The background features a dark blue gradient with faint, light blue circular patterns and a scale. The scale is a large arc on the left side, with markings from 40 to 260 in increments of 10. There are also several smaller circles and dashed lines scattered across the background, some with arrows indicating direction.

# VESTIBULAR CONSIDERATIONS FOLLOWING TBI & HOW TO RECOGNIZE THEM

DR. KELSY RAYL PT, DPT

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Owner and Physical Therapist at SparqPT

## Treatment Philosophy

- Engaging and supporting the whole person to optimize their care and healthcare experience

## Post Doctoral Accreditations

- Certified Orthopedic Manual Therapist (COMT)
- Certified Vestibular Specialist
- Certified Concussion Specialist
- Trigger Point Dry Needling Certified, Level 1&2

## Education

- University of Kansas Medical Center, Doctorate in Physical Therapy (2017)
- Kansas State University, Bachelor of Science in Kinesiology (2014)



# OBJECTIVES

- Summarize the function of the vestibular system
- Describe the difference between peripheral and central vestibular function
- Recognize the signs and symptoms of vestibular dysfunction in TBI patients
- Summarize the pathophysiology of vestibular dysfunction in TBI patients
- Apply vestibular screening tests to appropriate TBI patients
- Identify appropriate referral sources for patients with vestibular considerations following TBI

# WHAT IS THE VESTIBULAR SYSTEM



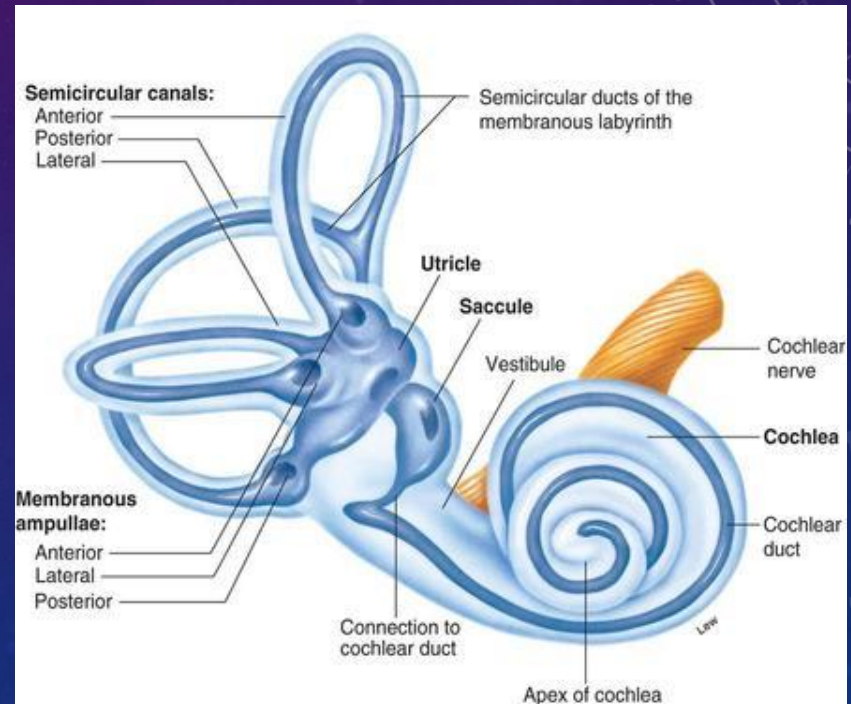
# ANATOMY AND FUNCTION OF THE VESTIBULAR SYSTEM

- Primary Function: obtains sensory information about motion, head position and spatial orientation
- Secondary Function: involved in motor functions for balance, head and body stability with movement, and maintaining posture
- Anatomy
  - Peripheral Vestibular System
    - Semi-Circular Canals
    - Otolith Organs: Utricle and Sacculle
  - Central Vestibular System
    - Vestibular Nuclei
    - Cerebellum & Cortex

# PERIPHERAL VESTIBULAR SYSTEM

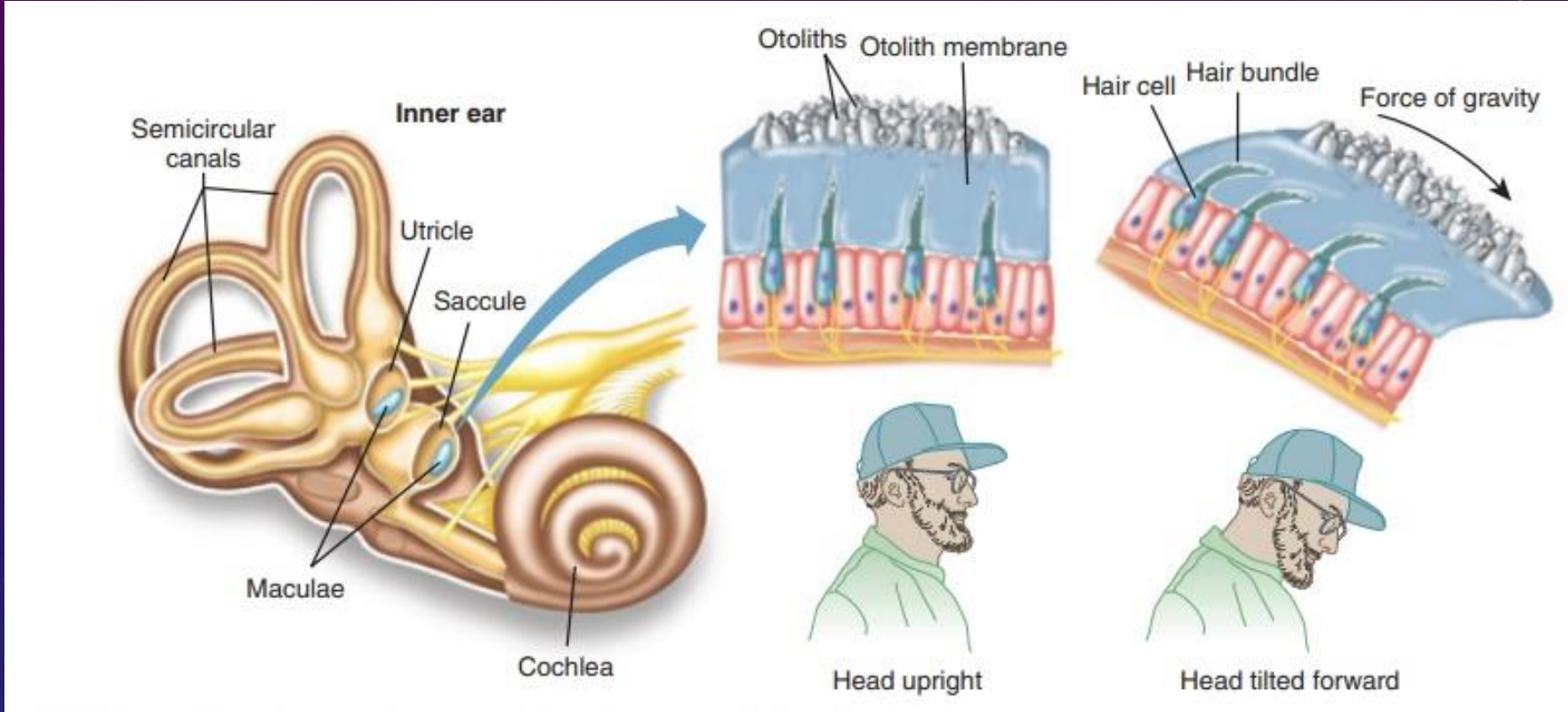
## Semi-Circular Canals

- 3 Canals
  - Arranged at perpendicular angles to one another
  - Filled with fluid (endolymph)
- Stimulated by specific head motions
  - Anterior Canal: detects ROLL (up/down)
  - Posterior Canal: detects PITCH (side/side tilting)
  - Horizontal Canal: detects YAW (rotation/turning)



# PERIPHERAL VESTIBULAR SYSTEM

- Otolith Organs: Detect linear acceleration/deceleration and gravity
  - Sacculle: Senses linear acceleration in the sagittal plane (head is pitched forward) or you're suddenly lifted vertically in an elevator
  - Utricle: Senses linear acceleration in the frontal plane (head tilt) as well as horizontal linear acceleration like sliding across the floor in a rolling chair
- Detection via otoconia (“crystals”) and hair cells

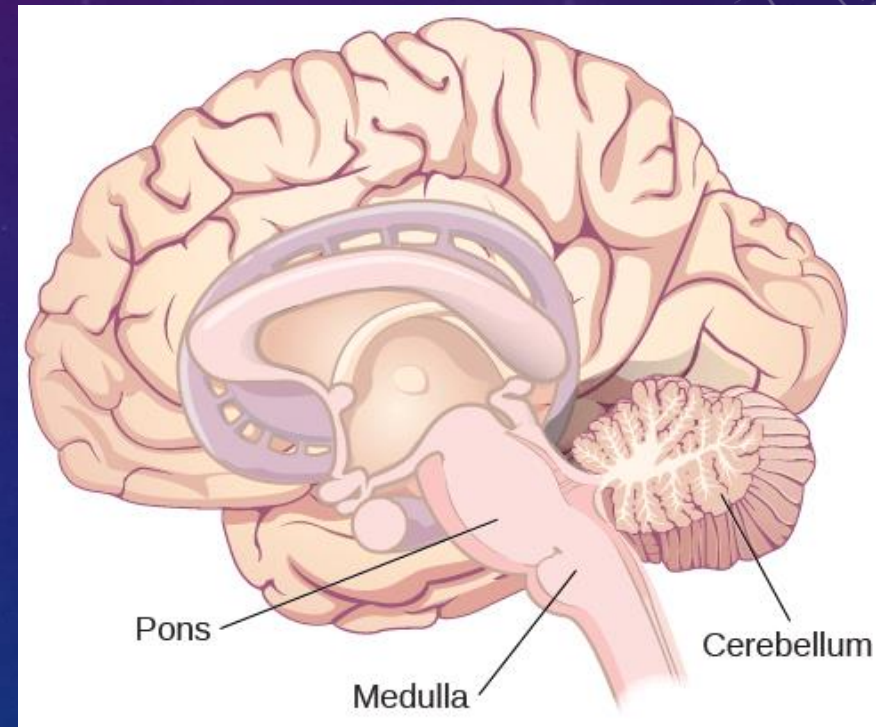




# CENTRAL VESTIBULAR SYSTEM

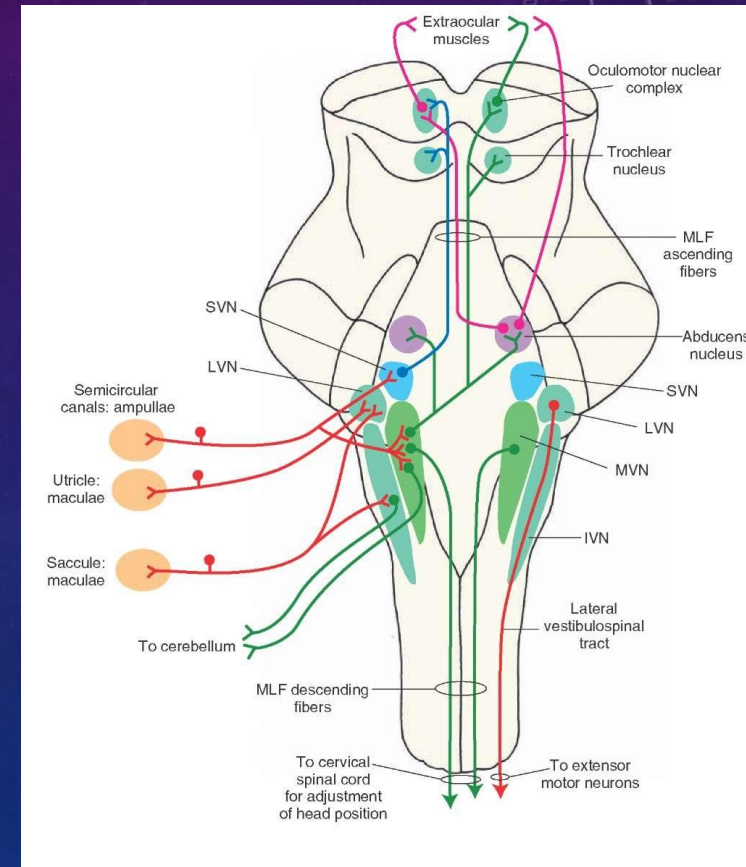
## Vestibular Nuclei

- Initial primary processor of incoming vestibular sensory information
- Ability for direct FAST connections between incoming information and motor output
- 4 nuclei, located in the pons & medulla



# CENTRAL VESTIBULAR SYSTEM

- Vestibular Nuclei
  - Superior vestibular nuclei – stabilize gaze
  - Medial vestibular nuclei – stabilize posture
  - Lateral vestibular nuclei – stabilize posture
  - Inferior vestibular nuclei – cerebellum



# CENTRAL VESTIBULAR SYSTEM

## Cerebellum

- Intimately connected with the vestibular system
- High-level main adaptive processor
- Monitors vestibular responses and adapts as necessary

## Cortex

- No “vestibular cortex”
- Vestibular information is integrated and processed in multiple areas of the brain
  - Including Temporoparietal Cortex, Thalamus, Limbic System, and even regions involved in sleep

# VESTIBULAR FUNCTION RECAP

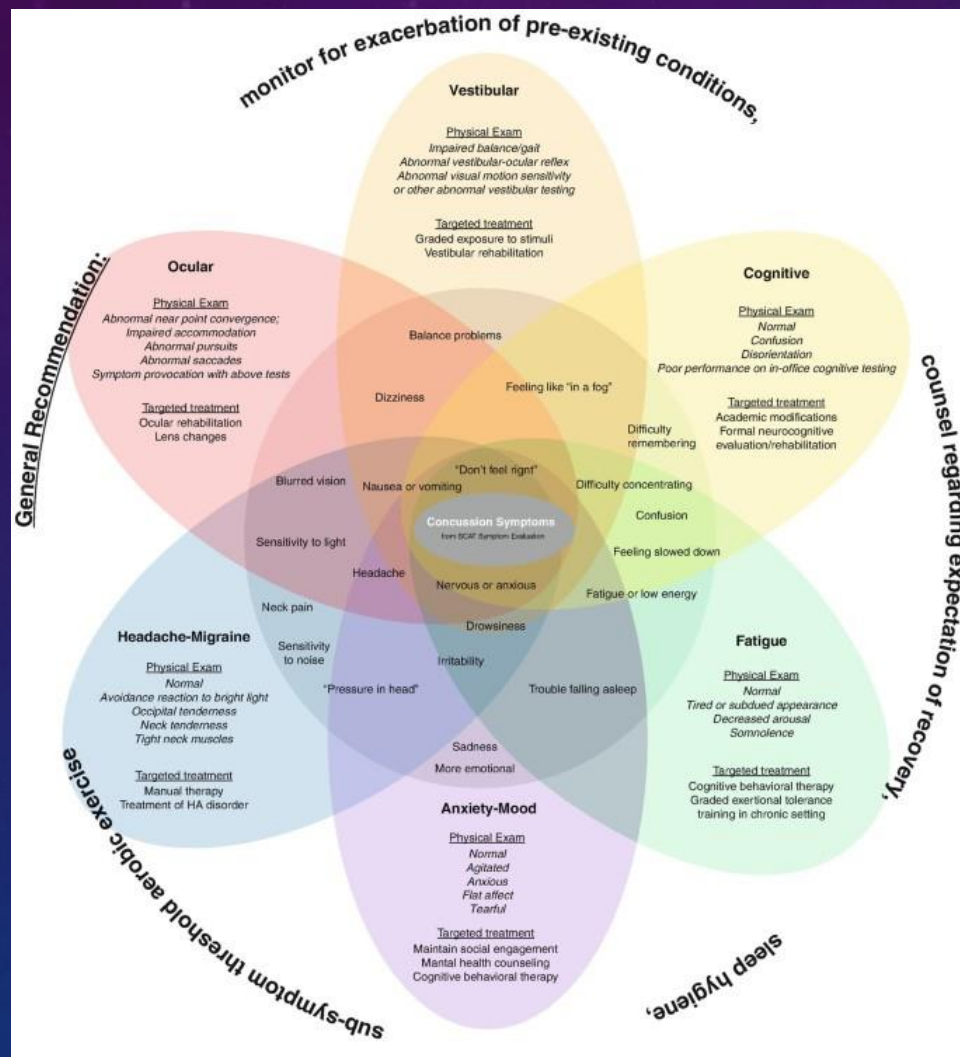
“The vestibular system is responsible for integrating information from head movements and limb position to maintain visual and balance control. It is a complex network that includes the inner ear, brainstem, cerebellum, cerebral cortex, ocular system, and postural muscles.”

- Peripheral System – “Raw Data Collector”
- Central System – “Information Transfer Center”

# SIGNS & SYMPTOMS OF VESTIBULAR DYSFUNCTION

The background is a dark blue gradient with a subtle pattern of small white dots. On the right side, there are several circular graphic elements. One is a large scale with numbers from 80 to 210, resembling a protractor or a circular ruler. Other elements include concentric circles, dashed lines, and arrows, some of which are partially cut off by the edges of the frame.

# SIGNS & SYMPTOMS OF TBI



# SIGNS & SYMPTOMS OF VESTIBULAR DYSFUNCTION

- **Reduced Desire to Move the Head**
- **More Cautious Movement**
- **Dizziness (with or without vertigo)**
- **Motion Sickness**
- **Poor balance**
- **Decreased Postural Control**
- **Nausea**
- **Vomiting**
- **Double Vision**
- **Oscillopsia (Bouncing Vision)**
- **Visual Motion Sensitivity**
- **Migraine/Vestibular Migraine**
- **Auditory Impairment**
- **Tinnitus (Ringing in the Ears)**

# CAUSES OF DIZZINESS IN TBI

## Peripheral

- Mechanical (i.e. BPPV)
- Hypofunction
- Nerve Damage

## Central

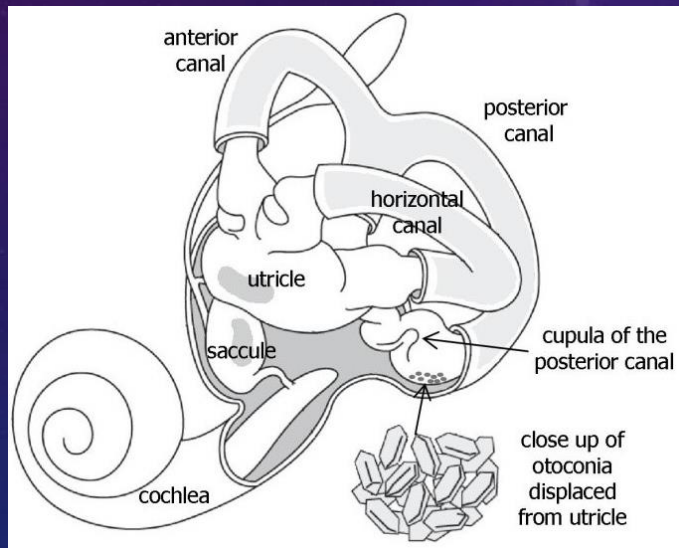
- Trauma (i.e. damage to the brain stem or cerebellum)



# CAUSES OF DIZZINESS IN TBI

## Mechanical

- Displaced otoconia disrupting the accuracy of the “raw data” collector



## Hypofunction

- When one or both “raw data” collectors aren’t functioning fully



# SCREENING TESTS FOR VESTIBULAR DYSFUNCTION

## Rhomberg Testing

- Stand with feet together with eyes open then closed
- Positive: Unable to maintain balance, opens eyes



## Fukuda Testing

- March in place for 60 seconds with eyes closed
- Positive Test: opens eyes, can't complete test for 60 seconds, moves more than 18" in any direction, rotates more than 30 degrees



# WHERE TO REFER

It depends...

- Vestibular Certified Physical Therapist
- Concussion Certified Physical Therapist
- ENT
- Audiologist
- Neuro-ophthalmologist

QUESTIONS?



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Insurance: Private Pay, Medicare, Medicaid

# SOURCES

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