



# MANAGING CONCUSSION IN THE CLINIC

By: Robbey Lindstedt, sDPT  
Class of 2022

# Introduction



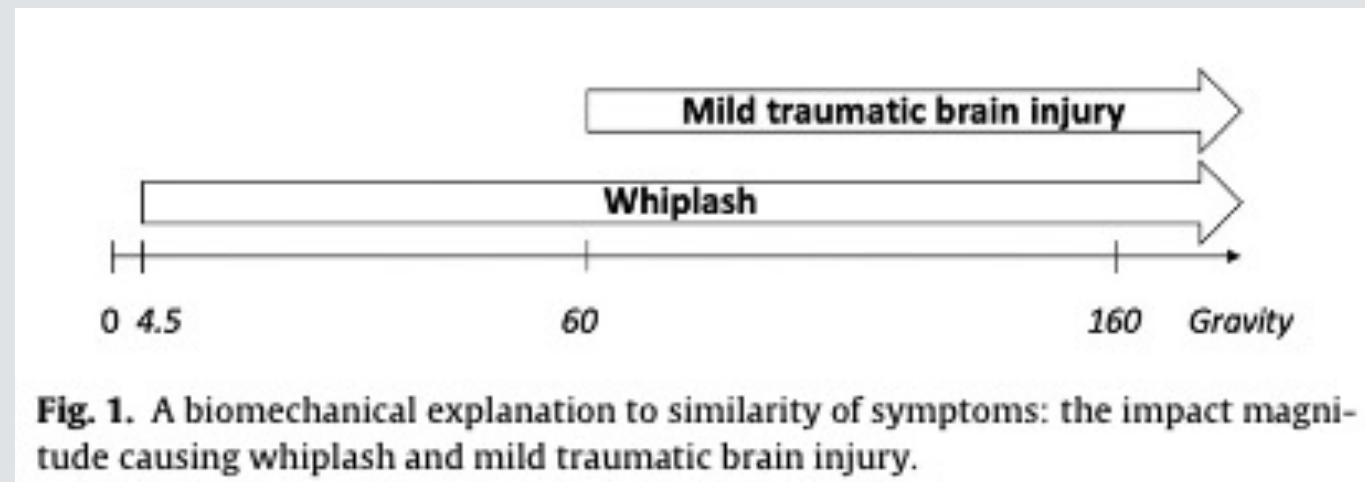
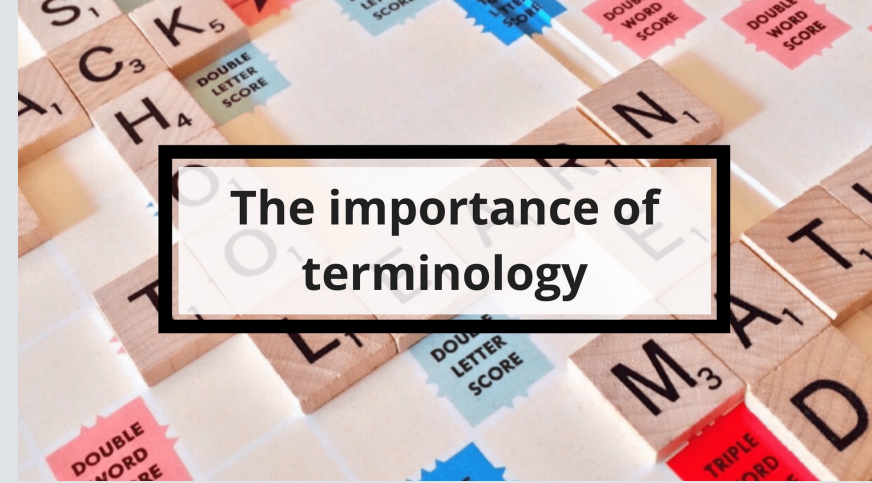
- 3<sup>rd</sup> year PT student at UNC-CH
- Interested in employing EBP techniques into the clinic
- I have a passion for evaluating, treating, and managing Post-Concussion Syndrome (PCS) & associated pathologies
- Please evaluate my ability to teach you and your ability to retain information at the end of the presentation

# Learning Objectives:

- Compare terminology on Concussions and associated pathologies
- Describe the Pathophysiology of Concussions
- Compare Signs and Symptoms
- List Updated Research on Evaluation of PCS
- Expand clinical reasoning for implementing EBP into Interventions
- Develop confidence and success for Return to Sport or Recreational activities

# Terminology- Diagnosis

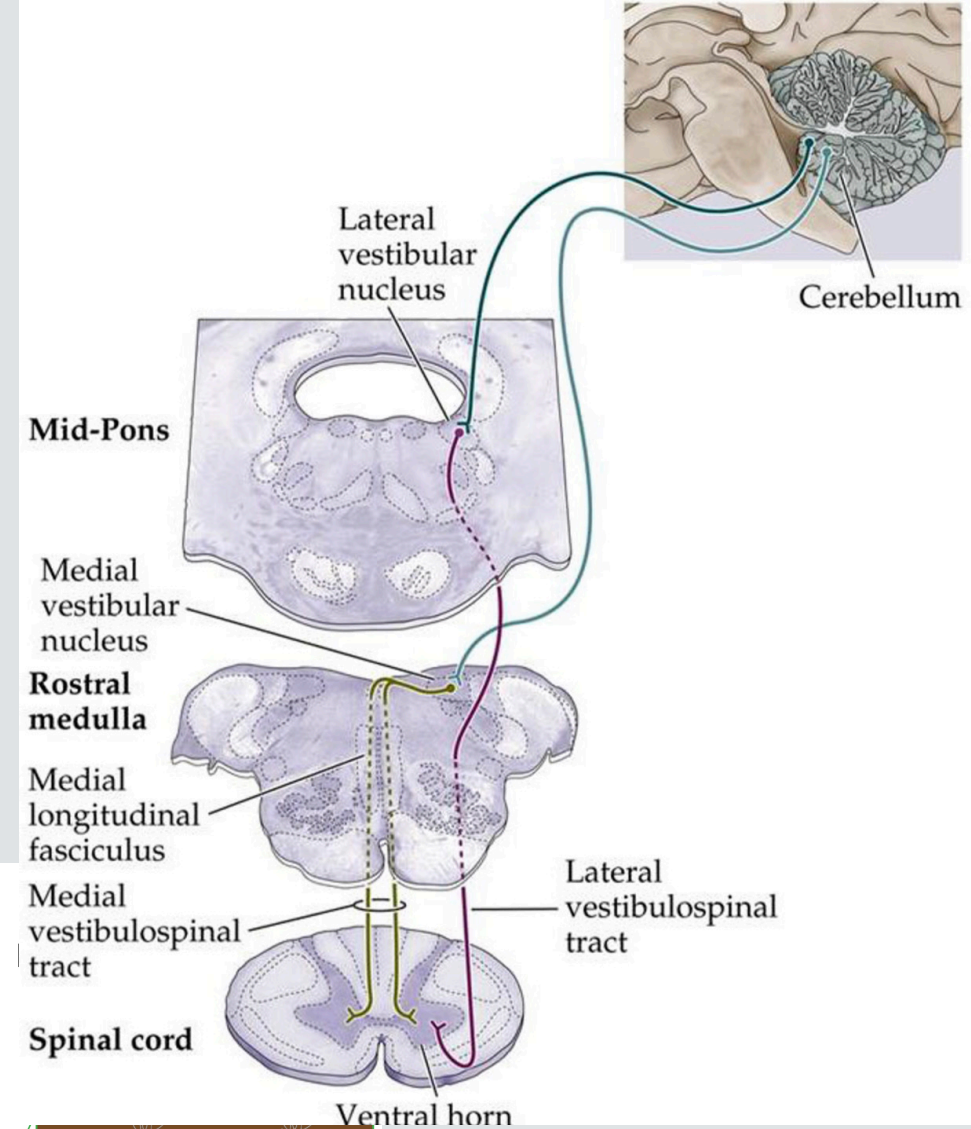
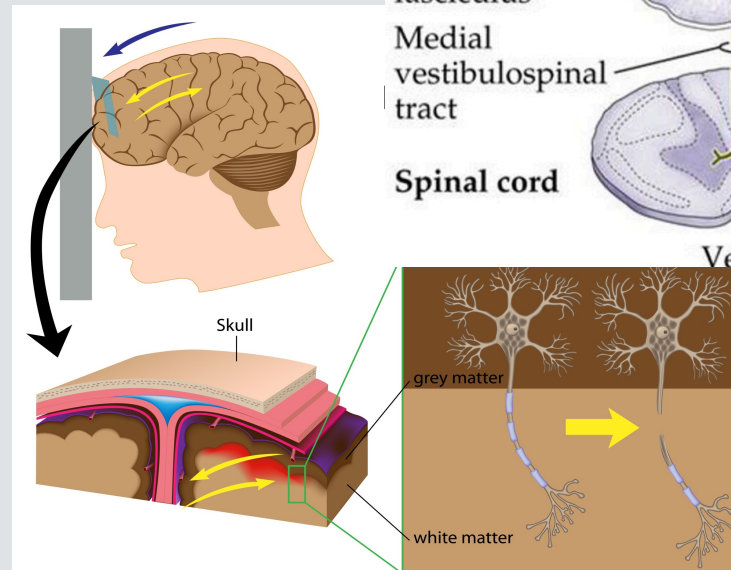
- Concussion/mTBI
- Post-concussion Syndrome
- Whiplash/Whiplash Associated Disorder (WAD)





# Pathophysiology

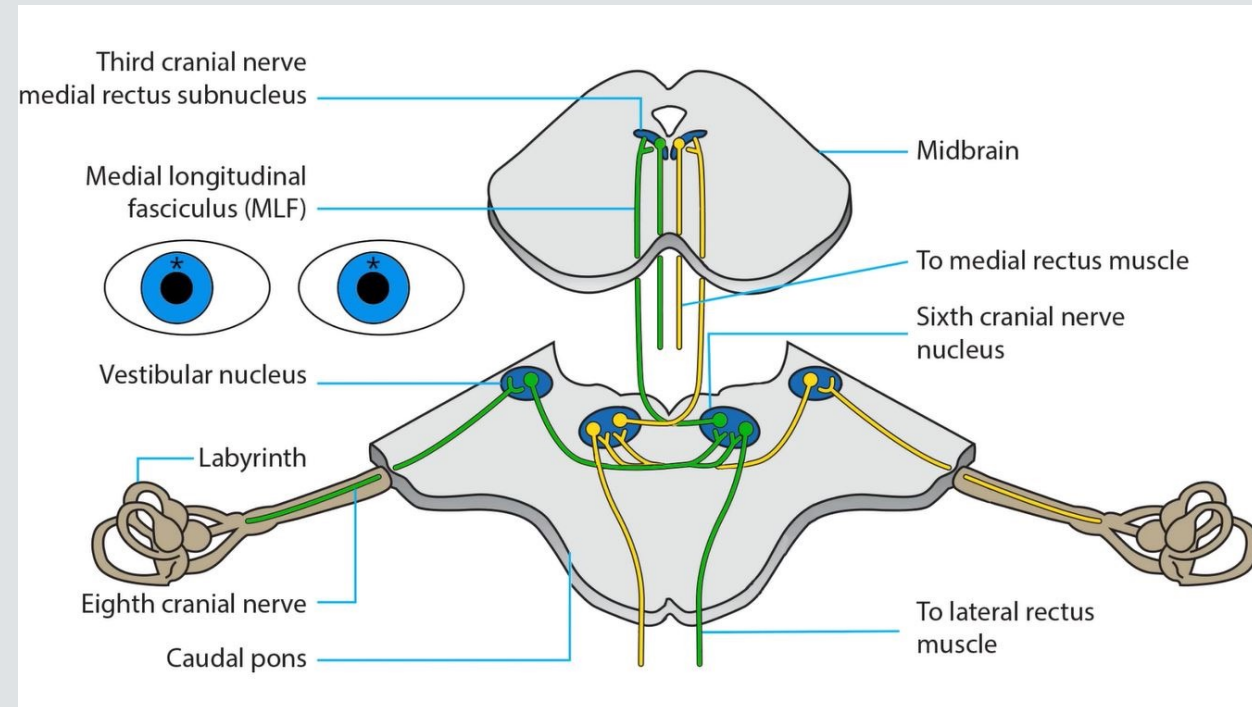
- Initial Injury
- Vestibulocochlear disorders
- Secondary onset of mTBI symptoms



# Signs and Symptoms-

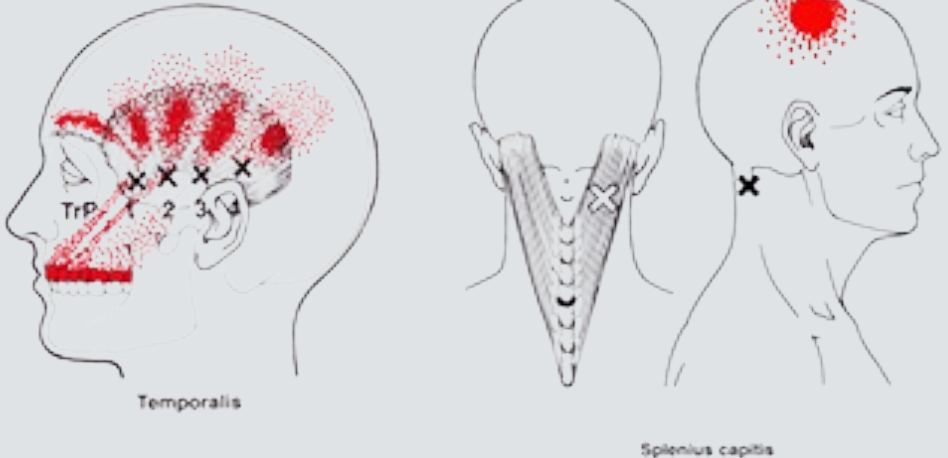
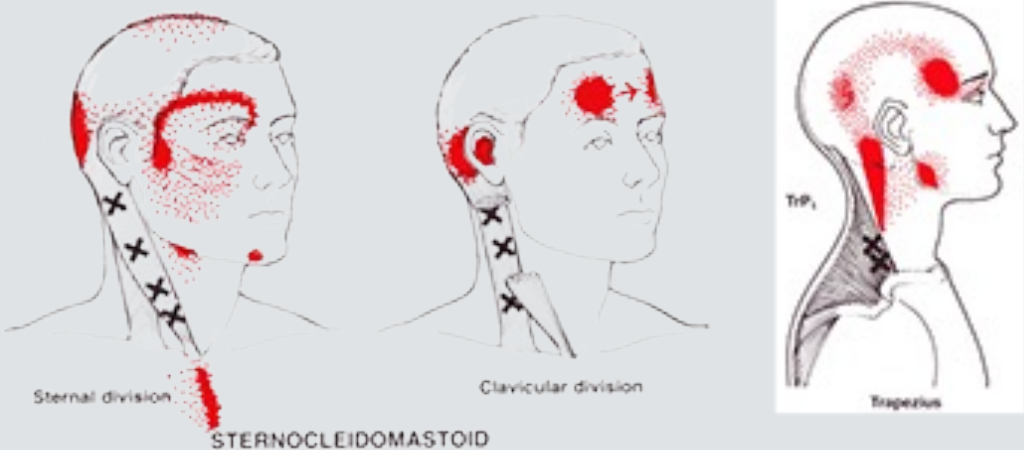
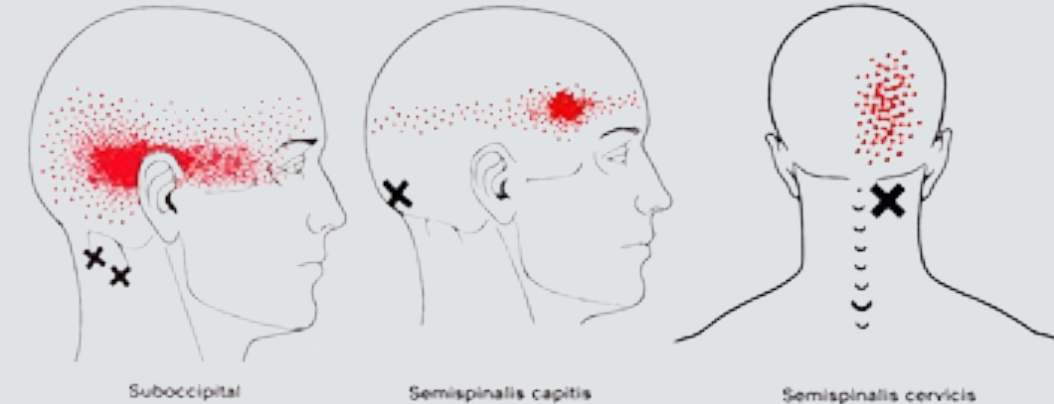


- Headaches
  - *Post-traumatic cephalalgia or Cervicogenic headache or Migraine or Post-traumatic headaches*
- Dizziness
- Vestibulo-oculomotor impairments
- Exertional Intolerance
- Motor Function impairments
- Social/Emotional distress
- Sleep/Fatigue




# Signs and Symptoms- Headaches


- Post-Traumatic Headache
- Cervicogenic Headache
- Migraine




**Cluster:** Pain in and around one eye.




**Tension:** Pain is like a band squeezing the head.



**Migraine:** Pain (one sided), Nausea and visual changes.



**Cervicogenic (referred from the neck):** Pain is at the top and/or back of the head.





# Signs and Symptoms- Dizziness

- Vestibular
- Cervicogenic
- Benign Paroxysmal Positional Vertigo
- Vision



# Signs and Symptoms- Vestibulo-oculomotor impairments

- Balance deficits
- Blurred Vision
- Headaches
- Fatigue

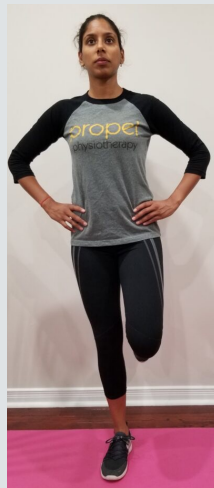


# Signs and Symptoms- Exertional Intolerance

- Autonomic Nervous System Dysfunction
  - *Altered blood flow*
  - *BP changes*
  - *HR variability*
- Poor tolerance
  - *Fatigue*
  - *Deconditioning*
  - *System exacerbation*

# Signs and Symptoms- Motor Function impairments

- Static Control
- Dynamic Control
- Dual Tasking
- Multitasking
- Delayed Reaction Time



# Signs and Symptoms- Social/Emotional distress

TABLE 2

PROTECTIVE AND PROVOCATIVE  
CONTEXTUAL FACTORS THAT MAY AFFECT  
RECOVERY AFTER CONCUSSION

Dimension	Protective/Resilience Factors	Provocative/Vulnerability Factors
Social <sup>49,52,55</sup>	<ul style="list-style-type: none"> <li>• High socioeconomic status</li> <li>• Supportive family, work, or team relationship</li> <li>• Financial security</li> <li>• Educational attainment</li> </ul>	<ul style="list-style-type: none"> <li>• Low socioeconomic status</li> <li>• Poor family dynamic, negative work or team relationship</li> <li>• Ongoing litigations, entitlement, perceived injustice</li> <li>• Low educational level</li> </ul>
Cognitive <sup>5,55</sup>	<ul style="list-style-type: none"> <li>• High self-efficacy</li> <li>• Cognitive flexibility</li> <li>• Mindfulness</li> <li>• Positive beliefs</li> <li>• Strong academic performance</li> </ul>	<ul style="list-style-type: none"> <li>• Low self-efficacy</li> <li>• Catastrophizing behaviors</li> <li>• Stigmatization, maladaptive coping, hyper-vigilance</li> <li>• Negative beliefs</li> <li>• Poor academic performance</li> </ul>
Psychological <sup>18,55</sup>	<ul style="list-style-type: none"> <li>• Equanimity, perseverance, self-reliance</li> <li>• Meaningfulness</li> <li>• Existential aloneness, high self-reliance</li> <li>• Resilience<sup>18</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Depression</li> <li>• Anxiety, fear</li> <li>• High levels of stress, frustration, worry, grief</li> <li>• Lack of resilience</li> </ul>
General health <sup>49</sup>	<ul style="list-style-type: none"> <li>• Lack of comorbid health conditions</li> <li>• Lack of a past history of concussion, migraine, dizziness, falls</li> </ul>	<ul style="list-style-type: none"> <li>• Comorbid health problems such as chronic pain, chronic migraine, fatigue</li> <li>• Past history of concussion, migraine, dizziness, falls</li> </ul>
Lifestyle <sup>49,55</sup>	<ul style="list-style-type: none"> <li>• Physically active</li> <li>• Good sleep hygiene</li> <li>• Good conditioning, tolerant of progressive physical loading</li> </ul>	<ul style="list-style-type: none"> <li>• Sedentary behaviors</li> <li>• Poor sleep hygiene</li> <li>• Deconditioning, unpredictable response to physical loading</li> </ul>



# Signs and Symptoms- Sleep/Fatigue

## ■ Sleep disturbances

- *Pain*
- *Depression*
- *Anxiety*
- *Excessive napping*
- *Poor quality*

## ■ Fatigue

- *Cognitive*
- *Physiological*



# Concussion Decision Making



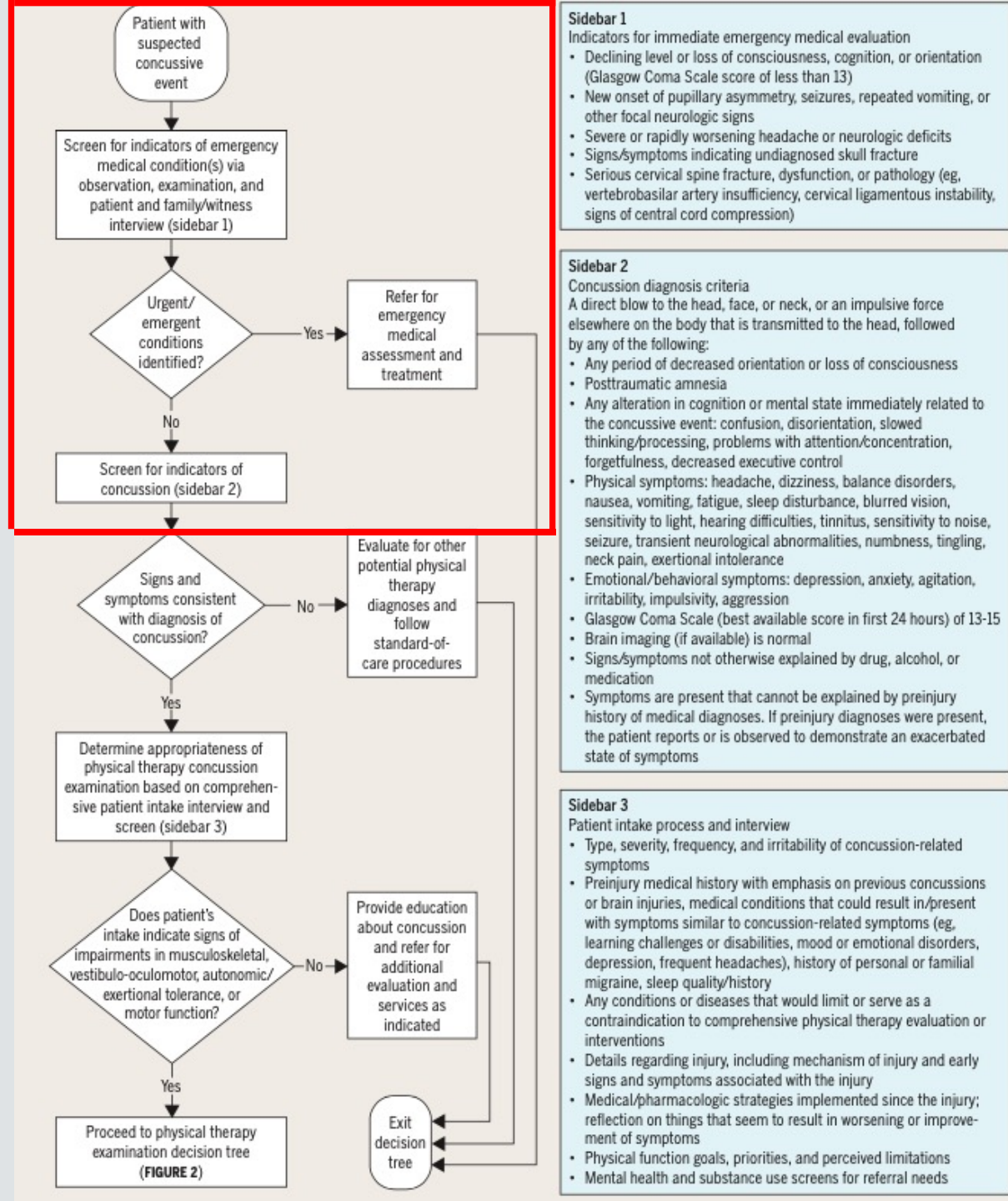
# Concussion—Yes! PT or Medical Referral?

Concussion?

Screen Red Flags

Are they appropriate for PT?

Assess Signs/Symptoms



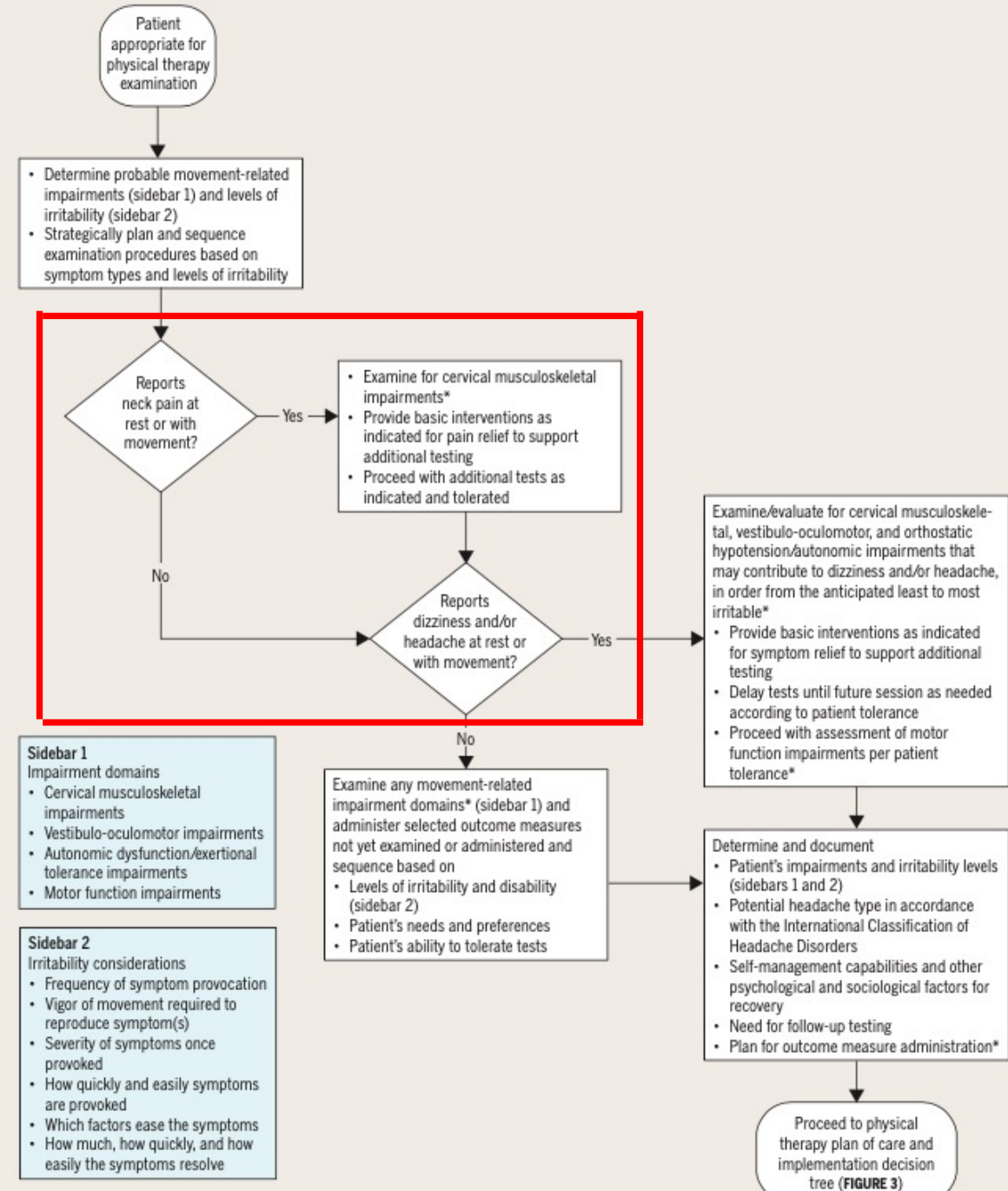
# Decision Tree— Patient Appropriate

Reports neck pain?

Reports dizziness/headache?

Impairments domains:

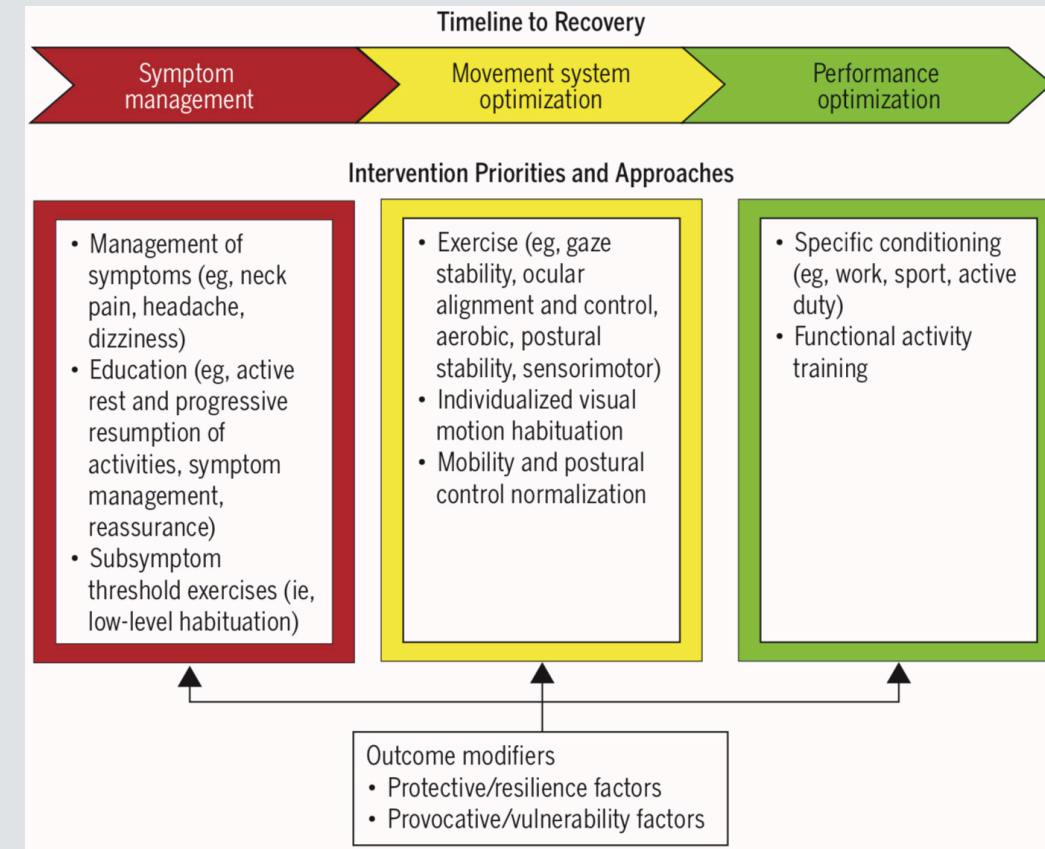
- Cervical MSK
- Vestibulo-oculomotor dysfunction
- Autonomic dysfunction/Exertional intolerance
- Motor function





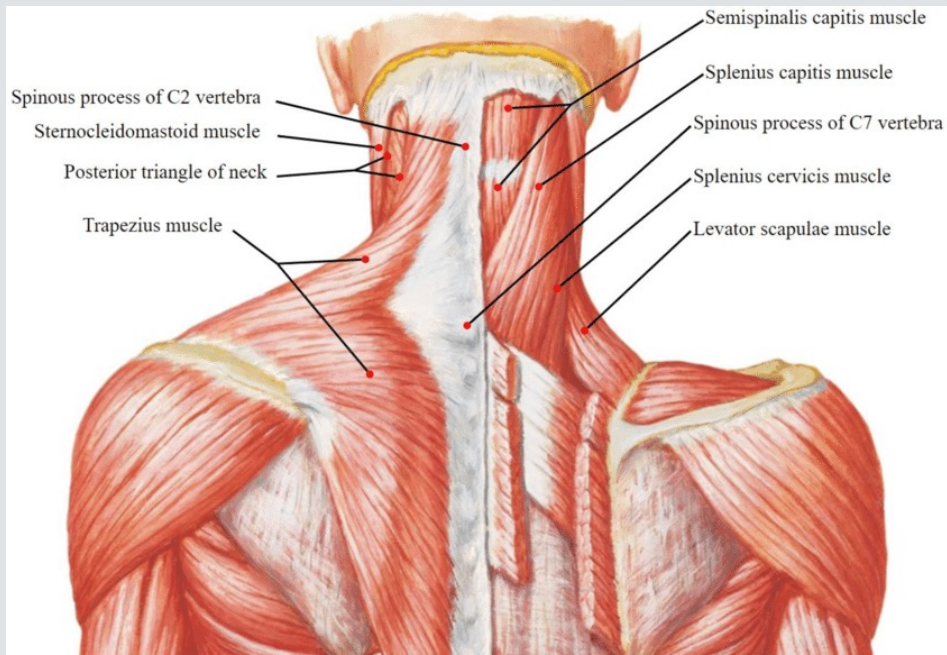
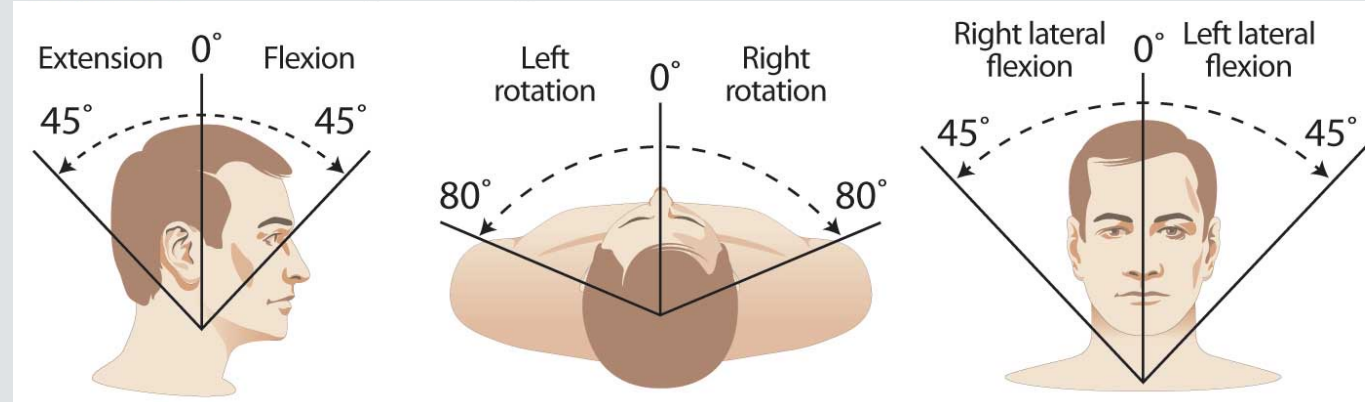
# Evaluation Domains

- Cervical Musculoskeletal (MSK)
- Vestibulo-oculomotor Dysfunction
- Autonomic Dysfunction/Exertional Intolerance
- Motor function
- Special Tests
- Patient Report Outcome Measures



# Evaluating Impairment Domains: Cervical MSK

- Cervical AROM/PROM
- Cervical Spine Joint Mobility
- MSK palpation



# Evaluating Impairment Domains: Cervical MSK

- Cranial cervical flexion Test

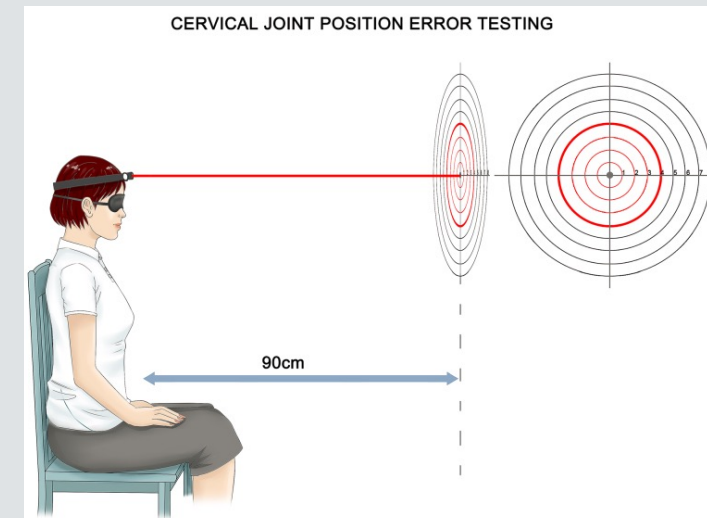


- Cervical flexion-rotation test
  - SN 88%; SP 92%



# Evaluating Impairment Domains: Cervical MSK

- Smooth pursuit neck torsion test
  - *WAD specific*
  - *SN 90%, SP 91%*
- Head-neck differentiation test
- Motor control assessment of deep cervical flexors and extensors





# Evaluating Impairment Domains: Vestibulo-oculomotor Dysfunction

- VOMS
  - *Smooth Pursuit*
  - *Saccades (H/V)*
  - *Convergence*
  - *VOR*
- Dix-Hallpike Test

**What to Know About the Vestibular Ocular Motor Screen**

It pinpoints causes of vertigo and dizziness after a concussion

It provides the information needed for tailored treatment

It measures 5 domains to induce symptoms

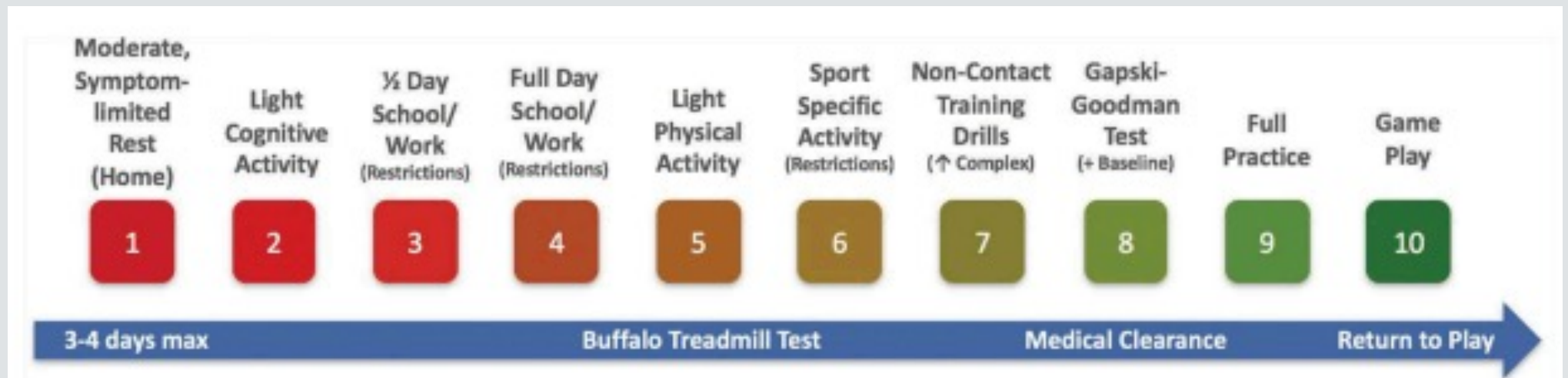
It is a simple test that lasts 5 to 10 minutes

It can improve symptoms and help you return to a normal state

The infographic features a central illustration of a doctor in a white coat pointing towards a patient sitting at a table. The patient is a young woman with blonde hair in a ponytail, wearing a red shirt with 'MILLVILLE Cheer' written on it. The background is a dark purple color with various icons and text boxes. The icons include a person with a star and moon, a lightbulb, a pie chart, and a person with arms raised.

# Evaluating Impairment Domains: Autonomic Dysfunction/Exertional Intolerance

- Treadmill Test
- Stationary bicycle Test
- Aerobic vs Dynamic Exercise Tests



# Evaluating Impairment Domains: Motor function

- Postural Control
  - *BESS*
- Reaction Time
- Dual-tasking

Test <sup>26</sup>	Health/ Control Duration (sec)	Concussion Duration (sec)	Statcal Significance
Single-Task TUG	9.9 ± 1.4	11.1 ± 1.9	p = 0.027
Dual-Task TUG	12.7 ± 1.9	14.4 ± 3.3	p = 0.047
Single-Task Tandem Gait	13.8 ± 4.4	19.8 ± 5.4	p = 0.003
Dual-Task Tandem Gait	16.8 ± 5.5	21.3 ± 6.3	p = 0.006

# Special Tests

- Suspected Cervical Instability
  - *Sharp-purser* (SN=87.8%, SP=91.6%)<sup>21</sup>
  - *Alar Side Bending Test* (SN=80%, SP=76.9%)<sup>20</sup>
- DNF endurance test

DNF test <sup>22</sup>	Duration (sec)
With Neck Pain	24.1 ± 12.8
Without Neck pain	38.95 ± 26.4

	Healthy <sup>23</sup> duration (sec)
Female	29.4 ± 13.7
Male	38.9 ± 20.1

# Patient Reported Outcome Measures To Consider

- Multi-modal
  - Dizziness Handicap Index (DHI)
  - Activities-specific Balance Confidence (ABC) Scale
- General Concussion Symptoms
  - Post-Concussion Symptom Scale (PCSS)
  - Patient Specific Functional Scale (PSFS)

# POC Considerations

- Prognosis
- Early Exertional Intolerance Testing
- Multi-model approach

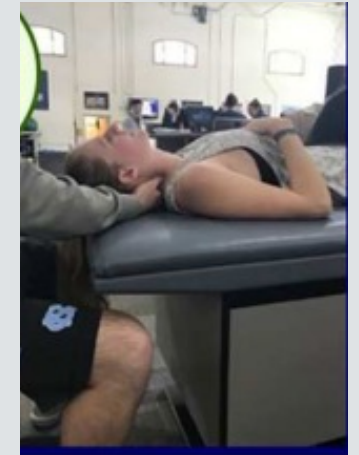


# Interventions

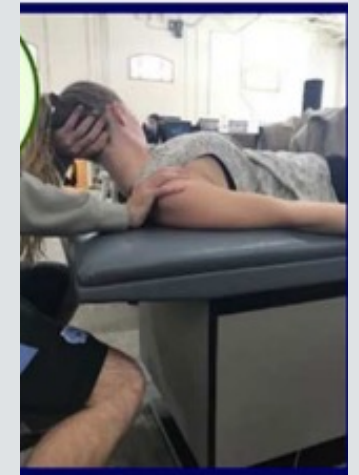
- Manual
- Vision
- VOR variations
- Balance
- Multi-tasking
- Progressive Exertional Activities

# Interventions— Manual

- Soft tissue mobilization
- Trigger Point Release
- Passive accessory intervertebral Mobilizations (PAIVMs)
- Functional Dry Needling
- Stretching
- PNF Principles
  - *Contract-relax*
  - *MET*
- Manual resisted isometric contractions



**Comfort:**  
Massage

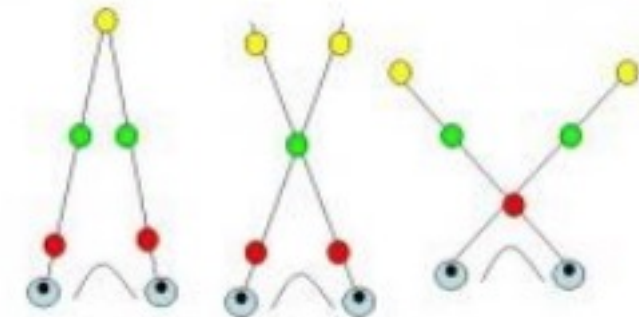
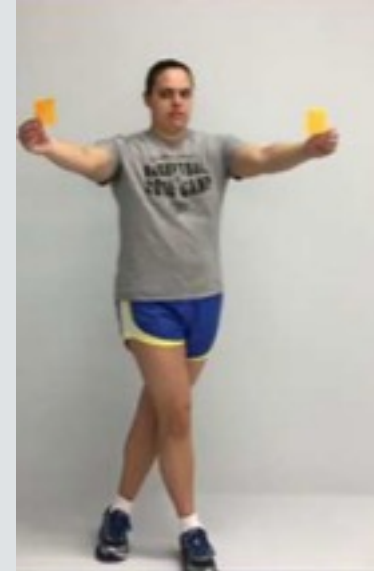


**Comfort:**  
Assisted stretching



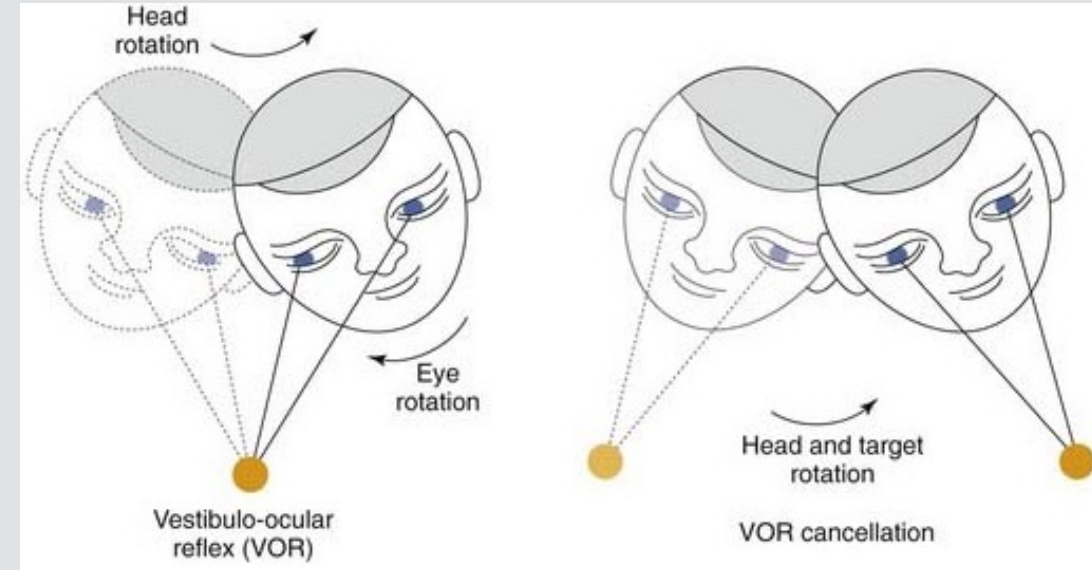
# Interventions— Vision

- Saccades
  - *Vertical*
  - *Horizontal*
  - *Speed*
  - *Background*
  - *Positioning*
- Convergence
  - *PPP*
  - *Block String*

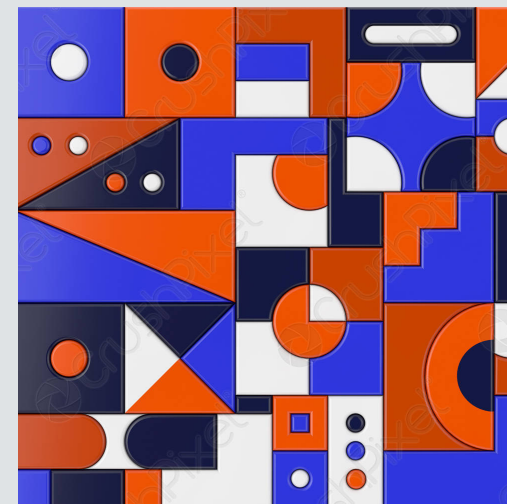
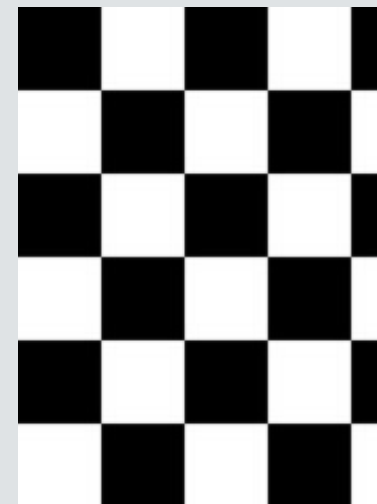
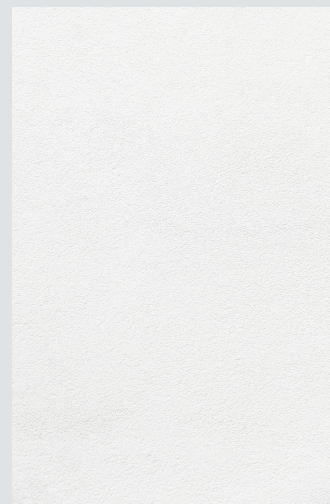


# Interventions— VOR

- VOR Cancellation
- VOR x1
- VOR x2
- Horizontal and Vertical
- Unstable environments
- Dynamic movements
- Speed



## Variation in Backgrounds

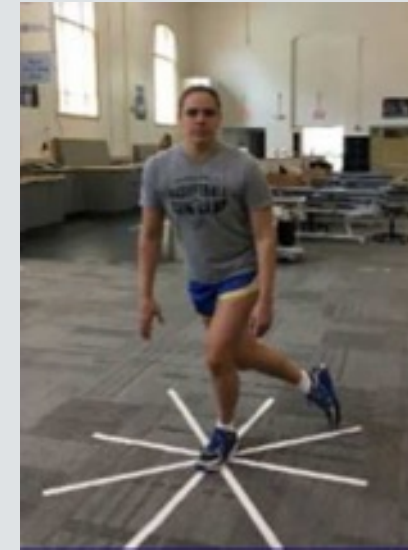


# Interventions— Balance

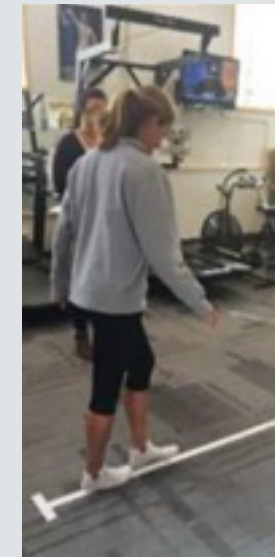
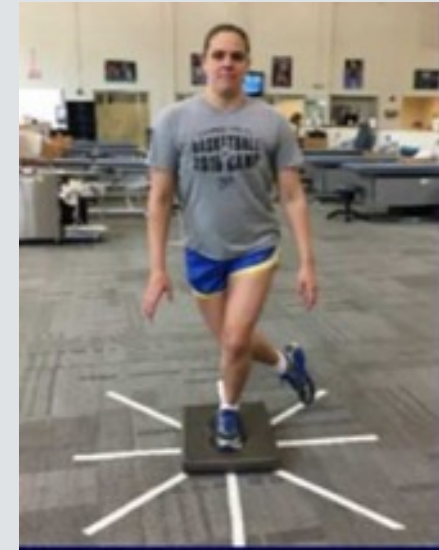
- Creativity and specificity!
- NBOS, Tandem, SLS
- BOSU
- Foam Pad
- Perturbations
- Y-Balance
- Walking Variation
- Lunges
- Eyes Open vs Closed



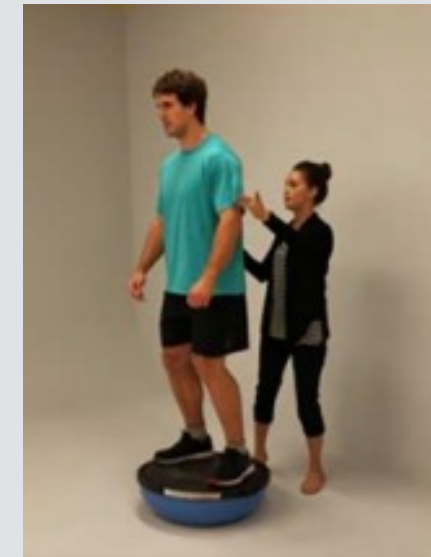
NBOS



Y-Balance



Tandem Walking



Standing on BOSU  
with Perturbations

# Interventions— Dual Tasking

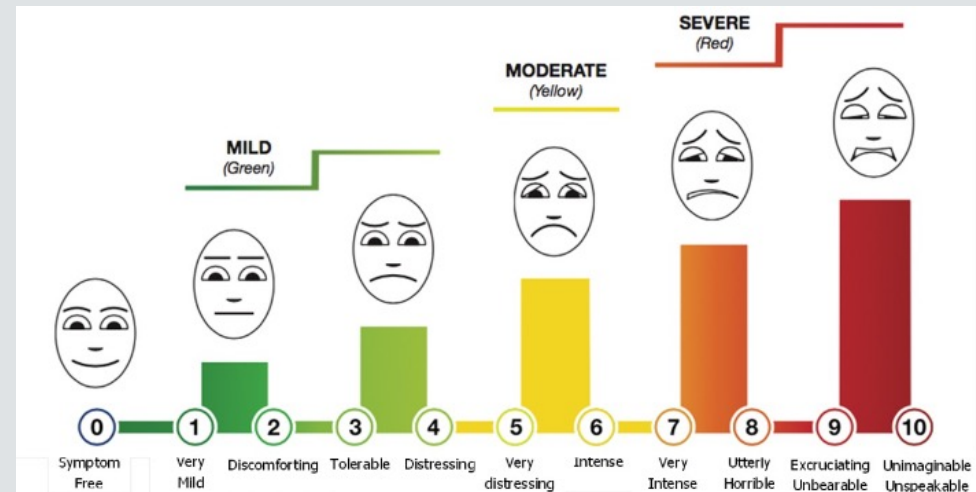
- Again, creativity!
- Cognitive
  - *Memory/Attention*
  - *Categories*
  - *Math*
- Physical
  - *Catching*
  - *Kicking*
  - *Switching between hands*



# Interventions— Progressive Exertional Activities

- Walking
- Stationary Cycling
- Running
- Sprinting
- Plyometrics
- Resistance Training

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills. No head impact activities	Add movement
4	Noncontact training drills	Harder training drills, e.g., passing drills. May start progressive resistance training	Exercise, coordination, and increased thinking
5	Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff

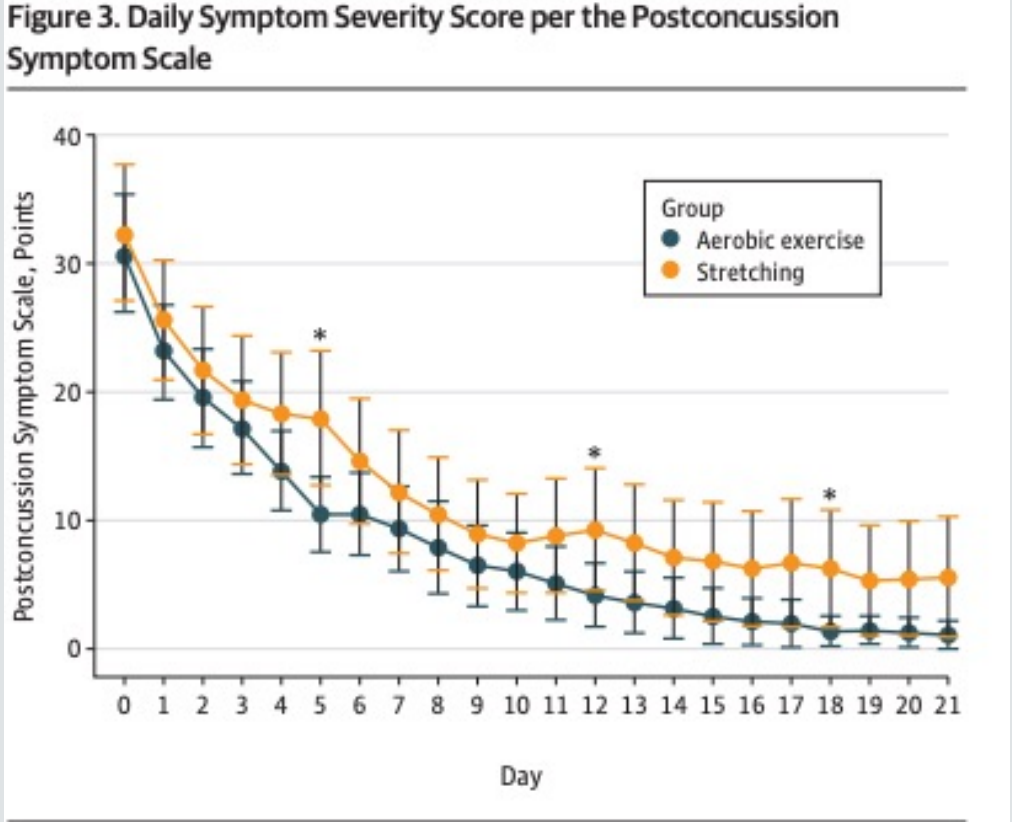




# Sub-Threshold Prescription

- No interventions <48hours from initial injury
- Initial Eval performed BCTT
- Aerobic Group (intervention)
- Stretching Group (control)
- Recovery time: RTS (mean)
  - *Intervention: 13 days*
  - *Control: 17 days*

	Intervention	Control
Resting heart rate, bpm	74.5 (12.7)	75.2 (12.3)
Buffalo Concussion Treadmill Test findings		
Heart rate at symptom exacerbation, bpm	136.9 (26.2)	136.6 (21.2)
Time to symptom exacerbation on first-visit test, min	8.7 (4.9)	8.6 (4.3)



Bars indicate 95% CIs; asterisks, a significant difference on analysis of variance.

# Sport Specific Conditions

- Sterile Environments
- Return to Sport
- Return to Recreational Activities

# “Sterile Environments”

PT Clinic



Real Life





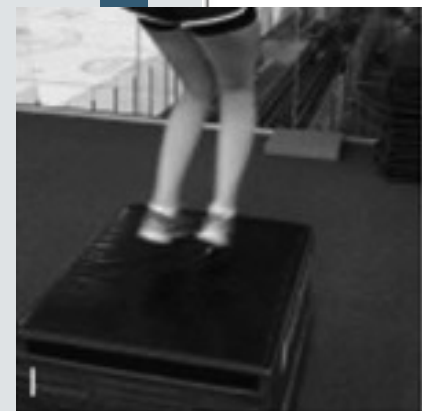
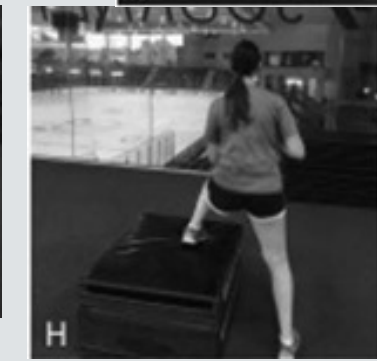
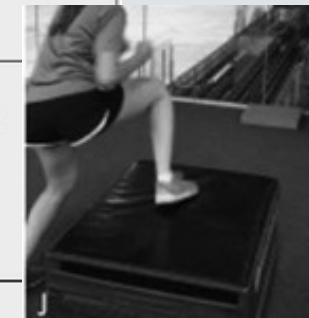
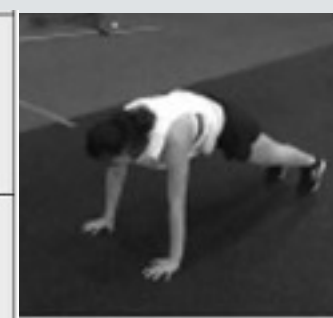
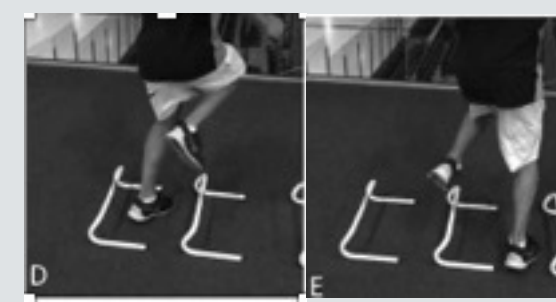
# RTS or Return to Recreational Activities



- BCTT or BCBT is not enough!
- GGT or mGGT
- Patient Specific considerations



# GGT or mGGT



	<p><b>2-foot hurdle hops</b> Laterally hop over three 6-10" hurdles (0:10) Sit down on 16-20" box (0:10) Repeat x4 0:40 rest</p>	<p><b>Single-foot hurdle step-overs</b> Laterally step over three 6-10" hurdles (0:10) Sit down on 16-20" box (0:10) Repeat x4 0:40 rest</p>
Plyometrics 2	<p><b>Burpees with full push-up</b> Continuous burpees with a full push-up (following hands with eyes) (0:10) Standing in neutral position (0:10) Repeat x3 1:00 rest</p>	<p><b>Burpees without full push-up</b> Continuous burpees with no full push-up (following hands with eyes) (0:10) Standing in neutral position (0:10) Repeat x3 1:00 rest</p>
Plyometrics 3	<p><b>Lateral Box Jumps (16-20" Box)</b> Two-foot hop onto box and down other side continuously (0:15) Sit down on box (0:15) Repeat x2 1:00 rest</p>	<p><b>Lateral Box Step ups (16-20" Box)</b> Single-foot step up onto box and down other side continuously (0:15) Sit down on box (0:15) Repeat x2 1:00 rest</p>
Plyometrics 4	<p><b>2-foot jump with 180° rotations</b> Continuously jump Right and back to Left 180° (0:10) Standing in neutral position (0:20) Continuously jump Left and Back to Right (0:10) Standing in neutral position (0:10) Repeat full sequence x2</p>	<p><b>2-foot jump with 180° rotations</b> Continuously jump Right and back to Left 180° (0:10) Standing in neutral position (0:20) Continuously jump Left and Back to Right (0:10) Standing in neutral position (0:10) Repeat full sequence x2</p>
	<p><b>5:00</b></p> <p style="text-align: center;"><b>Cooldown</b></p>	<p><b>5:00</b></p>

# STATIONARY BICYCLE PROTOCOL FOR GGT AND MGGT

Test Components		GGT				mGGT			
		Monark		LifeCycle		Monark		LifeCycle	
Bike 1	Time	Tension	RPM	Tension	RPM	Tension	RPM	Tension	RPM
	3:00	1.5	Increase to 90	11	Increase to 90	0.5	Increase to 80	7	Increase to 80
	0:30	2	90-95	12	90-95	1	80-85	8	80-85
	0:30	2.5	90-95	13	90-95	1.5	80-85	9	80-85
	0:30	3	90-95	14	90-95	2	80-85	10	80-85
	0:30	3.5	90-95	15	90-95	2.5	80-85	11	80-85
	0:30	4	90-95	16	90-95	3	80-85	12	80-85
	0:30	1.5	90-95	11	90-95	0.5	80-85	7	80-85
	0:30	2	90-95	12	90-95	1	80-85	8	80-85
	0:30	2.5	90-95	13	90-95	1.5	80-85	9	80-85
	0:30	3	90-95	14	90-95	2	80-85	10	80-85
	0:30	3.5	90-95	15	90-95	2.5	80-85	11	80-85
	0:30	4	90-95	16	90-95	3	80-85	12	80-85
	1:30	1.5	80	11	80	0.5	70	7	70
Bike 2	0:20	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:20	1.5	80	11	80	0.5	70	7	70
	0:20	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:20	1.5	80	11	80	0.5	70	7	70
	0:20	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:20	1.5	80	11	80	0.5	70	7	70
	0:20	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:40	1.5	80	11	80	0.5	70	7	70
	0:40	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped
Bike 3	0:10	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:10	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped
	0:10	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:10	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped
	0:10	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:10	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped
	0:10	4.0-5.0	Max	16-18	Max	3-4	Max	12-14	Max
	0:10	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped	Stopped
	0:40	1.5	80-85	11	80-85	0.5	80-85	7	80-85
	2:00	Rest	Off Bike	Rest	Off Bike	Rest	Off Bike	Rest	Off Bike

# Case “KP”

- 29 year old, Female
- Referral: Evaluate and Treat Concussion
  - *DOI: 8 days ago*
  - *Imaging: (x-ray) negative for fractures*
  - *PMHx: Anxiety, tension headaches*
- Initial observation as she walks to evaluation room
  - *Sunglasses*
  - *Forward head, rounded shoulders*
  - *Normal gait*

**How do you think we should set the clinic up for this individual?**



# Clinic Environment

- Stimulus Hypersensitivity
  - *Dim lights*
  - *Quiet space*
  - *Separate room if possible*





# KP Subjective

*subjective  
assessment*

What questions are we  
asking her?



passed." He has always been my rock and my emotional support. I have been some memory loss. I have been dizziness a lot and having a headache. I am still having light and sound sensitivity."

# Subjective Assessment

- PAIN -I wake up good, day progresses gets worse pressure over my heads. Some pain with chewing (been eating soft foods since injury) and talking
- Location: back of my head and forehead. Jaw
- Quality: Pressure, sharp
- Stability: Same/worse
- AGGs Factors- Reading, driving, listen to audiobook.
- EASING Factors: Aleve, Ibuprofen, muscle relaxers, reducing light and sound stimulus
- 24 HOUR BEHAVIOR - good in the morning but gets worse throughout the day.
- Vestibular/dizziness: (+)
- Cognition: (+)
- Sleep: (+)
- Headache: (+)
- Mood: (+)



# Objective Assessment

- AROM Cervical:
  - *All full, rotation and flexion caused some dizziness*
- Palpation -
  - *TTP- Generally sensitivity in whole bilateral cervical and scapular regions. More sensitive R>L*
  - *Especially in:*
    - R SCM, behind head radiating pain
    - R Upper Trap, behind head radiating pain
    - Suboccipitals, forehead radiating pain
    - C2 SP
- Cranial Nerve Screen (+/-)
  - III. Oculomotor (eye motion: gaze up/down/medial): Intact
  - IV. Trochlear (eye motion: down and out): Intact
  - VI. Abducens (eye motion: lateral): Intact
  - VIII: Vestibulocochlear (finger rub hearing test; balance/coordination): Intact

# VOMS

- Saccades (+/-): (under/over shooting)
- Smooth
  - *Up, Down, Right, Left, Diagonals: Normal motion, some dizziness symptoms*
- Convergence (in; normal is 3-4 in): normal
- Head Thrust Test: to right (+)
- VOR to slow head movements horizontal: (+)
- VOR to slow head movements vertical: (+)

Test	Dizziness	Headache	Cognition/Fog	Change
Baseline	4/10	3/10	4/10	
Saccades-Her pace for 30 sec	5/10	3/10	4/10	1 min return to baseline
Saccades- 60bpm ~20secs	5/10	3/10	5/10	3-4mins return to baseline
Saccades- 80bpm ~10sec	6/10	4/10	5/10	5 mins return to baseline



# Evaluation Treatment

- Extensive education
- Saccades
  - *60bpm*
  - *80bpm*
- What are other treatment options?
  - *Manual*
  - *VOR*
  - *DNF*
  - *Exertional tolerance testing*
  - *Balance*

? Questions? ?



Google Survey



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# Images

- Slide 2: <https://www.theraspecs.com/blog/symptoms-post-concussion-syndrome/>
- Slide 4: (top) <https://ab-translations.com/2020/11/understanding-terminology-the-basics/>; (Bottom) ^#3
- Slide 5:(left, bottom) <https://www.verywellhealth.com/the-whiplash-impact-296626>;(right, top) Dr.K Lecture 16; (right, bottom) [https://www.acquiredbraininjury-education.scot.nhs.uk/wp-content/uploads/shutterstock\\_89653558.jpg](https://www.acquiredbraininjury-education.scot.nhs.uk/wp-content/uploads/shutterstock_89653558.jpg)
- Slide 6: (top) <https://ab-translations.com/2020/11/understanding-terminology-the-basics/> ;(bottom) [https://novel.utah.edu/Trobe/fingertips/Supranuclear\\_Ocular\\_Motor\\_Pathways/Vestibulo-Ocular\\_Reflex.html](https://novel.utah.edu/Trobe/fingertips/Supranuclear_Ocular_Motor_Pathways/Vestibulo-Ocular_Reflex.html)
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- Slide 13: <https://www.healthline.com/health/sleep-disorders-warning-sign>
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# Images

- Slide 15: Image<sup>1</sup>
- Slide 16: Image<sup>1</sup>
- Slide 17: Image<sup>10</sup>
- Slide 18: (top) <https://www.jems.com/patient-care/why-ems-should-limit-use-rigid-cervical/>; (bottom) [https://www.researchgate.net/figure/Posterior-neck-muscles-Activated-in-neck-extension-extensors\\_fig6\\_350823152](https://www.researchgate.net/figure/Posterior-neck-muscles-Activated-in-neck-extension-extensors_fig6_350823152)
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- Slide 26: <https://www.shutterstock.com/search/prognosis>
- Slide 28: (Left) <https://www.nyp.org/healthlibrary/multimedia/isometric-exercise-hands-on-head>; (Right) image<sup>35</sup>
- Slide 29: (Top) image<sup>35</sup>, (Bottom) image<sup>39</sup>

# Images

- Slide 30:(Top) <https://entokey.com/evaluation-of-the-patient-with-dizziness/>; (Bottom, left) <https://unsplash.com/s/photos/plain-wall>; (Bottom, middle) <https://wallsheaven.com/photos/background-checker>; (bottom, right) <https://www.crushpixel.com/stock-photo/abstract-colorful-geomerical-blocking-shapes-3417203.html>
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- Slide 32: <https://management.co.nz/article/finding-balance-between-multi-and-uni-tasking>
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- Slide 34: Both images<sup>39</sup>
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- Slide 38: all image<sup>40</sup>
- Slide 39: image<sup>40</sup>