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Vestibular Rehabilitation in Post-Concussion Management

Laura King, PT, MPT

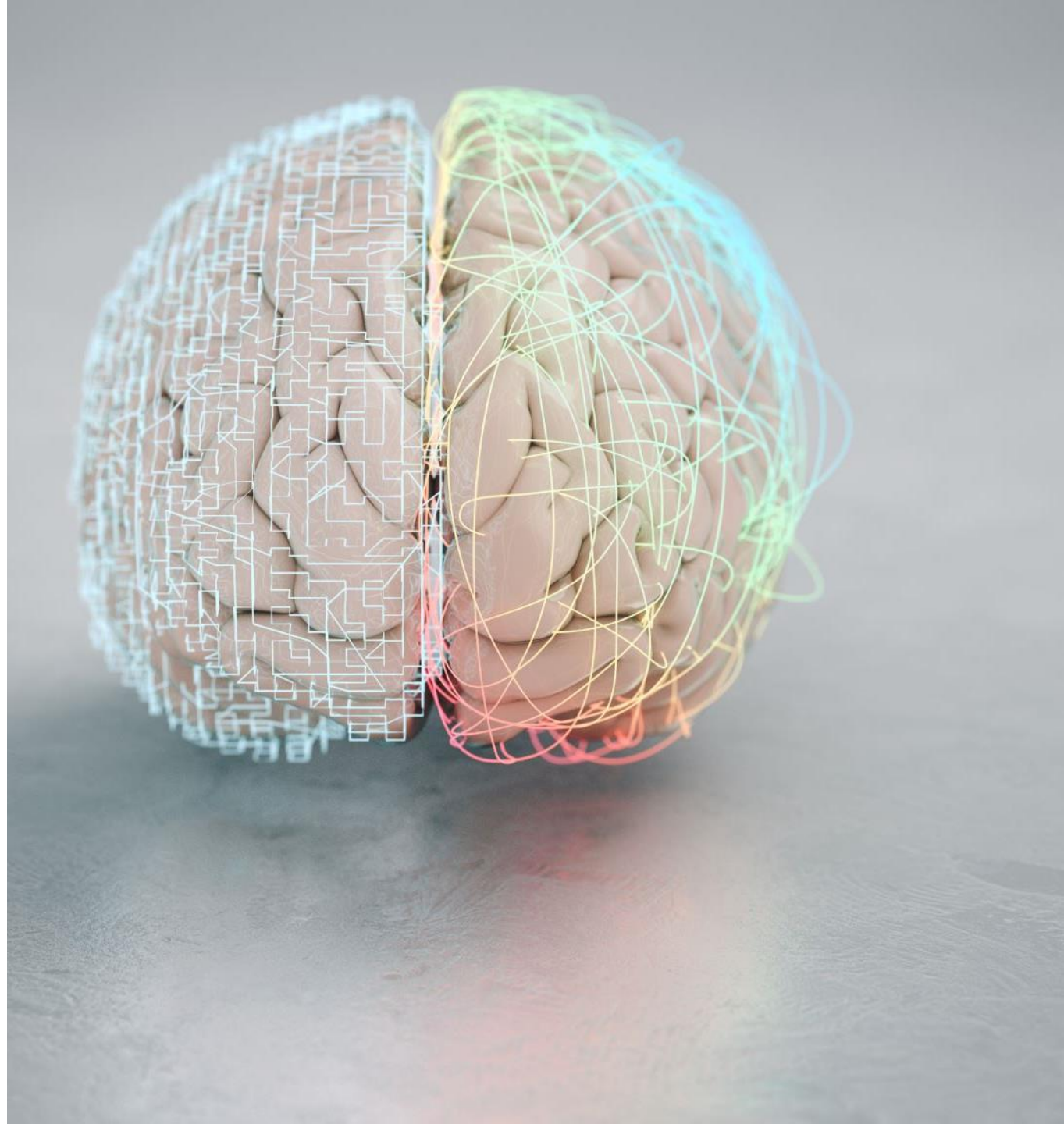
Objectives

1. Understand the anatomy and physiology of the vestibular system
2. Develop an early-phase concussion symptom management plan
3. Evaluate post-concussion symptoms to determine when referral to vestibular Physical Therapy is indicated

Vestibular System

A complex system responsible for:

- Balance
- Spatial orientation
- Eye movements
- Detecting head motion, speed, and direction
- Detecting gravitational forces,
- Sending signals to the brain to coordinate posture
- Stabilizing vision.



Integration of Systems



Peripheral Vestibular System

Comprised of the inner ear and bony labyrinth

Detects head movement and position, providing foundational balance information



Somatosensory/Proprioceptive System

Comprised of the receptors in joints, muscles and ligaments

Delivers proprioceptive feedback from muscles and joints, supporting postural stability.



Visual System

Comprised of the eyes

Calibrates vestibular signals and aids spatial orientation through environmental cues.

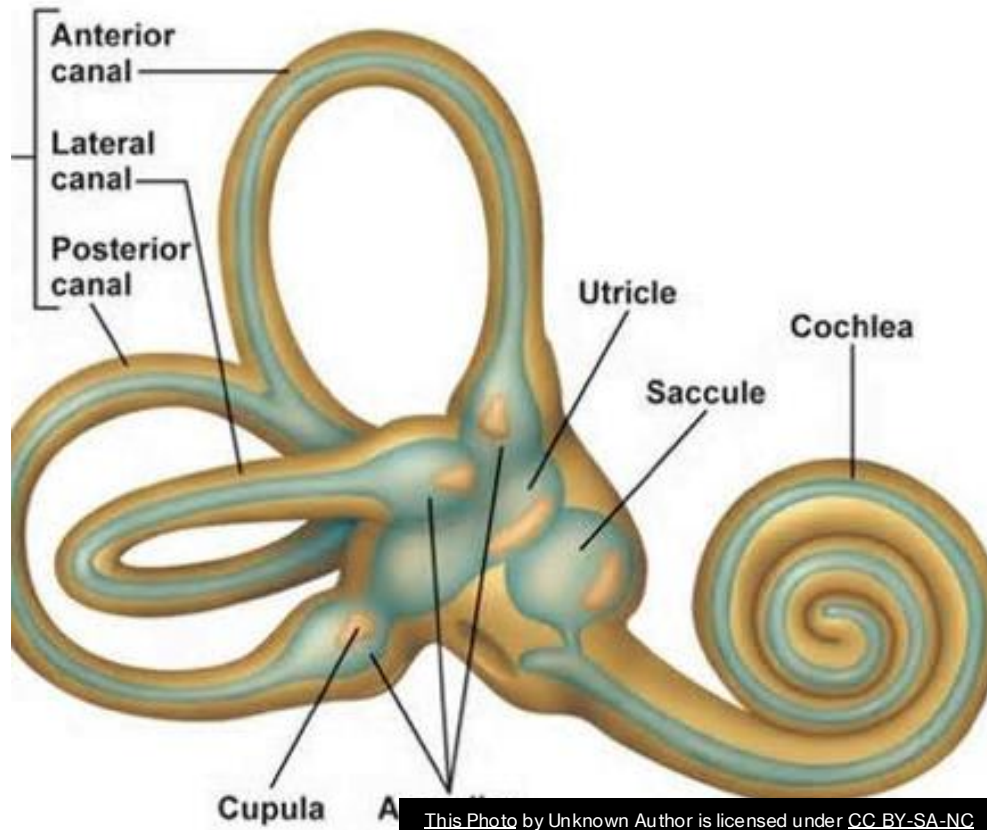


Central Vestibular System/ Multisensory Integration

Comprised of the brain and nerve pathways

Brain processing center. Combines inputs from all systems for coordinated movement and adaptive balance responses.

Peripheral Vestibular System



Comprised of:

3 semicircular canals

Utricle

Saccule

Vestibular portion of CN VIII

Function:

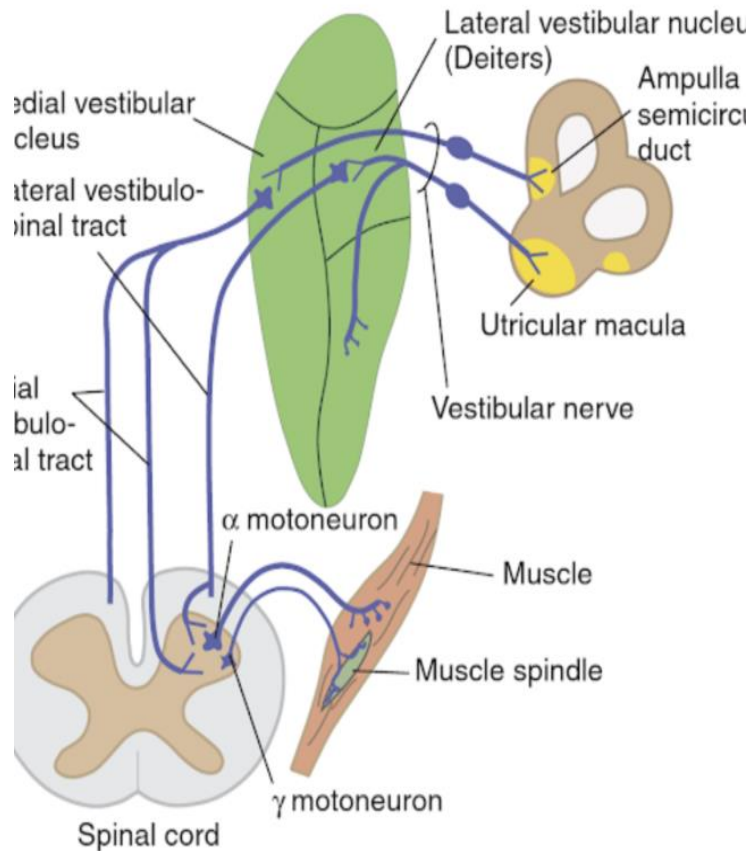
Detects angular acceleration

Detects linear acceleration

Detects gravity

Transmits signals to the brainstem for balance and spatial orientation

Central Vestibular System



Comprised of:

Vestibular nuclei

Vestibulocerebellum

Vestibulo-ocular pathways

Vestibulospinal pathways

Function:

Interprets movement

Maintains balance

Stabilizes gaze

Contributes to postural control

Differentiating Central Vs Peripheral

CENTRAL

- Related to the brain processing
- Symptoms are sustained or continuous and often of a lower intensity
- Pt will comment: “I am dizzy even when sitting,” “I feel dizzy and unsteady,” or “I always feel off.”
- Common symptoms
 - Abnormal smooth pursuit
 - Abnormal saccadic eye movement
 - Nystagmus may be downbeating or pendular

PERIPHERAL

- Related to the inner ear
- Symptoms are intermittent and often of higher intensity
- Typically normal oculomotor control
- Common symptoms
 - Position changes may reproduce nystagmus
 - Hearing loss, fullness in the ears, and tinnitus
 - Nystagmus has a slow and fast phase
 - Report a sense of spinning
 - Complaints of nausea

Early Concussion Management



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Recovery is rarely linear and never a one-size-fits-all approach

1. CDC, n.d, 2. Gioia, n.d

Screen for Red Flags

- Severe or worsening headaches
- Repeated vomiting
- Slurred speech, confusion, disorientation, behavior changes
- Neck pain w/suspected instability, new onset of weakness in extremities
- Seizure, pupil asymmetry, or prolonged loss of consciousness

Screen for common co-existing impairments

- Vestibular or balance dysfunction- Refer to PT
- Vision or oculomotor issues – Refer to PT, optometry, ophthalmology
- Cognitive symptoms – Refer to PT, OT, SLP
- Psychological stressors – Refer to Psychology

Brief 24-48 hour rest, then begin guided return to activity

- No more than 2/10 above baseline
- Symptoms last < 1 hour
- Work toward 30 minutes, 5x/week

Early Concussion Management



Education is Key!

- **Education:**
 - relative rest: meaning if symptoms go above 2 points over baseline symptom rating with any particular activity, then a break is needed
 - Use of voice texting or text-to-speech if scrolling and reading are problematic. If working on a computer or scrolling on a phone does not trigger symptoms, these activities do not need to be stopped.
 - Use of a hat or sunglasses, even indoors, if light sensitive
 - Calming strategies such as box breathing, yoga, mindfulness, meditation, joint compression, rhythmic movement, walking, or listening to quiet music
 - Importance of regular sleep patterns, balanced nutrition, and hydration

Early Concussion Management



Patient Education Handouts

Centers for Disease Control and Prevention (CDC)

- CDC handout Tips to Feel Better
- Healthy Habits for Your Brain
- Calming Concussion Strategies
- Military Health System
- **Keep working on this slide. Add in links for different handouts from medbridge course**

Education is Key!

Early Concussion Management



When is it time to refer?

- Room spinning sensation with position changes
- Constant sense of dizziness or imbalance, impaired midline orientation
- Inability to track with eyes without increased symptoms
- Headaches
- Nausea
- Motion Sensitivity
- Lower activity level and/or decreased activity threshold

Early Concussion Management



When is it time to refer?

- Poor concentration and memory
- Sleep disruptions
- Light and sound sensitivity, vision disturbances
- Fatigue
- Difficulty navigating complex environments (school, stores, etc)
- Anxiety or depression, unexplained or increased irritability
- Changes in hearing

Early Concussion Management



Screening tools

Concussion Clinical Profile Screen

- 29-item symptom-based, self-report inventory
- designed to measure clinical concussion profiles of anxiety/mood, cognitive/fatigue, migraine, ocular, and vestibular
- Includes modifying factors of sleep and neck
- [Concussion Clinical Profiles Screening \(CP Screen\) Tool: Preliminary Evidence to Inform a Multidisciplinary Approach](#)

Early Concussion Management



Screening tools

Bess Test (Balance Error Scoring System)

- Assesses effects of mild head injury on static postural stability
- 3 stance positions with eyes closed on firm and compliant surfaces
- Errors are recorded, includes a timed element
- [Balance Error Scoring System | RehabMeasures Database](#)

Early Concussion Management



Screening tools

Buffalo Concussion Treadmill Test

- Protocol for evaluating autonomic dysregulation, exercise tolerance and symptom severity in patients with post-concussive symptoms.
- Graded exercise test involves walking on a treadmill with increasing incline while monitoring symptoms of HR, perceived exertion and symptom exacerbation
- Bouncing may impact gaze stability and increase symptoms. Can perform test on bike instead
- Used to develop an initial exercise program
- [appendix-3-3.pdf](#)
- [Administration of the Buffalo Concussion Treadmill Test \(BCTT\)](#)

Early Concussion Management



Screening tools

Vestibular/Ocular-Motor Screening for Concussion (VOMS)

- Test ideal when patients cannot track without increased symptoms
- Screening tool used to identify provocation of symptoms from eye and head movements or motion sensitivity
- Used by Physical Therapist to help determine the state of concussion, where the oculomotor system breaks down, and where to begin with treatments
- [VOMS-explicit-directions.pdf](#)



Role of Physical Therapy



Dizziness Terms

- Vertigo: spinning
- Motion Sickness: world is moving
- Lightheadedness: feeling faint
- Off-balance, feeling drunk
- Nauseous

Oculomotor Assessment

Smooth Pursuits

- Smooth coordinated eye movements following a moving target

Saccades

- Rapid localizations of movement observed in the periphery to bring the object into direct line of sight

Vergence

- Convergence – coordinated movement of both eyes inward toward the nose
- Divergence – coordinated movement of both eyes back out to midline



Oculomotor Assessment

Visual Fixation

- Maintains visual gaze on a single object or location

Vestibular Ocular Reflex

- Analyzes info from pairs of eye muscles and semicircular canals
- Determines whether movement is external or movement of the head/body
- Keeps image stabilized on the retina during head and body movements





Musculoskeletal Assessment

Cervical instability screening

Cervical AROM

Palpation of cervical, neck and scapular muscles

Strength testing

Cervical proprioceptive assessment

Posture assessment

Balance Assessment

Berg Balance Test

Dynamic Gait Index/Functional
Gait Assessment

BESS Test

Five times sit to stand

Activities with eyes open and eyes
closed

Activities with altered base of
support and on various surfaces



Concussion Subtypes

Vestibular/Oculomotor

Symptoms: dizziness, blurred vision, gaze instability, difficulty reading and tracking, motion sensitivity

Impairments: faulty VOR, saccadic and/or smooth pursuit dysfunction, visual motion hypersensitivity, positional vertigo

Physical Therapy Treatments: stabilization exercises to improve visual focus, VOR x 1, VOR x 2 to retrain ocular reflex, oculomotor training targeting saccades, smooth pursuits, and vergence, visual motion habituation to improve sensitivity to busy or dynamic environments, canalith repositioning techniques, dual task training, optokinetic training





Concussion Subtypes

Cervical musculoskeletal

Symptoms: neck pain, headache, dizziness, imbalance

Impairments: decreased cervical mobility, muscle tenderness, cervical proprioceptive deficits

Physical Therapy Treatments: soft tissue mobilization, joint mobilization for cervical and thoracic spine, restore normal ROM, cervical and scapular muscle stabilization/strengthening, proprioceptive training, joint position error tasks, posture retraining

Concussion Subtypes

Motor Function

Symptoms: impaired balance, slowed coordination, difficulty multi-tasking or performing dynamic tasks

Impairments: static and dynamic balance deficits, impaired dual task performance, subtle motor control changes

Physical Therapy Treatments: static and dynamic balance training, coordination training, midline orientation tasks, integrate dual/multi-task activities to reflect real work cognitive and motor demands, graded exposure, visual motion desensitization strategies





Concussion Subtypes

Exertional Tolerance

Symptoms: fatigue, symptoms flare up with activity, reduced exercise capacity

Impairments: autonomic dysregulation, reduced exertional thresholds, orthostatic intolerance

Physical Therapy Treatments: use symptom-guided approach, graded exercise tests and progressions, improve autonomic regulation, monitor heart rate, & blood pressure. Add in cognitive tasks/dual tasks as the client progresses

Stages of Activity Progression

	Sports (Paticios et al., 2023)	Military (Military Health System, 2024)
STAGE		
1	Symptom-limited activity	Relative rest
2	Aerobic Exercise A: light (up to 55% max HR), then B: moderate (up to 70% max HR)	Symptoms-limited activity
3	Sport-specific exercise	Light activity
4	Noncontact training drills	Moderate activity
5	Full contact practice	Intensive activity
6	Return to sport	Return to full duty

At least 24 hours in each stage. If symptoms worsen, return to the previous stage

Full Recovery

Symptom Resolution	No symptoms at rest
Complete Symptom Resolution	No symptoms during or after maximal physical or cognitive exertion
Return to Learn	Return to pre-injury learning activities with no new academic support, accommodations or adjustments
Return to Sport	Return to pre-injury status, completion of RTS states without symptoms or clinical findings at rest or during maximal exertion

Vestibular Rehabilitation in Post-Concussion Management – Patient Education Handouts

Centers for Disease Control and Prevention (CDC)

- **Tips to Feel Better After a Mild Traumatic Brain Injury or Concussion:**
https://www.cdc.gov/traumatic-brain-injury/media/pdfs/2024/05/recovery_tips_ENG-508.pdf
- **Recovering From a Mild Traumatic Brain Injury or Concussion:**
https://www.cdc.gov/traumatic-brain-injury/media/pdfs/2024/05/patient_discharge_instructions_ENG-508.pdf

Military Health System

- <https://health.mil/Military-Health-Topics/Centers-of-Excellence/Traumatic-Brain-Injury-Center-of-Excellence/Provider-Resources>
- [Managing Headaches Fact Sheet](#)
- [Medication Overuse Headache Fact Sheet](#)

Unity Point Health

- [Calming Concussion Strategies \(Provided by UnityPoint Health\)](#)
- [Healthy Brain Habits \(Provided by UnityPoint Health\)](#)