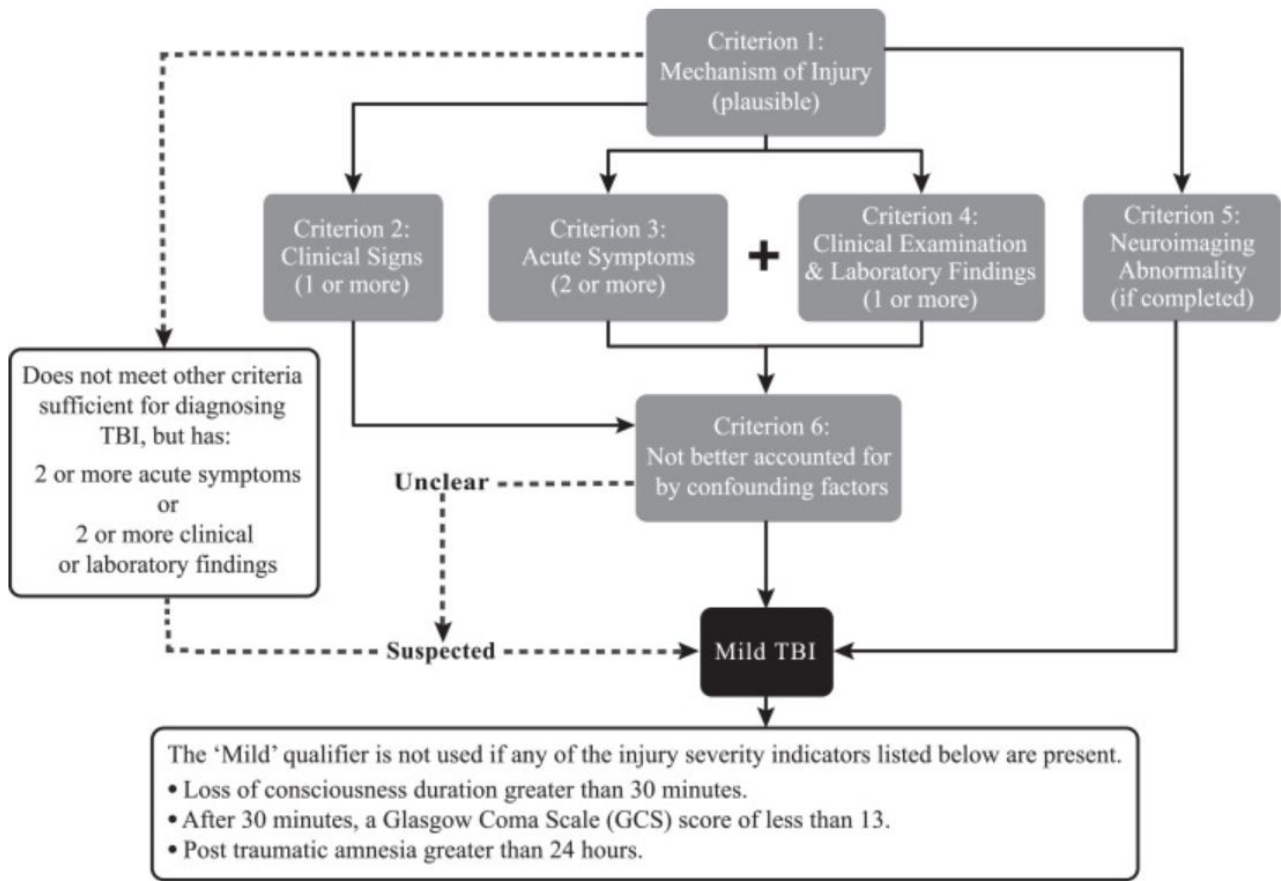


# Concussion:

# Resources for Examination and Treatment

Danish Physiotherapists' Professional Congress 2025  
Presented by Helena Esmonde, PT, DPT, NCS





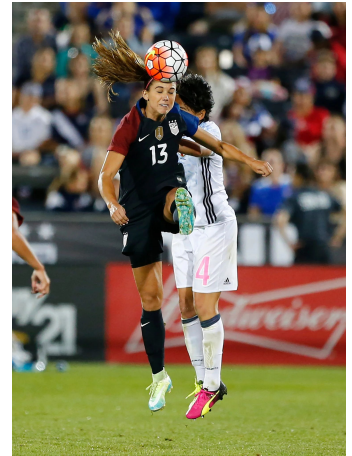
# American Congress of Rehabilitation Medicine: Diagnostic Criteria

Silverberg et al., 2023



# What Not to Miss: Red Flags for Possible Bleed

1. Signs of new serious neurological damage (concern for intracranial or cervical vascular injuries)
  - a. Limb paralysis
  - b. Numbness or tingling in an arm or leg
  - c. Severe head/neck pain (particularly behind one eye)
  - d. Aphasia or major change in vision
  - e. Loss of consciousness for more than one minute
  - f. Increasing confusion or inability to stay awake
  - g. Repetitive vomiting
  - h. Very abnormal vital signs; unresponsive
  
2. When in doubt - image and consider going past CT head to MRI head and CTA/MRA especially if symptoms worsen

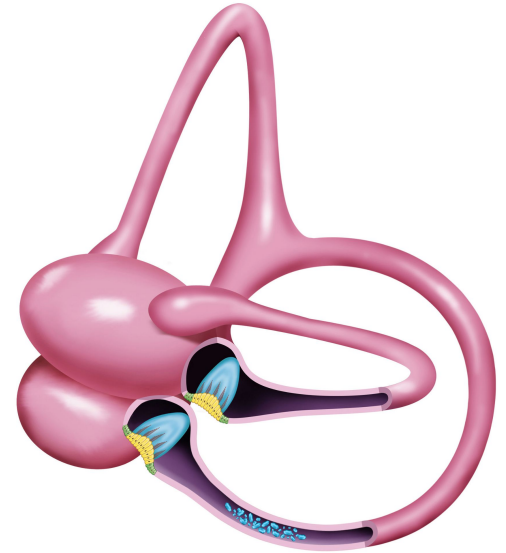


Kumar et al., 2018; Nakao et al., 2023



# What Not to Miss: BPPV

- “All patients with a TBI should have all canals assessed for BPPV as there is no relationship between the side of focal damage and canal involvement.” (Harrell et al., 2023)
- 34% have BPPV acutely (Smith et al., 2024), 21% within 3 months of trauma (Andersson et al., 2022)
- Patients post-brain injury have increased risk for vestibular agnosia (Cedras et al., 2025)
  - No sense of dizziness or vertigo at all
  - Predicts worse recovery of balance
  - Untreated BPPV can cause PPPD (Madrigal et al., 2024)



Treatment resource: BPPV maneuvers and more:

<https://vestibularfirst.com/education/resources/>



## Concussion Clinical Trajectories



Reynolds et al., 2014; Kontos 2019

## Concussion Exam

- Figure: The University of Pittsburgh Medical Center Sports Concussion Program symptom clusters
- After 7 days, the symptoms can be broken down into specific clinical trajectories: cognitive, vestibular, ocular, anxiety, cervical, and migraine
- Clinical Profiles by Kontos et al. (2019) add sleep as an important modifier



# Resources for Concussion Exam/Outcomes

1. Clinical Practice Guidelines for Concussion: “Physical Therapy Evaluation and Treatment After Concussion/Mild Traumatic Brain Injury” (JOSPT, Quatman-Yates et al., 2020).  
<https://www.jospt.org/doi/10.2519/jospt.2020.0301>
2. Vestibulo-Ocular Motor Screening (VOMS) - screening and symptom provocation exam
  - a. [https://learning.gaa.ie/sites/default/files/2023-11/VOMS%20Assessment%20Guide\\_0.pdfm](https://learning.gaa.ie/sites/default/files/2023-11/VOMS%20Assessment%20Guide_0.pdfm)
  - b. <https://youtu.be/CJF6kJcFGqE?si=3gCc12he0rbk3TyE>
  - c. <https://impacttest.com/wp-content/uploads/VOMS-Scorecard-and-Instructions.pdf>
3. Dynamic visual acuity: <https://youtu.be/f6eFoNRMUj4?si=PIZM91jQCm38rGdr> using ETDRS
4. Buffalo Concussion Treadmill Test - exertion tolerance testing  
[https://cdn-links.lww.com/permalink/jsm/a/jsm\\_2020\\_01\\_28\\_haider\\_19-313\\_sdc1.pdf](https://cdn-links.lww.com/permalink/jsm/a/jsm_2020_01_28_haider_19-313_sdc1.pdf)



# Resources for Concussion Exam/Outcomes

5. Dizziness Handicap Inventory: [v1st.co/DHI](http://v1st.co/DHI) for online calculator and printable versions in English and available in Danish via Danish Society of Physiotherapy
6. Binocular vision dysfunction: <https://www.vision-specialists.com/patients/bvd-questionnaire/>
7. Hospital Anxiety and Depression Scale - screening for mood issues
  - a. English: <https://www.svri.org/sites/default/files/attachments/2016-01-13/HADS.pdf>
  - b. Danish: <https://lungemedicin.dk/wp-content/uploads/2021/06/HADS-dansk-1.pdf>
8. Pittsburgh Sleep Quality Index:
  - a. English:  
[https://www.med.upenn.edu/cbti/assets/user-content/documents/Pittsburgh%20Sleep%20Quality%20Index%20\(PSQI\).pdf](https://www.med.upenn.edu/cbti/assets/user-content/documents/Pittsburgh%20Sleep%20Quality%20Index%20(PSQI).pdf)
  - b. Danish by request at <https://eprovide.mapi-trust.org/instruments/pittsburgh-sleep-quality-index>



# Resources for Concussion Exam/Outcomes

## 9. Migraine or headache after concussion

a. Migraine criteria:

<https://ichd-3.org/1-migraine/1-1-migraine-without-aura/>

b. Vestibular migraine criteria (Lempert et al., 2022):

<https://pmc.ncbi.nlm.nih.gov/articles/PMC9249276/>

c. Patient handout

<https://health.mil/Reference-Center/Fact-Sheets/2024/03/06/Magnifying-Headaches-Following-Concussion-Fact-Sheet>

d. HIT-6 for headache impact

<https://health.mil/Reference-Center/Publications/2020/07/31/Headache-Impact-Test-HIT6>

e. Vestibular Migraine questionnaire: [v1st.co/VMPATHI](http://v1st.co/VMPATHI)

## 10. Cervical Joint Position Error Testing: Free printable target at

[v1st.co/equip](http://v1st.co/equip); NDI for neck pain

[https://healthcare.msu.edu/\\_assets/documents/lymphedema/NDI.pdf](https://healthcare.msu.edu/_assets/documents/lymphedema/NDI.pdf)

<b>Vestibular Migraine</b>	
<b># of episodes fulfilling criteria?</b>	<b>5</b>
<b>Observed and documented..</b>	<b>History of migraine with or without aura</b>
<b>Episode length</b>	<b>5 min to 72 hours</b>
<b>Symptoms</b>	<b>Moderate to severe dizziness; may have headache, light and/or sound sensitivity, and/or visual aura</b>





# Resources for Concussion Exam

## 11. Balance

### a. Functional Gait Assessment:

[https://geriatrictoolkit.missouri.edu/FGA/Wrisley-2007-FGA\\_PTJ\\_84-10-Appendix.pdf](https://geriatrictoolkit.missouri.edu/FGA/Wrisley-2007-FGA_PTJ_84-10-Appendix.pdf)

### b. HiMAT: <https://www.tbims.org/himat/HiMAT.pdf>; in Danish @ Danish Society of Physiotherapy

### c. Tandem Gait for 3 meters (Oldham et al., 2021; Van Deventer et al., 2021)

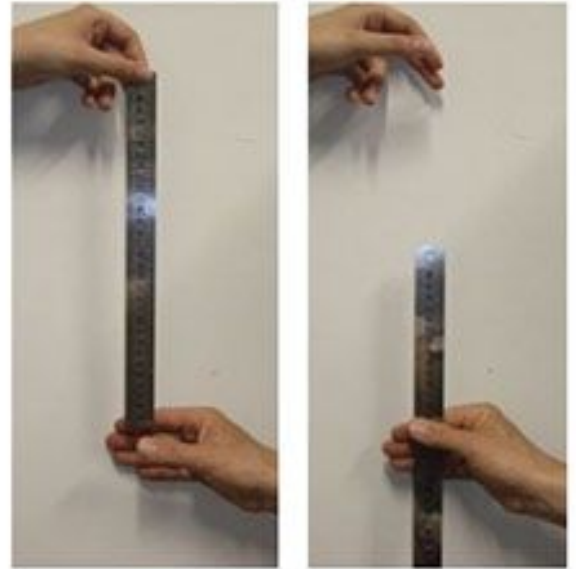
- i. Collegiate athletes: Acutely post-concussion, the concussion group performed single-task tandem gait slower (worse) than controls (Concussion:  $11.36 \pm 2.43$  seconds, Controls:  $9.07 \pm 1.78$  seconds)
- ii. Dual-task tandem gait - no norms yet for adults; can compare pre/post treatment for time and number of errors (spell word backward, count back by 7's from 100)
  1. Pediatric persistent post-concussion group had slower dual-task tandem gait test times (mean difference = 7.9 s)
  2. Should compare pre/post exertion to monitor for differences prior to return to play



# Resources for Concussion Exam

## 12. Reaction time - low tech ruler drop (Del Rossi, 2017)

- i. Catch the ruler as quickly as possible without moving hand
- ii. The distance the ruler fell before grasped is measured at the most superior aspect of the patient's thumb and converted into a reaction time (milliseconds=ms)
  1. Reaction time calculator can be found online
  2. Norms
    - a. Children 6-12 years: 214.2 ms-248.8 ms (Aranha et al., 2017)
    - b. High school age (tested prior and after concussion): ~26 milliseconds slower at 48 to 72 hours postinjury, almost 18 ms slower on day 7, and returned to baseline day 14 postinjury (Del Rossi, 2017)



# Resources for Concussion Exam

13. Practice videos for identifying abnormal eye movements during vestibular and oculomotor exam

- a. Dr. Dan Gold <https://novel.utah.edu/collection/dan-gold/#tab-collection>
- b. Dr. Michael Teixido, ENT - <https://www.youtube.com/user/DRMTCI>
- c. Moran Core <https://www.youtube.com/channel/UCIdQrI18TtG0AJ4JLhh1fQ>
- d. Dr. Timothy Hain in Chicago - <https://www.dizziness-and-balance.com/sitedvd.htm>
- e. Scott Sanders at BalanceMD in Indianapolis - <https://www.youtube.com/user/BalanceMD/videos>
- f. Kregg Ochitwa's Video Library - <https://courses.north49therapy.com/oculomotor-library>

2 hour continuing education course: “Eye Movements in Vestibular Pathology”

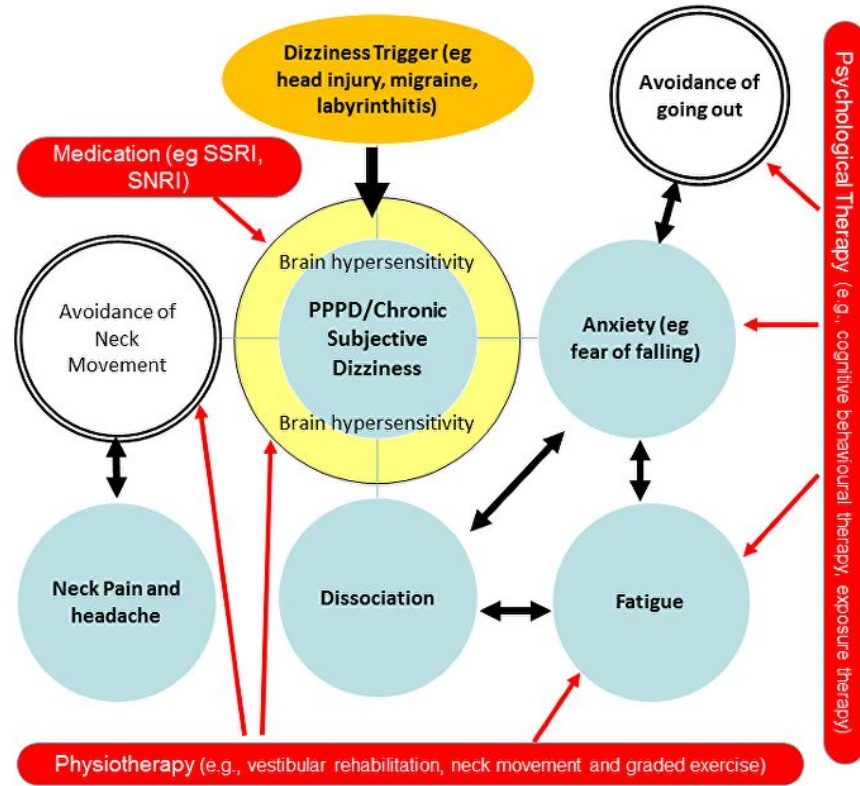
<https://vestibularfirst.talentlms.com/catalog>

14. PPPD criteria: Staab et al., 2017

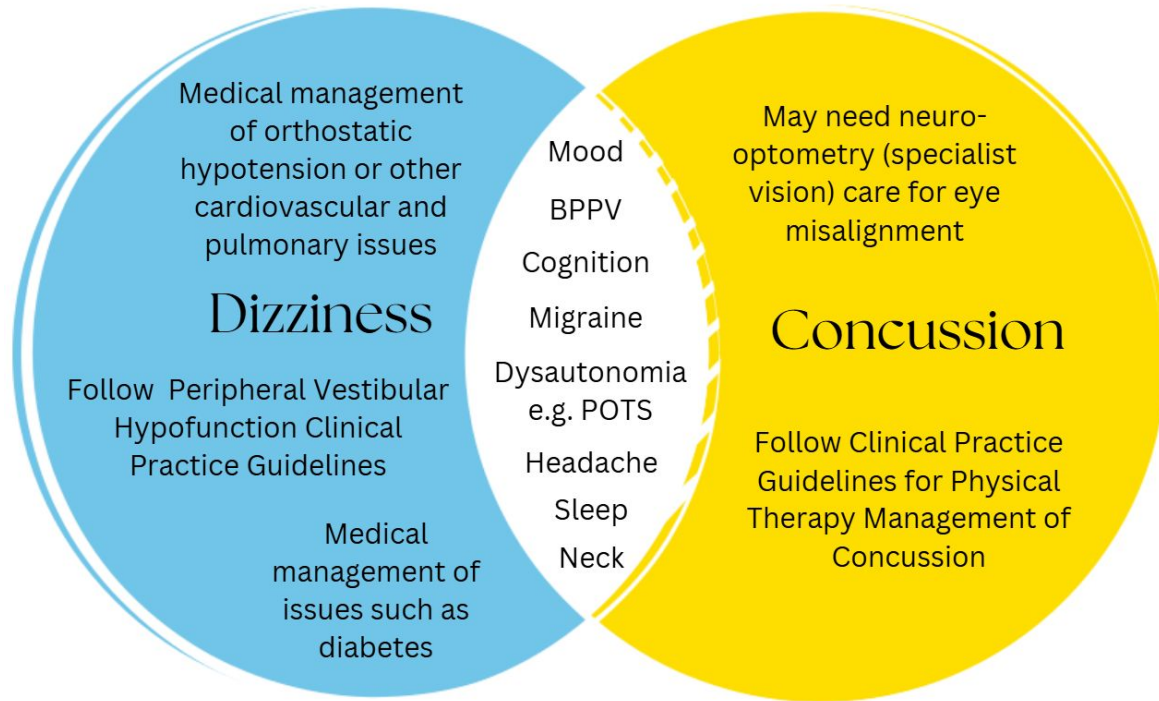
<https://pmc.ncbi.nlm.nih.gov/articles/PMC9249299/>



# Persistent Postural Perceptual Dizziness



# Dizziness vs. Concussion



# Take-Home Message:

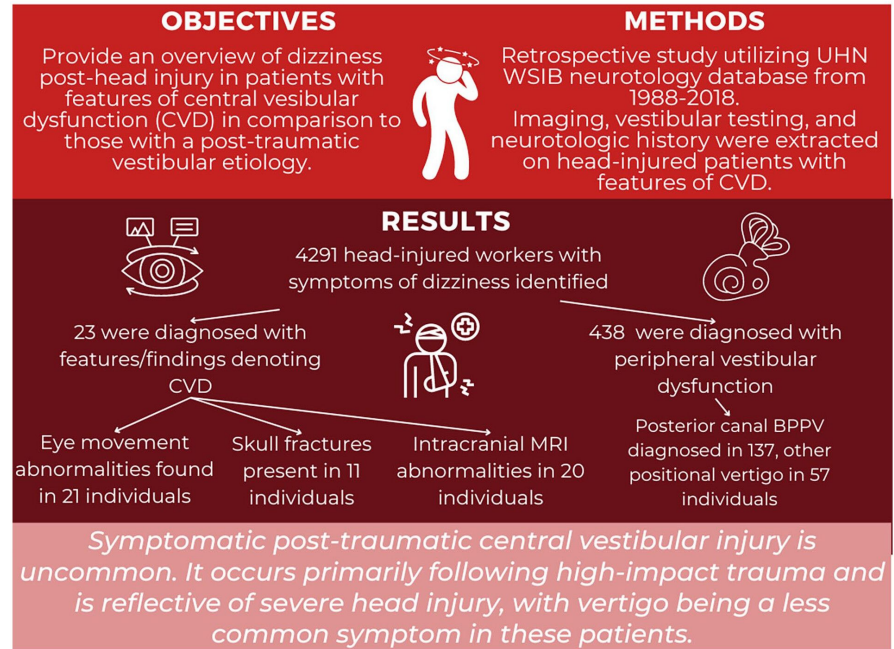
If a patient is dizzy post-concussion, it may be due to peripheral vestibular issues (abnormal calorics/VEMPs or BPPV)

more often than “detectable” central vestibular disorder (as indicated by abnormal smooth pursuit, saccades and/or abnormal head imaging)

Note: neck not assessed; those with primary headache or migraine excluded, and what about PPPD?

## CENTRAL VESTIBULAR DYSFUNCTION IN HEAD INJURY

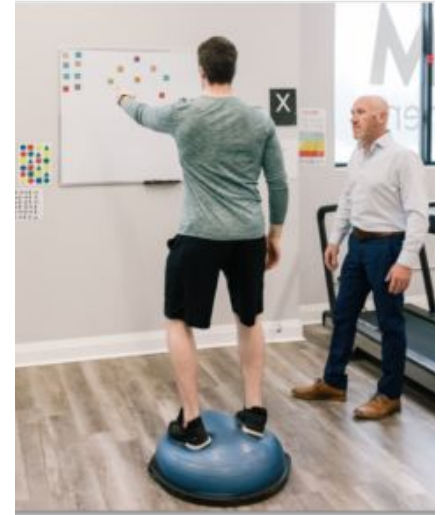
Kraus M, Hassannia F, Dabiri S, Vergara Olmos G, Rutka J





# How Long To Expect Recovery

- Overall, ~80-85% recover in ~2-4 weeks
- Most sports-related pediatric patients (52.3%) recovered within 14 days of injury (Allen et al., 2023)
  - 21.5% recovered within 15-27 days
  - 26.2% had a recovery period of 28 days or longer
- Predictors of recovery (includes adolescent/college-age)
  - initial PCSS score out of 126 (score >29 most predictive of prolonged recovery)
  - time to presentation (>7 days predictive of prolonged)
  - prior concussions ( $\geq 1$  predictive of prolonged)
  - cognitive impairments (measured by SAC)
  - visual exam findings (King Devick)
  - vestibular exam findings (VOMS)



Allen et al., 2023; Martinez et al., 2020



# Delayed Recovery in Adults

- 79 adults with persistent concussion symptoms (Terpstra et al., 2023)
  - Current anxiety, symptom catastrophizing, fear avoidance behavior, and somatization were associated with increased symptoms during the VOMS
  - Symptom provocation test failure should be interpreted with caution because it might indicate psychological maladjustment rather than lingering brain injury or incomplete neurophysiological recovery
- Predictors 3 months post concussion for adults (18 or older): premorbid psychiatric conditions, pre-injury health system usage, and older age (Langer et al., 2021)

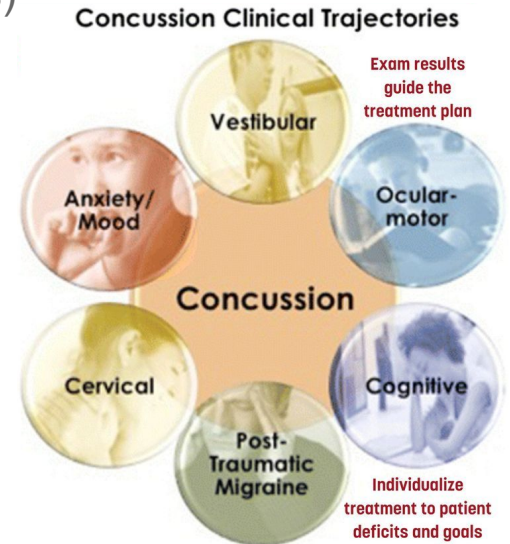




# Concussion Treatment


Prioritization (sleep, nutrition, stress, accommodations for work/school)

1. Exercise as able; goal 80-90% HR provoked symptoms on exertion test
2. Treat cervical spine (if looking down provokes, often neck issues)
3. Oculomotor/vestibular exercises\*\* specific to patient once able to tolerate neck movements needed; 2 unit rule  
\*\*4 weeks of PT, still having visual symptoms - refer to neuro-optometry
4. If migraine is barrier to PT, refer promptly
5. If mood is barrier to PT, refer promptly
6. If cognition is significant issue or not improving with 4 weeks of PT, refer (neuropsychology, speech therapy)
7. Progress to balance, sensory integration, dual task, and functional (work/sport-specific) activities




# Resources for Concussion Rehab Exercises


1. Balancing Act Rehab: two targets, VORx1, VORx2  
<https://www.youtube.com/@BalancingActResources/videos>
2. Vestibular First on YouTube: <https://www.youtube.com/@VestibularFirst>



**JOURNAL CLUB**



Vestibular Rehab with Stroke and Neuro Patients



With Special Guest  
Dr. Christina Garrity, PT, DPT, NCS




**JOURNAL CLUB**




Vestibular Treatment Ideas for the Older Adult




With Special Guest  
Dr. Alex Germano, PT, DPT, GCS




**JOURNAL CLUB**






Concussion Vision Problems: Convergence, Parvocellular vs. Magnocellular Pathways, and More



With Special Guest  
Dr. Becky Bliss, PT, DPT, DHSc




**JOURNAL CLUB**






Concussion Expert Panel:  
Return to Play vs. Return to Academics

With Special Guests  
Dr. Steven Broglio, PhD, ATC  
Dr. David Bruton, Jr., PT, DPT  
Dr. Elizabeth Pieroth, PsyD, ABPP, MPH




**JOURNAL CLUB**





Dysautonomia and Concussion

With Special Guests  
Dr. Lauren Zicks, PT, DPT, ATC, NCS &  
Dr. Jenna Tucker, PT, DPT, NCS, CBIS



**JOURNAL CLUB**



Vestibular and the brain: Cognitive risks and benefits of dual task rehab

With Special Guest  
Dr. Mike Studer, PT, DPT, MHS, NCS, CEEAA, CWT, CSST, CSR, CBFP, FAPTA



# Resources for Concussion Rehab Exercises

3. Gabrielle Pierce's videos to use with VOR exercises to decrease visual motion sensitivity: <https://www.youtube.com/@PTVideoSource>

4. Emory Dizziness and Balance for Modified Motion Sensitivity Test + other videos: <https://www.youtube.com/@emorydizzinessandbalance5916>

5. Social media accounts to follow on Instagram (and @BBlissDPT on X/Twitter)

- a. @SmithDizzyPT
- b. @vestibular\_neuro\_pt
- c. @dr.trevor.neuropt
- d. @theneuroguy\_dpt
- e. @VestibularFirst



# Resources for Concussion Courses

1. Evaluation and Treatment of Vestibular Dysfunctions Following Concussion with Sonia Vovan, PT, 10 hours of content (introductory/intermediate level):  
<https://cnsed.learnworlds.com/course/the-dizzy-brain>
2. Multiple expert clinicians teach 30 hours of on-demand material plus live remote mentorship sessions: <https://www.concussioncorner.org/courses>
3. Multi-disciplinary 28 hours of material that must be completed within 90 days: <https://members.completeconcussions.com/offer/course/>
4. Medbridge online including courses by Drs. Sue Whitney and Anne Mucha <https://www.medbridge.com/search?q=concussion>



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