions should be tailored patient specific symptom management

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