Modern Strategies for Vestibular Assessment + Management in the Clinical Setting

Curtis Wetmore - Aud(C). RCASLPNB (#625)

Hi! I'm Curt

Curtis Wetmore, BSc.HK, MSc.Aud(C)
Registered *Audiologist & Owner, Tidal Hearing + Balance*

- **St. FX - BSc in Human Kinetics** — developed an early interest in human movement, balance, and vestibular disorders.
- **Graduated from Dalhousie University Audiology program in 2015**
- **8 years at Toronto General Hospital Centre for Advanced Hearing and Balance Testing:**
  - Developed expertise in vestibular assessment
  - Worked in a specialized neurotology environment with complex hearing and balance disorders
- **Held Lecturer status with the University of Toronto faculty of Medicine (2019-2022)**
- **Current Dalhousie University adjunct scholar/instructor (2022 - present)**
  - Teach 2nd-year Audiology students vestibular assessment and management
- **Returned home to New Brunswick** and founded **Tidal Hearing + Balance**
  - Independent audiology clinic serving school-aged children through adults
  - Hearing assessments & hearing aids
  - Vestibular assessment & rehabilitation
- Previously worked part-time with **Horizon Health Network** in Sussex NB while establishing my practice
- **Now fully focused on my practice, Tidal Hearing + Balance!**

A professional goal of mine is to make vestibular assessment and rehabilitation more accessible and approachable!

"I'm coming to the cottage"



My best friend Remy

Overview

- Overview of vestibular anatomy & physiology
- Introduction to vestibular pathologies (peripheral and central)

BREAK - lunch

- Quick overview on vestibular assessments (gold standard!)
- Bedside testing / vestibular screening (without equipment!)
    a. Bedside head impulse + oculomotor assessment
    b. Functional balance assessment

BREAK

    a. Positional testing + repositioning
    b. Intro to Vestibular Rehabilitation Therapy (VRT)

BREAK

- Hands-on workshop stations
- Q+A (all things vestibular)

Vestibular Anatomy/Physiology

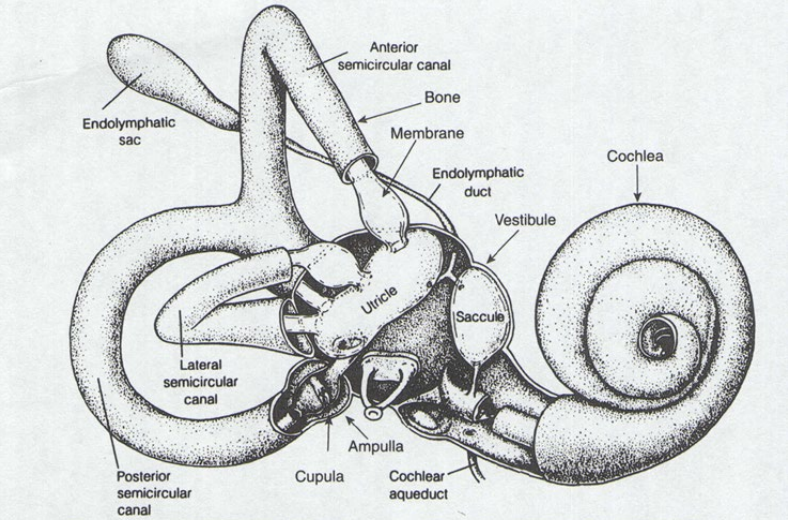


Figure 1.3 The membranous and bony labyrinths. The *inset* illustrates the perilymphatic and endolymphatic fluid compartments. (Adapted from an illustration by Mary Dersch; originally adapted from Pender, 1992.[2])

The ear is more than just hearing!

- Vestibular tests assess:
  - 5 peripheral vestibular end organs bilaterally
    - **Semicircular canals (3)** (angular acceleration)
      - Lateral / horizontal
      - Posterior
      - Anterior
    - **Otolithic organs (2)** (linear acceleration)
      - Saccule
      - Utricle
  - Central vestibular function

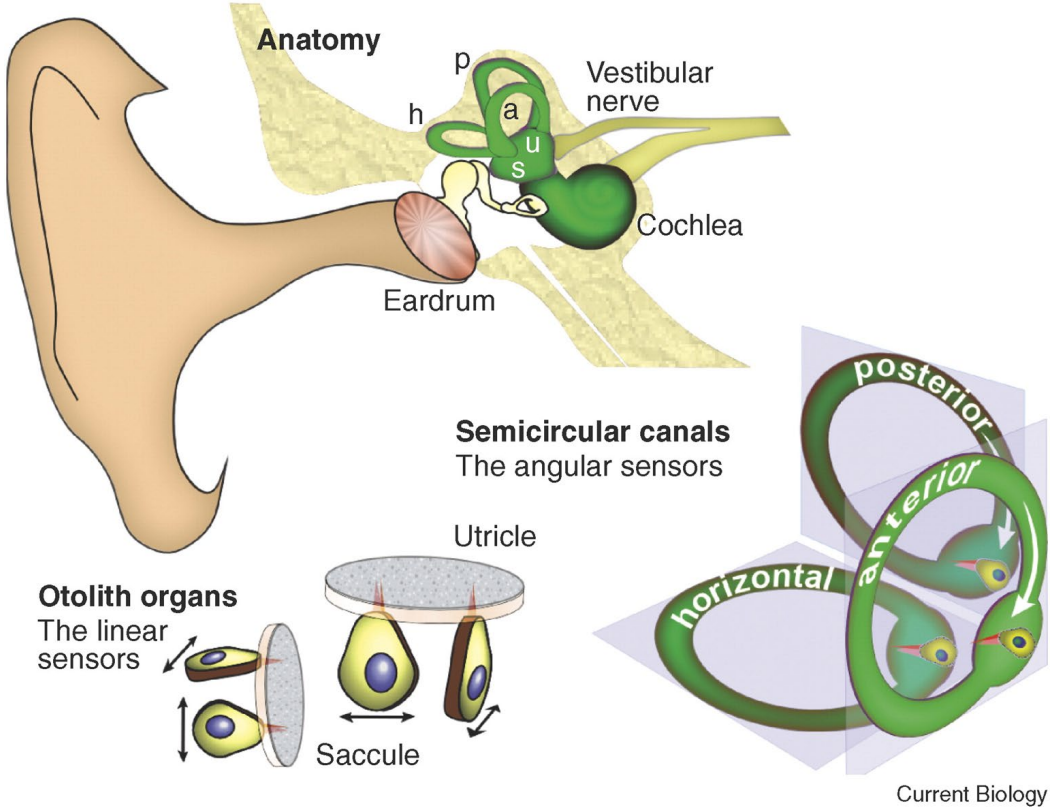
Role of the Vestibular System

- Senses and perceives body movement, direction, & acceleration
- Generates eye movements to promote gaze stabilization
- Maintains postural equilibrium and balance



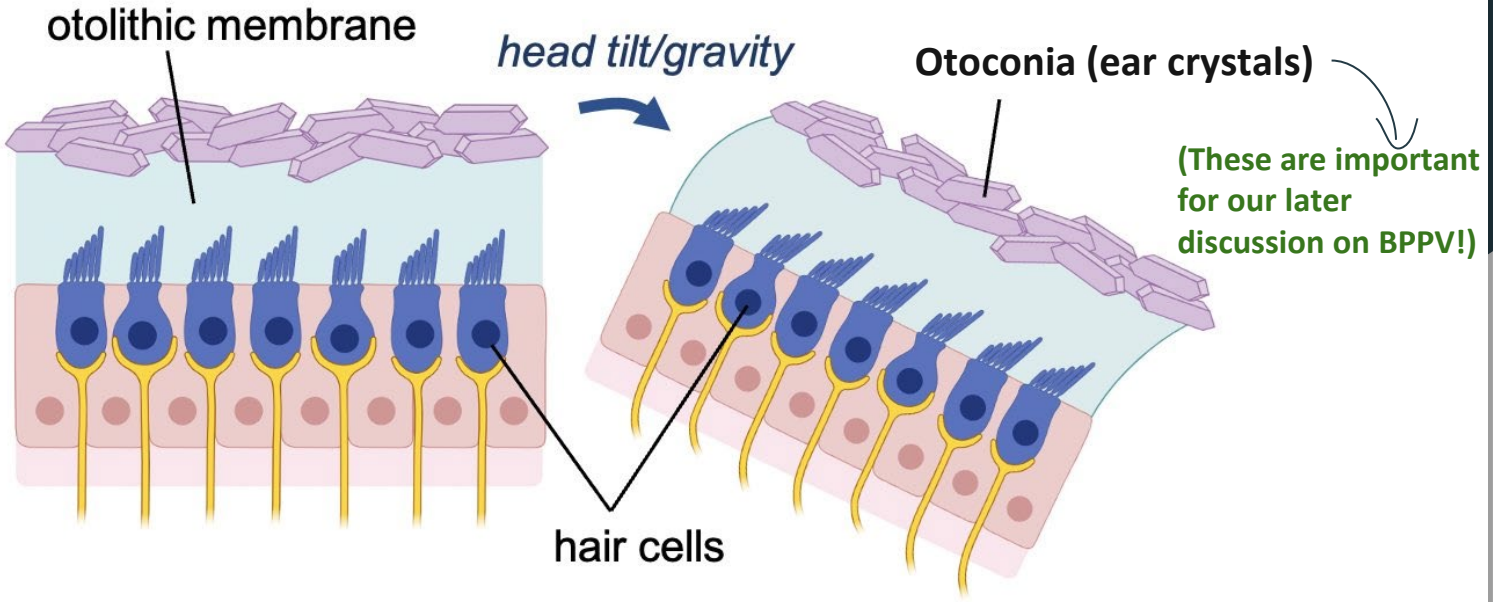
There are 3 main players on the vestibular “team”:

1. Vestibular system
2. Vision
3. Proprioception


Anatomy
p
h
a
u
s
Vestibular nerve
Cochlea
Eardrum
Semicircular canals
The angular sensors
posterior
anterior
horizontal
Utricle
Otolith organs
The linear sensors
Saccule
Current Biology

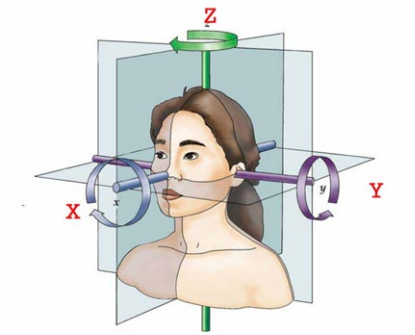
Static System

- The Utricle and Saccule (otoliths) are biological-mechanical sensors that measure the linear acceleration of the head in the plane of the otolith
- The **Utricle** lies mainly **horizontally**
(senses gravity best when we are laying down)
- The **Saccule** lies mainly **vertically**
(senses gravity best when we are upright)



The brain interprets the orientation of the head by comparing the otoliths from both ears to the input from the eyes allowing the brain to discriminate a tilted head from movement of the entire body

Kinetic System



Function:

The semicircular canals respond to perceptions of rotation and angular acceleration of the head

Range:

The head commonly moves 0.5 – 7 Hz

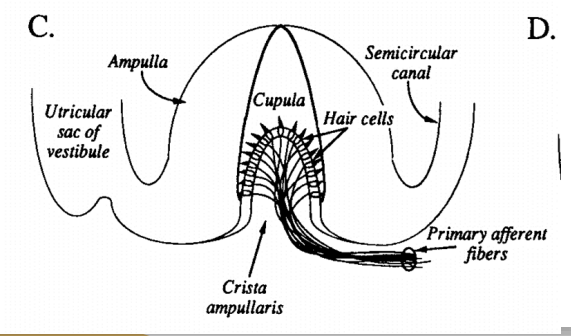
(Head velocities up to 550 degrees/sec)

Orientation:

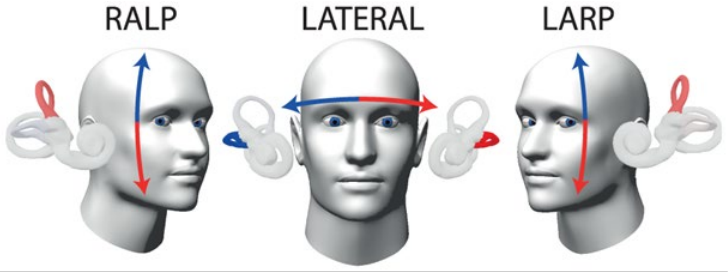
The semicircular canals work as pairs between ears

Semicircular Canals

- A semicircular canal is a continuous ring of endolymph
- Each canal enlarges at the utricular end to form the ampulla which houses the cupula
- The cupula separates the endolymph by forming a tight seal with the superior aspect of the ampulla
- Senses angular acceleration (change in velocity) through deflection of the cupula



Semicircular Canals Pairs



1: The Right and Left Horizontal Canals
(leftward and rightward accelerations of the head)

2: The Right Anterior and Left Posterior Canals (RALP)
(head turned left with forward [RA] and backward [LP] accelerations)

3: The Left Anterior and Right Posterior Canals (LARP)
(head turned right with forward [LA] and backward [RP] accelerations)

The Vestibular System

Peripheral: Motion sensors that send info to the CNS about head angular velocity and linear acceleration

Central: Vestibular nucleus/cerebellum process these signals and combines them with other sensory information to estimate head and body orientation

Motor Output: The output of the central vestibular system goes to the ocular muscles and spinal cord to serve three important reflexes to keep us upright and not feeling dizzy:

- **VOR** – Vestibulo-ocular reflex (vHIT, VNG, Rotary Chair, oVEMP)
- **VSR** – Vestibulospinal reflex (Posturography)
- **VCR** – Vestibulocollic reflex (cVEMP)

Vestibular Reflexes & corresponding Vestibular Tests

VOR: Generates eye movements that enable clear vision while the head is in motion

- VNG calorics
- oVEMPs
- vHIT
- Rotary Chair

VSR: Generates compensatory body movements in order to maintain head and postural stability and prevent falls

- Posturography

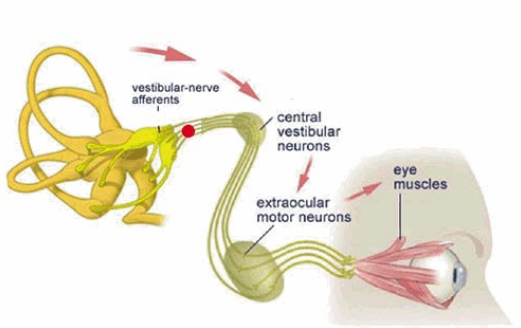
VCR: Acts on the neck musculature to stabilize the head

- cVEMPs

Vestibular Reflexes (VOR,VSR,VCR)

Vestibulo-ocular Reflex: VOR

- Responsible for gaze stability during head motion
- Rotation of head to the left results in rightward compensatory eye motion

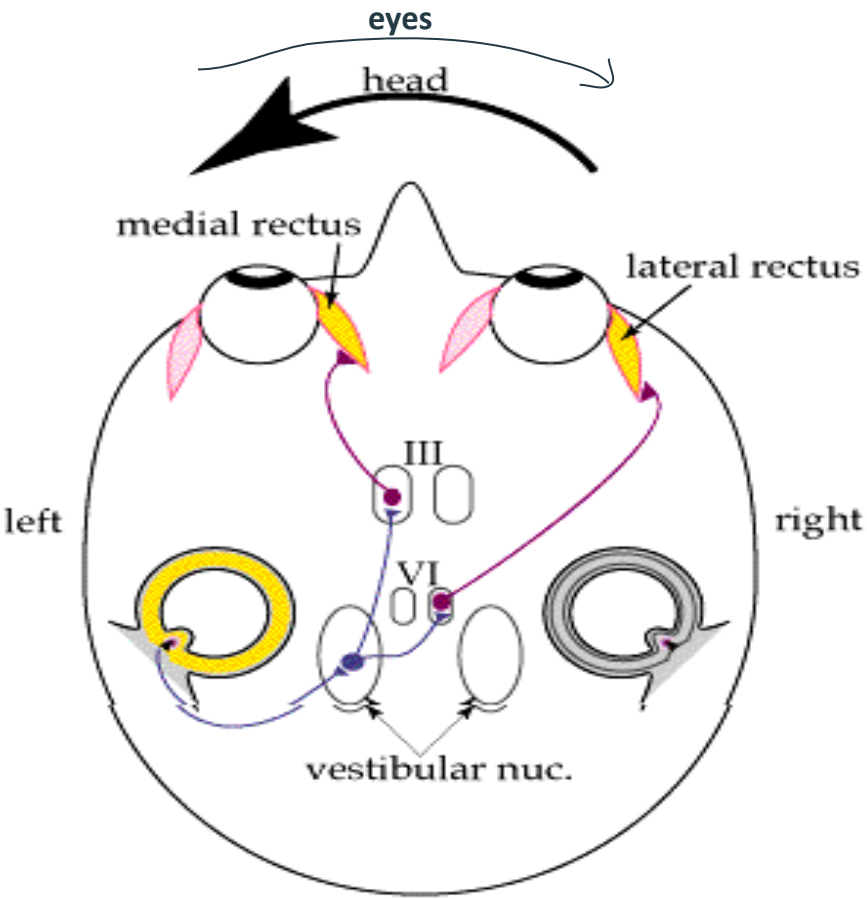


Output neurons of the VOR:

- Motor neurons of the ocular motor nuclei drive the extraocular muscles

Extraocular Muscles:

- Arranged in pairs
- Oriented in planes very close to those of the canals
- Enables a single pair of canals to be connected predominantly to a single pair of extraocular muscles
- Results in conjugate movements of the eyes in the same plane as head motion
- Equal and Opposite

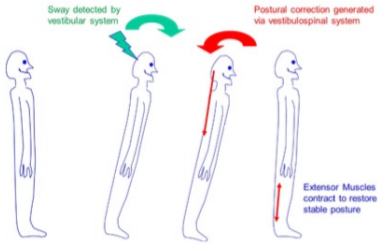

eyes
head
medial rectus
lateral rectus
III
left
right
VI
vestibular nuc.

Vestibulo-ocular Reflex (VOR)

- The function of VOR is to keep image stable on retina during head movement by producing an equal and opposite eye movement
  - When VOR function is reduced: the eye movements will come up short and need to correct themselves to stay on the target. Functionally, this means the patient will have blurred vision and feel like their eyes are lagging which results in dizziness, disorientation, and unsteadiness

Vestibular Reflexes (VOR,VSR,VCR)

Goal of vestibulospinal reflex : to maintain vertical alignment of the trunk.
When the head tips in one direction, the body elongates to that side and shortens on the other



What happens:

- Endolymphatic flow deflects the cupula and shear force deflects hair cells within the otoliths
- The vestibular nerve and vestibular nucleus are activated
- Impulses are transmitted to the spinal cord
- Extensor activity is induced on the side to which the head is inclined, and flexor activity is induced on the opposite side

Vestibular Reflexes (VOR,VSR,VCR)

Vestibulocollic response : VCR

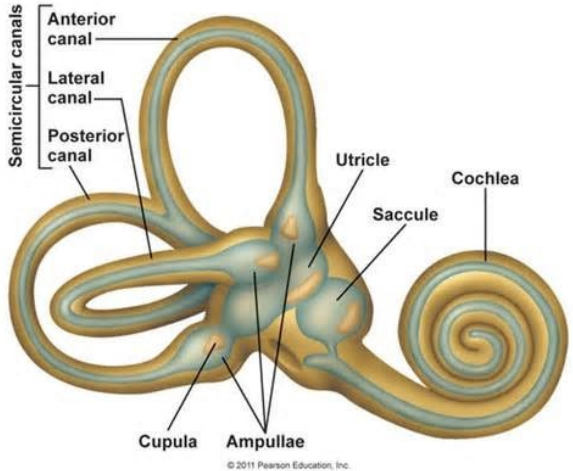
- Plays an important role in stabilizing vision by compensating for head movements when the body is in motion
- The VCR produces contractions of the neck muscles which minimizes bobbing of the head caused by vibrations transmitted from the heels as they strike the ground during walking and running



During walking:

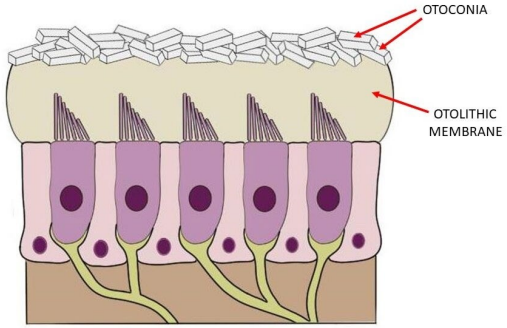
- Vestibular signals caused by linear translations stimulate nerve receptors of the saccule
- In response, the saccule transmits afferent signals to the vestibular nuclear complex in the brainstem
- From the vestibular nucleus, signals are sent to the neck muscles to contract in a direction that counteracts the head movement.

Peripheral Vestibular Disorders



Benign Paroxysmal Positional Vertigo (BPPV)

- Displaced otoconia end up in a semicircular canal which causes a change in mass in endolymph, confusing the ampullae (as if the head is moving more than it actually is)
- Otoconia can become displaced by: trauma, chemical, hormones, age, utricular dysfunction, etc.
- Results in acute attacks of vertigo lasting seconds to minutes, typically when lying down or rolling over or looking up
- BPPV is the most common vestibular disorder in adults (Bhattacharyya et al., 2008)



Benign Paroxysmal Positional Vertigo (BPPV)

Benign – not life threatening or progressive
Paroxysmal – occurs suddenly
Positional – change in head position
Vertigo – abnormal sensation of motion

Benign Paroxysmal Positional Vertigo (BPPV)

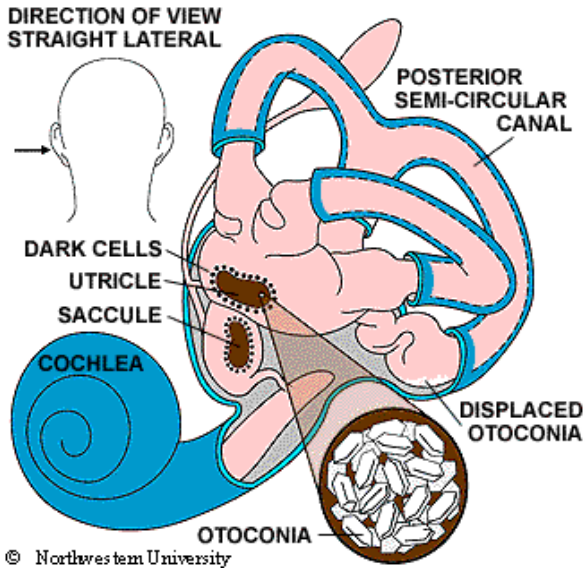
Symptoms brought on by head movements:

- Looking up
- Rolling over
- Getting out of bed

Symptoms include:

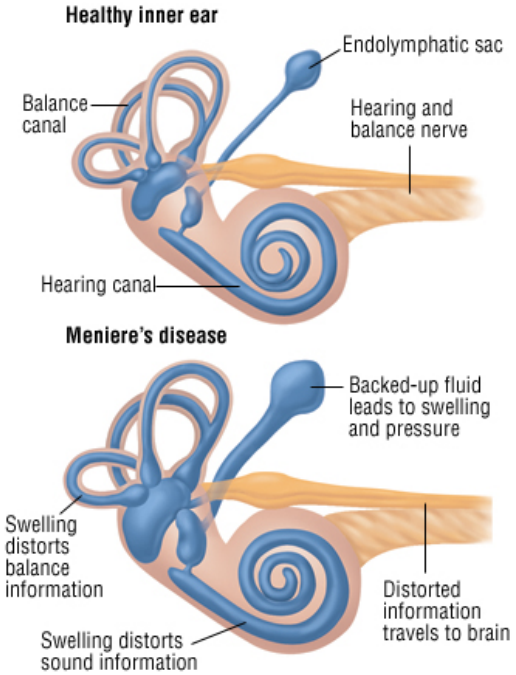
- Vertigo (lasting seconds - minutes only)
- Imbalance
- Nausea

Easily treated with repositioning maneuvers that aim to get the otoconia back to the otolithic membrane!



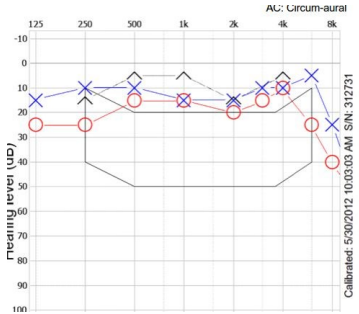
Meniere's Disease (MD) / Endolymphatic Hydrops

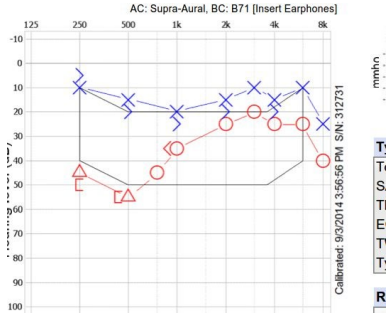
- Due to excessive endolymph, causing swelling of the endolymphatic portion of the inner ear (scala media)
- Results in acute episodic attacks of vertigo lasting hours
- Associated with tinnitus (roaring), aural fullness, and low frequency hearing loss (fluctuating)
- Typically gets progressively worse (balance and hearing) until ablated



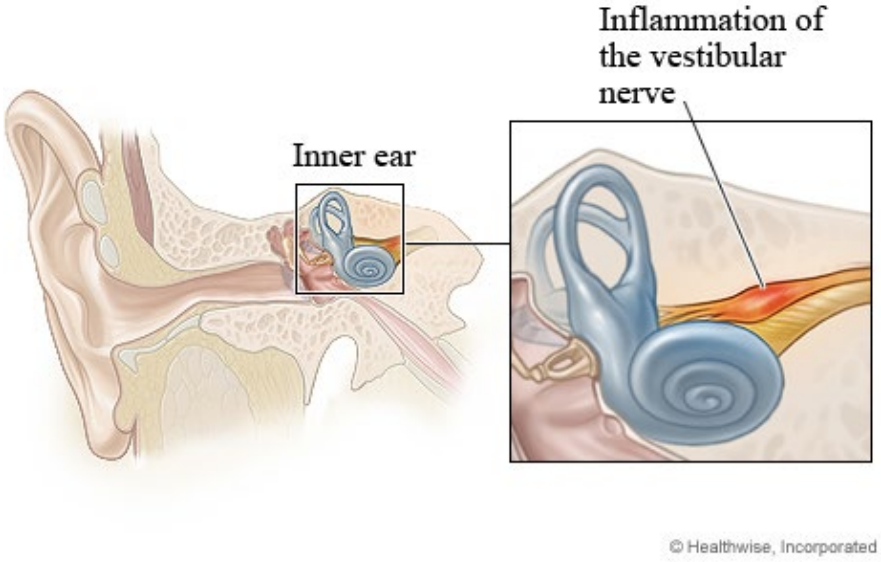
Endolymphatic Hydrops: Why the Fluctuating/hearing loss?

- Leads to rupture of the labyrinthine membrane and exposure of the hair cells to perilymph
- Mixing of inner ear fluids has a toxic effect on the hair cells and causes them to briefly become hyperactive followed by a much longer period of deactivation
- Once the rupture closes and the perilymph is flushed out of the labyrinthine space, most but not all of the hair cells regain function
- With each episode, more and more hair cells may fail to regain normal function





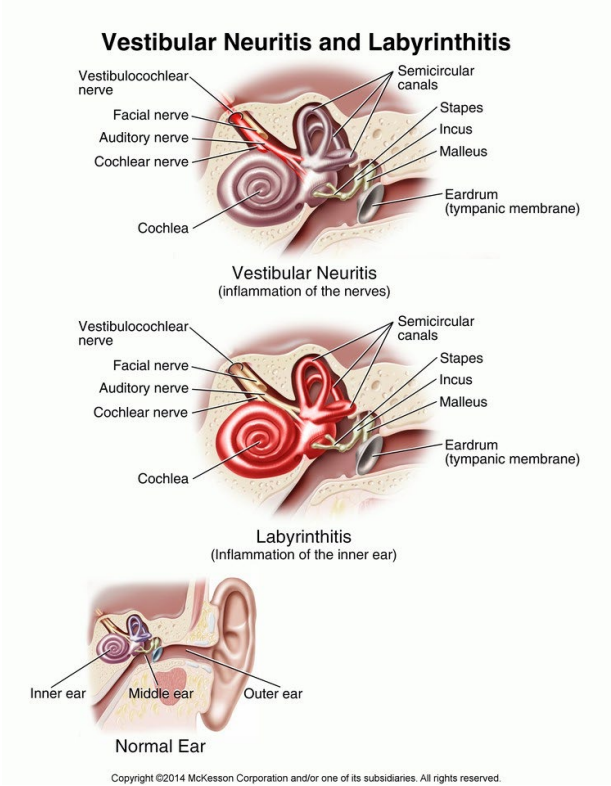
Vestibular Neuritis



- Generally understood to be a viral or post viral inflammatory disorder affecting the vestibular portion of the CN VIII
- Sudden onset of disabling vertigo <u>lasting 24 hours to multiple days</u> often associated with nausea and vomiting *without auditory symptoms*
- Vertigo as a result of the imbalance of vestibular afferent firing between L & R
- <u>Not associated with hearing loss</u>

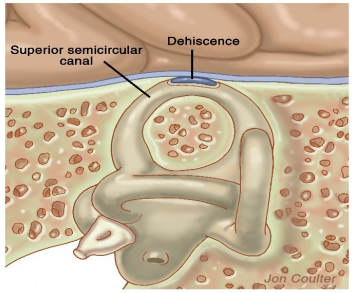
Labyrinthitis

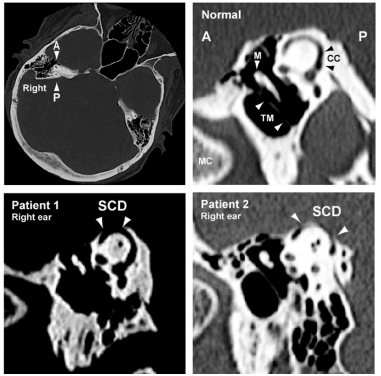
- Affects entire labyrinth (balance & hearing)
- Caused by an inflammation of the inner ear
- Sudden onset of disabling vertigo lasting 24 hours to multiple days often associated with nausea and vomiting
- Associated with sudden sensorineural hearing loss (ideal to be treated by ENT within 10 days)



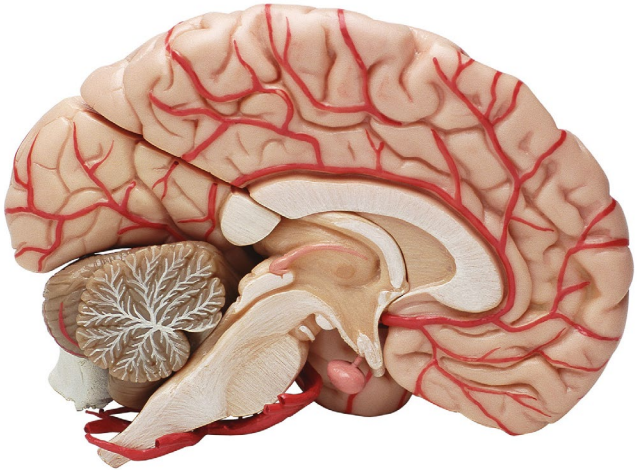
Superior Semicircular Canal Dehiscence (SSCD)

- Thinning of a portion of bony labyrinth causes a "3rd window" effect
- Caused by; trauma, congenital, deterioration, infectious processes
- Resulting vertigo typically lasts for seconds to minutes, can occur with loud sound and/or pressure changes (straining)
- Associated with low-Hz conductive hearing loss with normal immittance testing
- Autophony & aural fullness

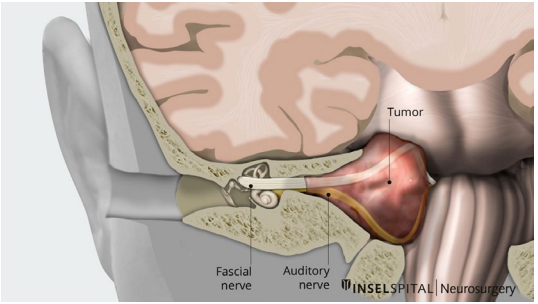




Central Vestibular Disorders



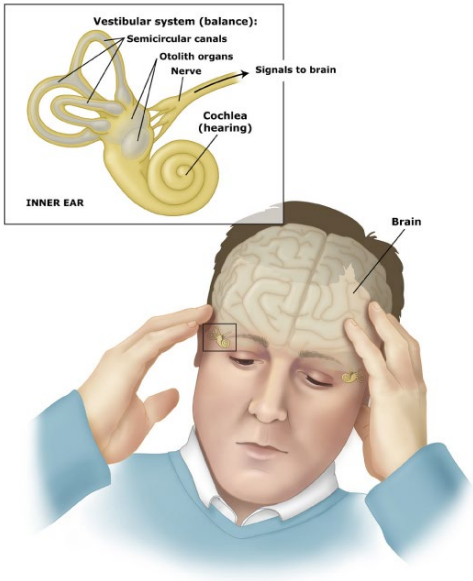
Vestibular Schwannoma



- Sometime referred to as an Acoustic Neuroma (but depends on which part of CN VIII is affected)
- Benign growth
- often associated with a slow decline in hearing and vestibular function as the nerve becomes compromised with tumour growth
- Symptoms often include:
  - Gradual hearing loss (unilateral mostly, bilateral with NF2 patients)
  - Tinnitus
  - Imbalance and unsteadiness BUT rarely vertigo (due to slow growth and ability for the system to compensate as progression occurs)

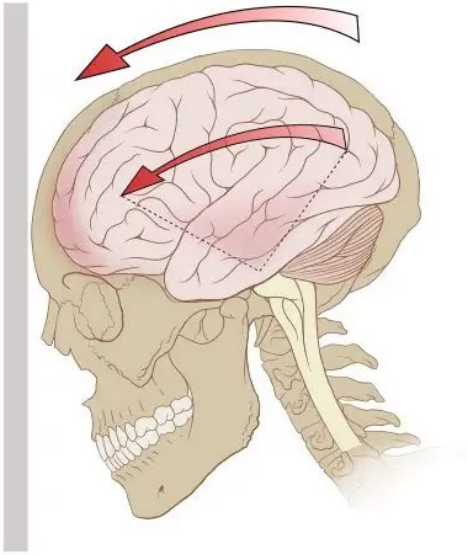
Vestibular Migraine

- Vestibular migraine is a common cause of dizziness and vertigo, with episodes typically lasting 5 minutes to 72 hours.
- Headache may be absent during an attack; patients may instead report light/sound sensitivity, visual symptoms, nausea, or motion sensitivity. (Lempert & von Brevern, 2019)
- Vestibular migraine is seen in approximately 11% of patients in specialized dizziness/vestibular clinics. (Bárány Society/IHS, 2022)



Traumatic Brain Injury

- A TBI is caused by a bump, blow, or jolt to the head or a penetrating head injury that disrupts the normal function of the brain
- The severity of a TBI may range from mild to severe
- The pathophysiology of traumatic dizziness and vertigo from a head injury includes damage to the central nervous system, vestibular labyrinth (labyrinthine concussion), the neck, or some combination
- Dizziness and balance problems are very common after concussion, with dizziness reported in roughly 30–80% of people following mild traumatic brain injury. *(Bölükbaş et al., 2026; Gianoli, 2022)*



Mal De Débarquement



- Mal de debarquement means ‘sickness of disembarkment.’
- Although this term originally referred to the illusion of movement felt as an after effect of travel on water by ship or boat, some experts now include other types of travel (such as by airplane, automobile, and train).
- Most individuals experience this illusion of movement almost immediately after the cessation of the precipitating event, and the sensation usually resolves within 24 hours.
- This sensation is very common, and approximately 75% of all professional sailors experience it.
- Persistent mal de debarquement has been defined as that which lasts longer than one month.
- The most common symptoms associated with mal de debarquement are rocking, swaying, and disequilibrium. **Although this disorder may be accompanied by anxiety and depression, it is seldom accompanied by a true spinning vertigo.**
- A hallmark of persistent MDD is that symptoms subside when the patient is in motion

Persistent Postural Perceptual Dizziness (PPPD)

The primary symptoms of PPPD are persistent sensations of rocking or swaying unsteadiness and/or dizziness without vertigo lasting 3 months or more (Baranay Society, 2017)

- Symptoms are present on more days than not (at least 15 of every 30 days); most patients have daily symptoms.
- Symptoms are typically worse with:
  - Upright posture (standing or sitting upright)
  - Head or body movement
  - Exposure to complex or motion-rich environments

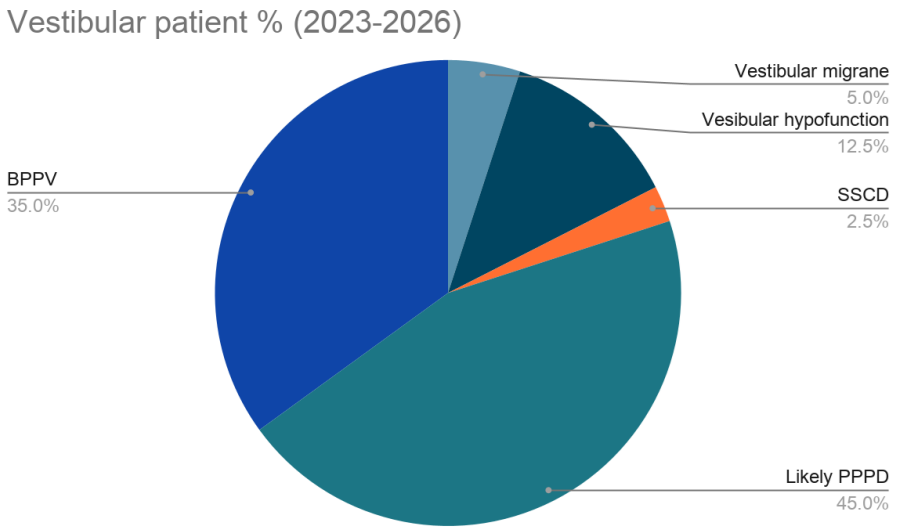
PPPD typically starts shortly after an event that causes acute vertigo, unsteadiness, dizziness, or disruption of balance such as:

- A peripheral or central vestibular disorder (e.g., BPPV, Vestibular migraine, concussion, etc.)

**often associated with ++ anxiety

Who presents most often in a vestibular clinic?

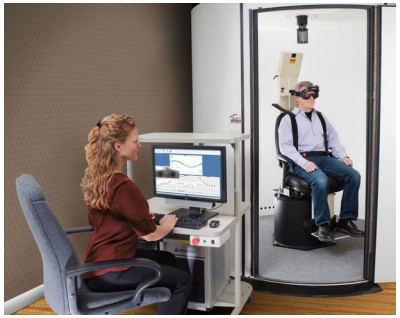
In my private practice in New Brunswick, here is the *approximate* breakdown of my vestibular patients (some of this data is updated following a report back from ENT!):

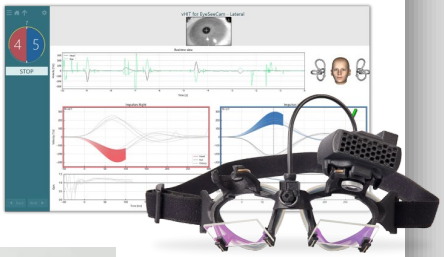


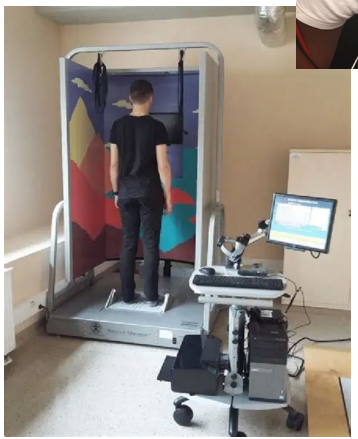
BREAK!

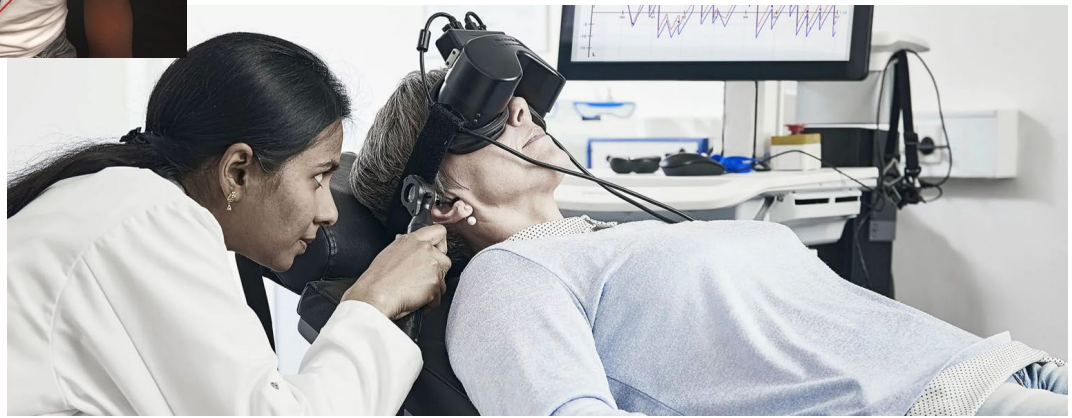
Intro/recap on vestibular assessment with equipment









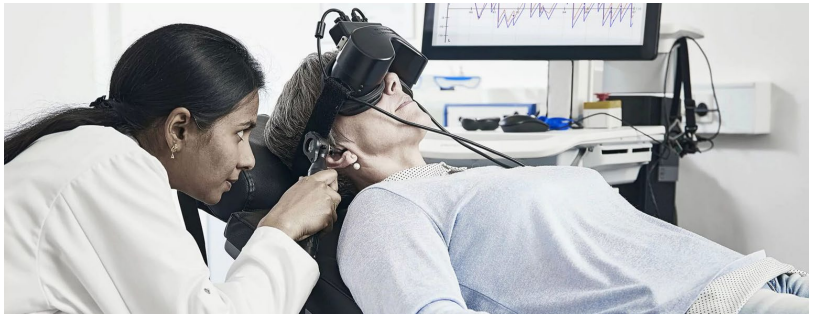


Videonystagmography (VNG)

What is it looking for?
Measures eye movements/nystagmus to assess vestibular function as well as central oculomotor pathways. Calorics assess each ear independently at low-frequency stimulation.

Equipment

- Infrared video goggles/camera
- Visual stimulus/bar or screen
- Air or water caloric irrigator



Helpful for identifying:

- Unilateral peripheral vestibular weakness
- BPPV
- Vestibular neuritis
- Ménière's disease
- Central oculomotor abnormalities

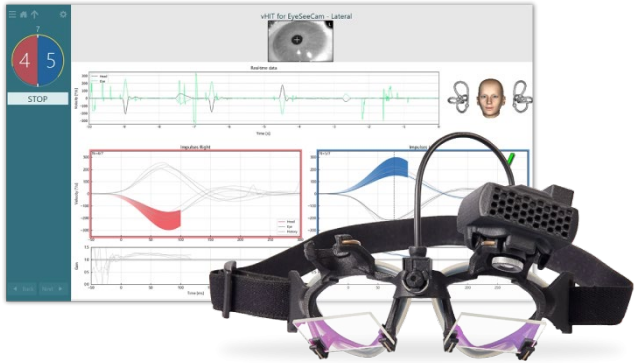
Key point:
VNG = central assessment + positional testing + calorics. VNG is especially useful for identifying unilateral vestibular asymmetry.

Video Head Impulse Test (vHIT)

What is it looking for?
Measures the vestibulo-ocular reflex (VOR) during rapid head movements and assesses the function of all 6 semicircular canals.

Equipment

- Lightweight video goggles
- High-speed infrared camera
- Head-motion sensors
- Visual fixation target



Helpful for identifying:

- Unilateral vestibular hypofunction
- Bilateral vestibular hypofunction
- Vestibular neuritis
- Semicircular canal dysfunction
- Vestibular loss following ototoxic exposure

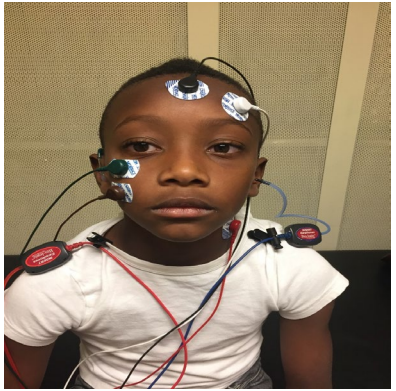
Key point:
vHIT = high-frequency semicircular canal function (in all 6 canals)

Vestibular Evoked Myogenic Potentials (VEMP)

VEMP — Vestibular Evoked Myogenic Potentials

What is it looking for?
Assesses otolith function using sound or vibration evoked muscle responses (SCM in the neck ipsilaterally and the inferior oblique muscle below the contralateral eye).

- cVEMP assesses saccule / inferior vestibular nerve
- oVEMP assesses utricle / superior vestibular nerve



Equipment

- Insert earphones/headphones
- Surface electrodes
- EMG recording system
- Audiologic/vestibular stimulus generator

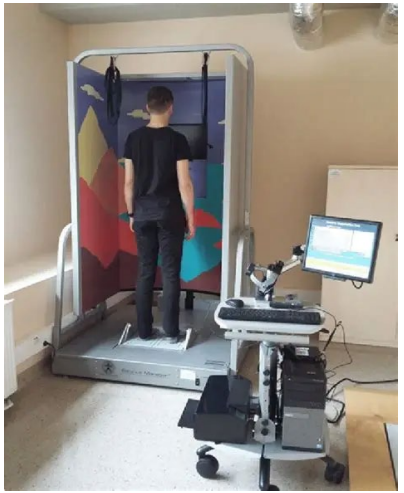
Helpful for identifying:

- Superior semicircular canal dehiscence (SSCD)
- Selected otolith (saccule & utricle)/vestibular nerve abnormalities

Key point:
VEMP = otolith function (saccule + utricle) as well as both superior and inferior vestibular nerve branches. Particularly useful in identifying SSCD.

Posturography

What is it looking for?
Measures functional balance control and how well the patient uses and integrates visual, vestibular, and somatosensory information.



Equipment

- Force platform
- Moving/sway-referenced support surface
- Visual surround
- Computerized analysis system

Helpful for identifying:

- Functional balance impairment
- Difficulty using vestibular information
- Bilateral vestibular loss
- Sensory integration deficits
- Fall-risk and balance-control problems

Key point:
Posturography = How does the patient use their sensory systems to maintain balance?

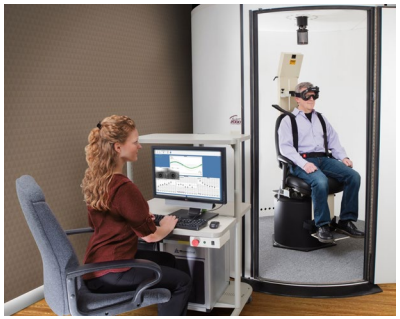
Posturography is functional rather than a lesion-localization test.

Rotary Chair

What is it looking for?
Measures the VOR during controlled whole-body rotation across a range of frequencies. Both ears are stimulated simultaneously

Equipment

- Motorized rotary chair
- Visual/optokinetic stimulus system
- Infrared video goggles or eye-movement recording system
- Computerized analysis



Helpful for identifying:

- Bilateral vestibular hypofunction
- Residual vestibular function
- Vestibular compensation

Key point:
Rotary chair = good at identifying bilateral VOR loss

I want to take a moment to say that I have the utmost respect for vestibular assessment/labs and that these tests and interpretations are the gold standard for fully assessing the vestibular system!

That being said:

The reality is:

- Vestibular complaints are common. Dizziness and imbalance are frequent reasons for seeking healthcare.
- There are not enough vestibular specialists to assess every patient with vestibular symptoms.
- Vestibular equipment is VERY expensive and not available in every clinic.
- Many patients can be screened effectively using a focused history and bedside examination.

What Screening Can Tell You

- Oculomotor & eye movement assessment
- VOR function abnormalities
- BPPV / positional vertigo
- Balance function
- Which patients need further vestibular testing or a referral!

Bottom Line

You don't need a vestibular lab to recognize a vestibular problem.

A structured bedside screen can help identify, triage and appropriately refer patients making specialized vestibular services more accessible to those who need them most!

Where do we start?

Case History! Important for figuring out what is going on.

1. **What does the dizziness feel like?** (Spinning/vertigo, lightheadedness, rocking/swaying, imbalance)
2. **When did it start, and how did it begin?** Sudden vs. gradual; first episode; constant vs. episodic; any precipitating event (infection, head injury, surgery, travel, etc.).
3. **How long does each episode last, and how often?** (Seconds, minutes, hours, days, or continuous symptoms?)
4. **What brings it on or makes it worse?** Head position/movement, rolling in bed, standing up, walking, busy visual environments, exertion, sound/pressure, stress)
5. **Are there any associated symptoms?** (Hearing loss, tinnitus, aural fullness, headache/migraine symptoms, nausea, visual symptoms, falls)



Van de Berg, R., & Kingma, H. (2021) ; Tarnutzer, A. A., et al. (2025)

bedside head impulse testing

How to perform:

1. Have the patient fixate on your nose.
2. Hold the patient's head firmly at the sides.
3. Deliver small, rapid, unpredictable head rotations (~10–20°) to one side.
4. Observe the patient's eyes during and immediately after the impulse.

Interpretation:

- **Normal:** Eyes remain fixed on the target = VOR intact
- **Abnormal:** Eyes move with the head and then make a corrective saccade back to the target. This suggests impaired VOR on the side of the head turn.

Halmagyi, G. M., & Curthoys, I. S. (1988) ; Jorns-Häderli et al., 2007

Think back to vHIT!

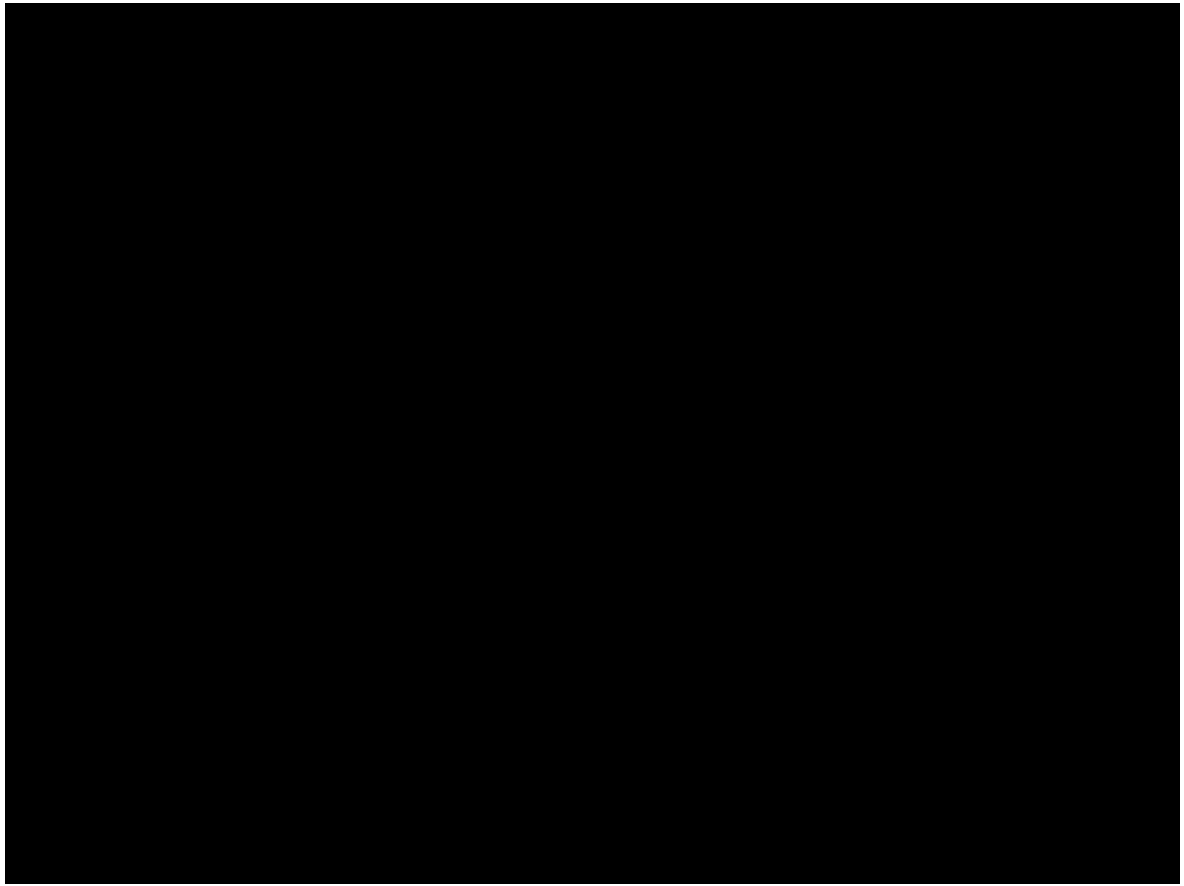
Equal and Opposite. Your patient should be able to maintain their gaze on you while you move their head

But instead of vHIT goggles, you observe the patient's eyes

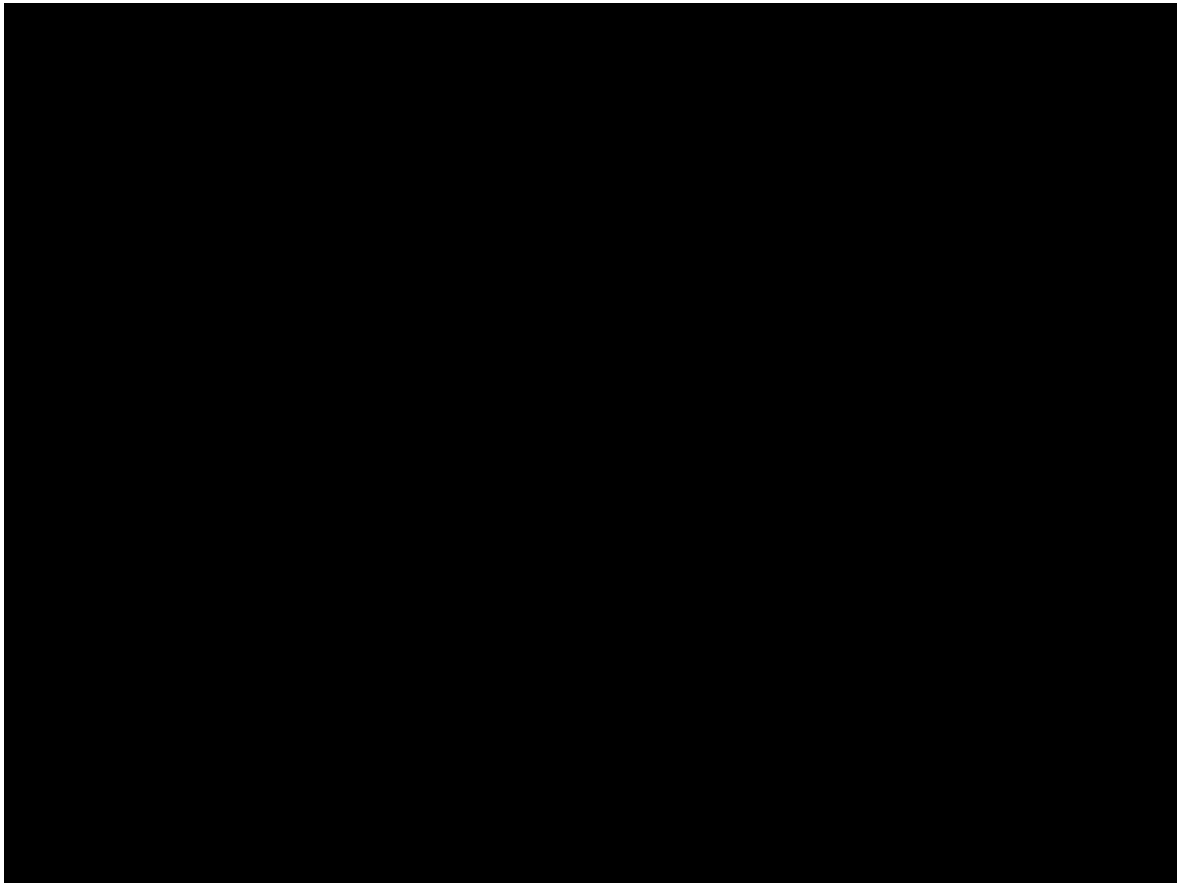
OR use a smartphone to record video



Abnormal VOR (bedside head impulse)



Abnormal left VOR (bedside head impulse)



Quick patient history:

- Had previous VNG - results normal!
- Had previous VEMP - results normal
- Has seen physio and was given vestibular rehab 3 years ago but did not do exercises regularly
- Fell last year and broke her elbow
- Currently unsure why she can't balance, especially when it is dark at night.
- Also has a mild sloping to severe SNHL bilaterally and does not wear hearing aids.



Bedside Oculomotor tests

1. Smooth Pursuit

- Ask patient to follow your finger/target without moving their head
- Move target slowly in an **H-pattern** or horizontal/vertical directions
- Watch for catch-up saccades, asymmetry, or inability to maintain fixation

Tarnutzer, A. A., & Dieterich, M. (2019)

Saccadic smooth pursuit (post head injury)



Bedside Oculomotor tests

2. Saccades

- Ask patient to rapidly look between two targets (e.g., your nose and your finger)
- Test horizontal and vertical saccades
- Observe for overshoot, undershoot, slowed movements, or general struggle/inaccuracy.

Bedside Oculomotor tests

3. Gaze-Evoked Nystagmus

- Ask patient to look 20–30° to the right, left, up, and down
- Hold each position for several seconds
- Look for direction-changing or sustained nystagmus in these gaze positions

Functional balance tests:

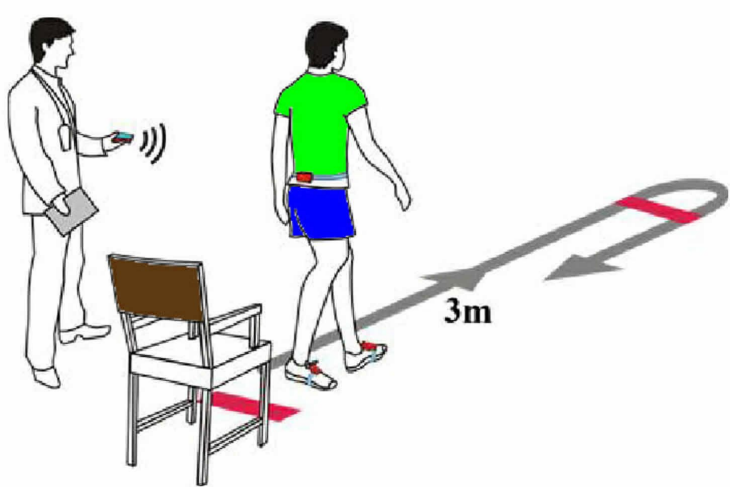
1. Timed Up and Go test
2. Functional Reach test
3. mCTSIB



1. Timed Up and Go (TUG) Test

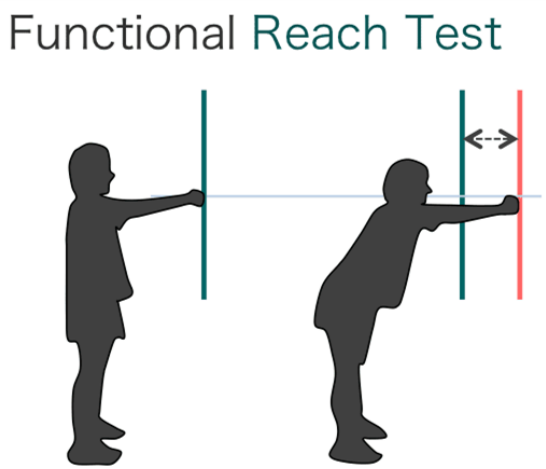
1. Rise from a chair (with armrests)
2. Walk 3 meters
3. Turn around and walk back
4. Sit back down in the chair

An able-bodied individual should be able to do this task in under **13.5 seconds**



* Older adults who take longer than 13.5 seconds to complete this task are considered at risk of falling (90% prediction rate) Shumway-Cook et al, Phys Ther, 2000

2. Functional Reach Test



- In standing, measure the distance of a patient's outstretched arm
- Then, measure distance of outstretched arm in a maximal forward reach, while maintaining a fixed base of support

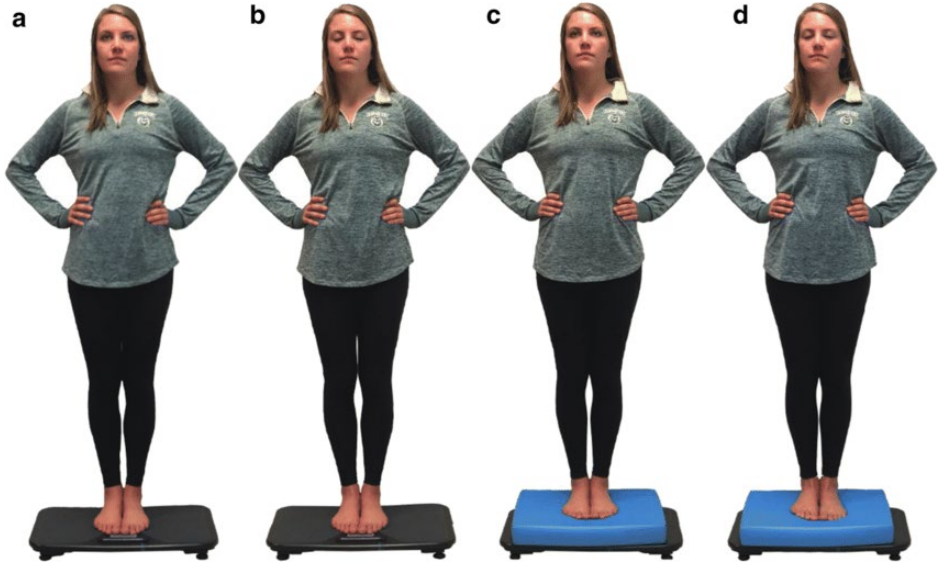
Difference between measurements:

1. 10" or greater = low risk of falls
2. 6" - 10" = risk of falling 2x greater than normal
3. 6" or less = Significant risk of falling (4X greater than normal)
4. Unwilling to attempt = risk of falling is 8x greater than normal

(Duncan et al., 1990)

3. mCTSIB

Modified Clinical Test of Sensory Interaction on Balance



a. Eyes open standing on a firm surface
b. Eyes closed standing on a firm surface
c. Eyes open standing on foam
d. Eyes closed standing on foam

- A more advanced test.
- Failure to maintain balance on condition “d” indicates a vestibular disorder.
- Failure to maintain balance in any 4 of these conditions indicates a risk of falling

*Hint: If you don’t have access to “foam”, you can get the patient to stand in tandem (one foot in front of the other)

Antoniadou et al., 2020 ; Cohen et al., 1993

*Pediatrics

1) Review motor milestones
2) Quick balance assessment

1.

Milestone	
Response to tilt	should right within seconds
Head control	4 months
Sitting Unassisted	9 months
Walking	18 months

2.

Standing on one-foot test	
3 years	2 seconds eyes open
4 years	5 seconds eyes open
5 years	8 seconds eyes open

McCaslin DL. Pediatric vestibular disorders and the role of the audiologist. AudiologyOnline 2016; article 17145.



***An abnormal finding during at least one of these 2 steps for a child with any degree of SNHL should indicate a referral to an ENT/vestibular audiologist for a vestibular evaluation.**

Break!

BPPV

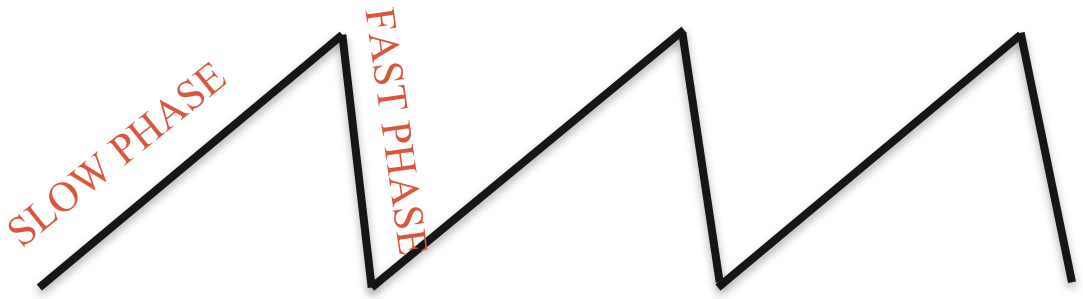
Benign – not life threatening or progressive
Paroxysmal – sudden onset, brief duration
Positional – caused by change in head position
Vertigo – sensation of movement in the absence of true movement

BPPV

- Displaced otoconia (“ear crystals”) in the semicircular canal (SCC) causes a change in mass of endolymph, which confuses the ampullae.
  - Otoconia are 1-30μm - Almost 3x heavier than endolymph - (Kao, Parnes, & Chole, 2018)
- Otoconia can become displaced by: trauma, chemicals, hormones, age, utricular dysfunction & structural variants
- Results in acute attacks of rotational vertigo lasting **seconds to minutes only**, typically when lying down, looking up, or rolling over
  - This can be identified by observing for nystagmus
- Most common vestibular disorder in adults (Wang, Chan, Liu, 2019)
  - Posterior Canal BPPV (most common), lateral canal BPPV (2nd most common), Anterior canal BPPV (least common)

A brief intro to the concept of nystagmus:

- Involuntary eye movements.
- Can be congenital, acquired, or provoked (ex: provoked by Calorics, **Dix Hallpike, Horizontal roll test**, hyperventilation etc.)
- Usually fast phase and slow phase (“jerk”)

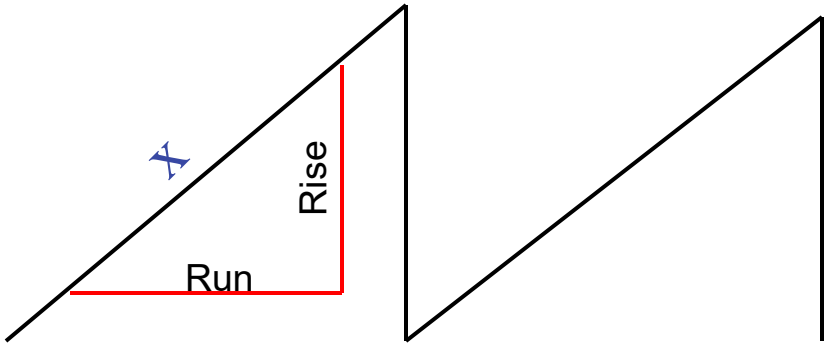


Nystagmus


The Different
Types of
Nystagmus
Christopher Chang, MD
Faugère ENT Consultants

How to interpret nystagmus with equipment

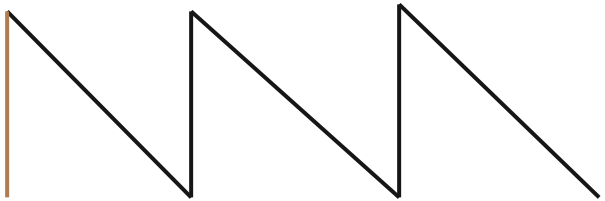
- Graph of Distance (°) x Time (s)
- Velocity is slope (v=d/t)
- Slow phase velocity (SPV) in x°/s



Note: Without specialized equipment, we cannot *quantify* nystagmus (ex: velocity or precise eye movement characteristics), **but we can *identify* and *characterize its presence and direction* through bedside observation**

Nystagmus - basic terminology

- Upbeating Nystagmus (UBN), Downbeating Nystagmus (DNB, Right beating Nystagmus (RBN), Left beating Nystagmus (LBN)
- Rotary or torsional - may be described at clockwise (CW) or counterclockwise (CCW). More important for posterior/anterior canal BPPV
- Geotropic (towards the earth) or Ageotropic (away from the earth). **Very important for lateral canal BPPV



BPPV

In order to correctly perform a repositioning maneuver for BPPV treatment, you need to know **3 main things**:

1. Which ear is affected
2. Determine which canal is involved
3. Know the mechanism (canalithiasis vs. cupuloithiasis)
    a. Geotropic vs. Ageotropic if lateral canal (more to come on this)

Patient education is critical!

- Both prior to assessment and treatment
  - To inform about provocation of symptoms, to give a brief explanation of BPPV, and to emphasize success rates of treatment (more on next slide)
  - Remember: most patients are worried about provocation of symptoms; however, they are more afraid about it not being taken care of

** It should also be noted that lateral canal BPPV (and repositioning) can result in patients feeling very nauseous.

Clinical tip: Have a bucket close by! 😬😵

BPPV repositioning maneuver success rates

(Wang, Chan, Liu, 2019)

Posterior canal BPPV: 78% after first attempt, 96% after repeated treatments

Lateral canal BPPV: 79 - 94% after first attempt (ageotropic vs geotropic), 100% after repeated treatments for both!

Dix Hallpike - How To

Purpose: Primarily used to assess for posterior canal BPPV

RIGHT Dix–Hallpike

- Patient starts seated upright
- Turn head 45° to the right
- Bring patient supine
- Extend the neck approximately 20° so the head is slightly below the level of the body
- Keep the patient's eyes open and observe for nystagmus
- Ask about vertigo and observe the eyes for 30–60 seconds
- Slowly return the patient to sitting and observe for reversal of nystagmus

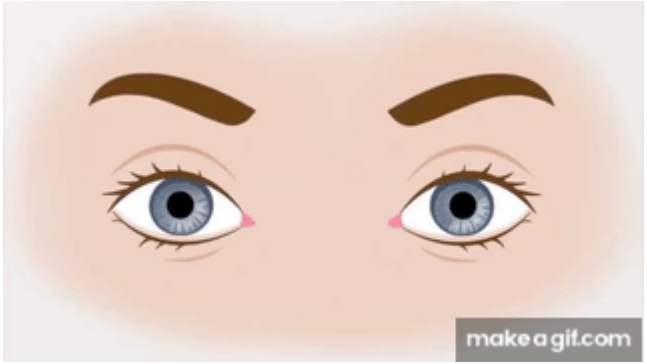
Repeat with the LEFT ear down if the right side is negative.

Tip: Support the patient's head throughout the maneuver as this will make them feel more comfortable

Bhattacharyya, N., et al. (2017)

What are we looking for?!

Posterior Canal BPPV = **Upbeat + Torsional Nystagmus**

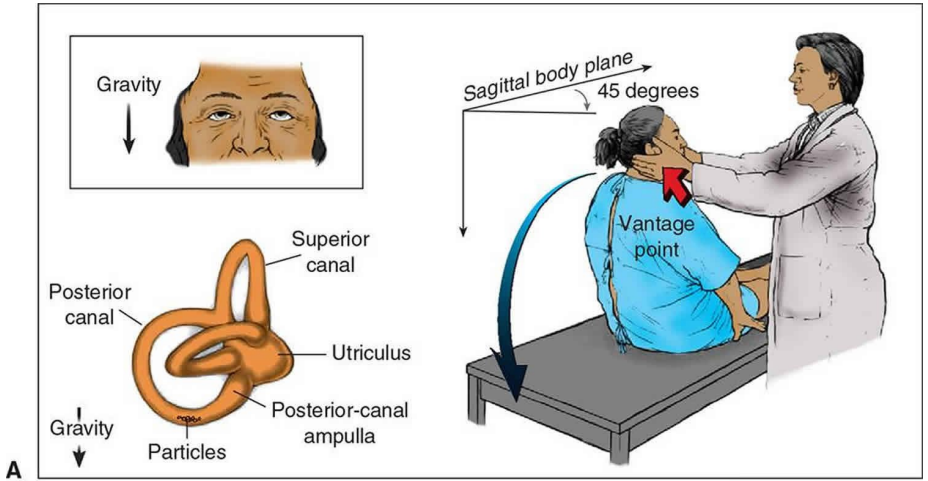


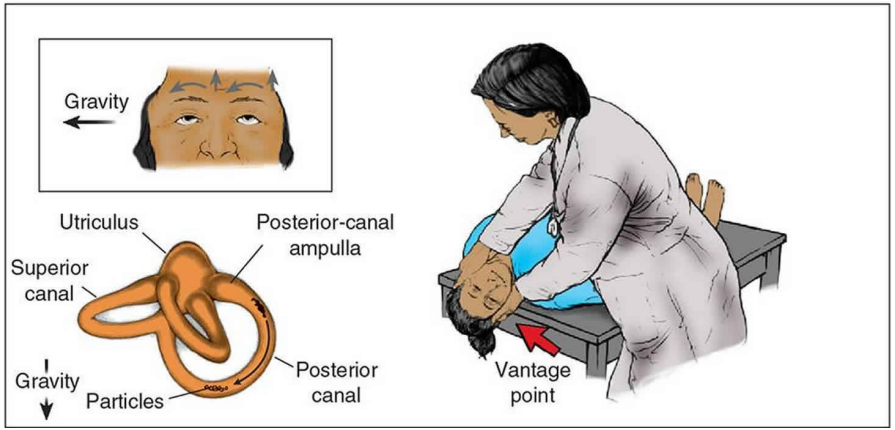
Typical positive Dix–Hallpike:

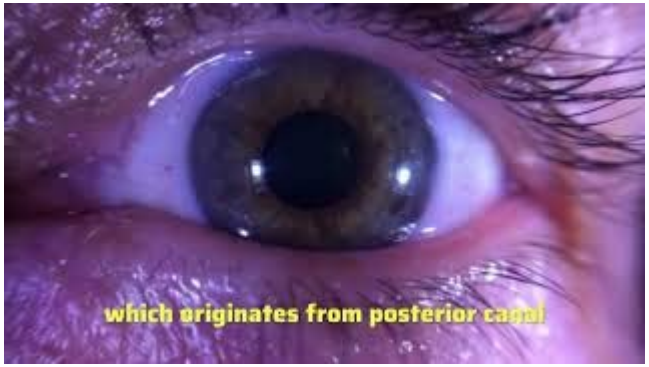
- Upbeating nystagmus
- Torsional component toward the test ear/ear that is down
- Vertigo is typically provoked (patient will feel dizzy)
- Often has a brief latency (Canalithiasis)
- If continuous, a sign of cupulothiasis (otoconia stuck to cupula)
- Nystagmus typically builds and then resolves within 60 seconds

Example:

Right ear down results in upbeat + rightward torsional nystagmus = Right posterior canal BPPV


Gravity
Sagittal body plane
45 degrees
Vantage point
Superior canal
Posterior canal
Utriculus
Posterior-canal ampulla
Gravity
Particles
A


Gravity
Utriculus
Posterior-canal ampulla
Superior canal
Gravity
Particles
Posterior canal
Vantage point
B


which originates from posterior canal

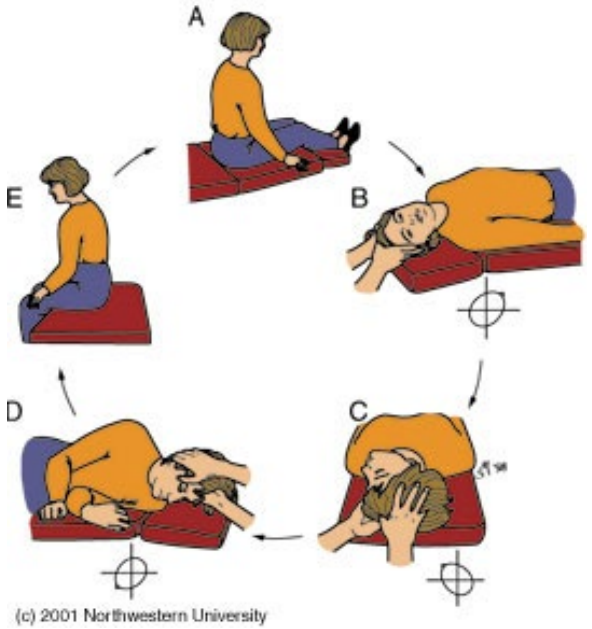
Repositioning for Posterior Canal BPPV

- Effectively treated with the **Modified Epley Maneuver** or the **Semont Liberatory maneuver**.
- Often, more than one repositioning attempt is needed (this goes for all repositioning, really)
- Best practice would be to see the patient for follow up 1-2 weeks after initial repositioning to follow up
- Patients may feel “off” or “wobbly” for a few hours as the otoconia re-settles.
- Some patients may require post procedure precautions (ex: Sleeping with a few pillows to prop themselves up) or longer term restrictions (No contact sports, etc)

Modified Epley Maneuver

Table 10. Stepwise Sequence for the Performance of the Canalith Repositioning Maneuver.[a]

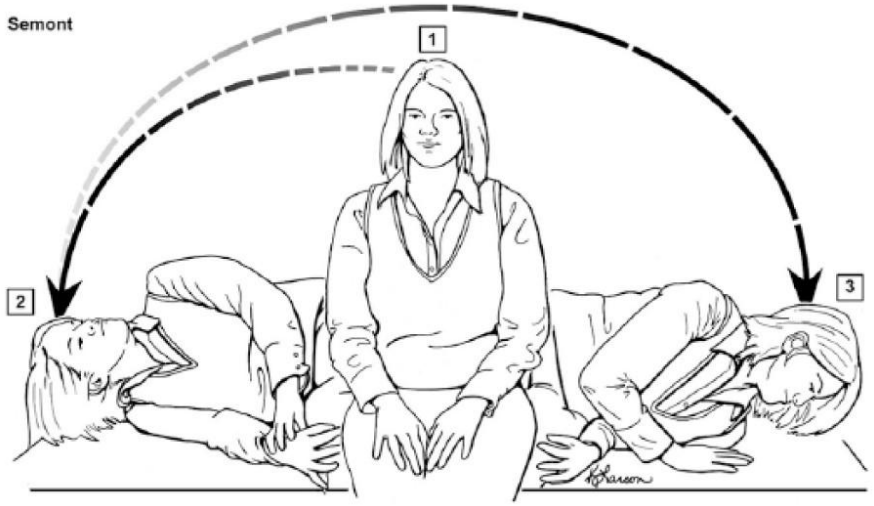
Step	Action
1	The patient is placed in the upright position with the head turned 45° toward the affected ear (the ear that was positive on the Dix-Hallpike testing).
2	The patient is rapidly laid back to the supine head-hanging 20° position, which is then maintained for 20-30 seconds.
3	Next, the head is turned 90° toward the other (unaffected) side and held for about 20 seconds.
4	Following this, the head is turned a further 90° (usually necessitating the patient's body to also move from the supine position to the lateral decubitus position) such that the patient' head is nearly in the facedown position. This is also held for 20-30 seconds.
5	The patient is then brought into the upright sitting position, completing the maneuver.



Semont Liberatory Maneuver

Table 11. Stepwise Description of the Performance of the Semont Liberatory Maneuver (Right Ear Affected).

Step	Action
1	Start with the patient sitting on a table or flat surface with the head turned away from the affected side.
2	Quickly put the patient into the side-lying position, toward the affected side, with the head turned up. Nystagmus will occur shortly after arriving at the side-lying position. Keep the patient in this position until at least 20 seconds after all nystagmus has ceased (some recommend up to 1-2 minutes).
3	Quickly move the patient back up and through the sitting position so that he or she is in the opposite side-lying position with the head facing down (head did not turn during the position change). Keep the patient in this position for about 30 seconds (some recommend 2-10 minutes).
4	At a normal or slow rate, bring the patient back up to the sitting position.



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What if the nystagmus is downbeat?

Downbeat + torsional nystagmus can indicate possible anterior (superior) canal BPPV

- Anterior canal BPPV is uncommon (~1–3% of reported BPPV cases)
- Do NOT automatically assume that downbeat nystagmus = anterior canal BPPV

🚩 Downbeat nystagmus is a central red flag

Downbeat positional nystagmus can also occur with brainstem or cerebellar pathology.

Be especially cautious with:

- Predominantly/isolated downbeat nystagmus (without torsion)
- Persistent downbeat nystagmus
- Other abnormal neurologic/oculomotor findings

When in doubt, refer onto ENT or Neurology!

What if the nystagmus is left or right beating?

Horizontal Roll Test - How to:

We use the **Roll Test** to look for Horizontal Canal BPPV. Identified as horizontal nystagmus.

1. Have the patient lay supine with head elevated 30 degrees (this puts the horizontal canals in a perfectly vertical plane.
2. Then roll the patient's head over to the right as far as possible and observe for nystagmus
3. Bring the patient's head back to midline and wait for nystagmus to subside
4. Rotate the patient's head to the left as far as possible and observe for nystagmus

Horizontal (lateral) Canal BPPV

A true horizontal canal BPPV will result in lateral nystagmus with the head in **both right and left positions**!

We need to identify if the nystagmus is beating toward the earth (Geotropic) or away from the earth (Ageotropic or Apogeotropic) in both positions:

Geotropic Nystagmus → Canalithiasis

Ageotropic Nystagmus → Cupulolithiasis

Hint: Cup is Up!

Repositioning for Horizontal canal BPPV

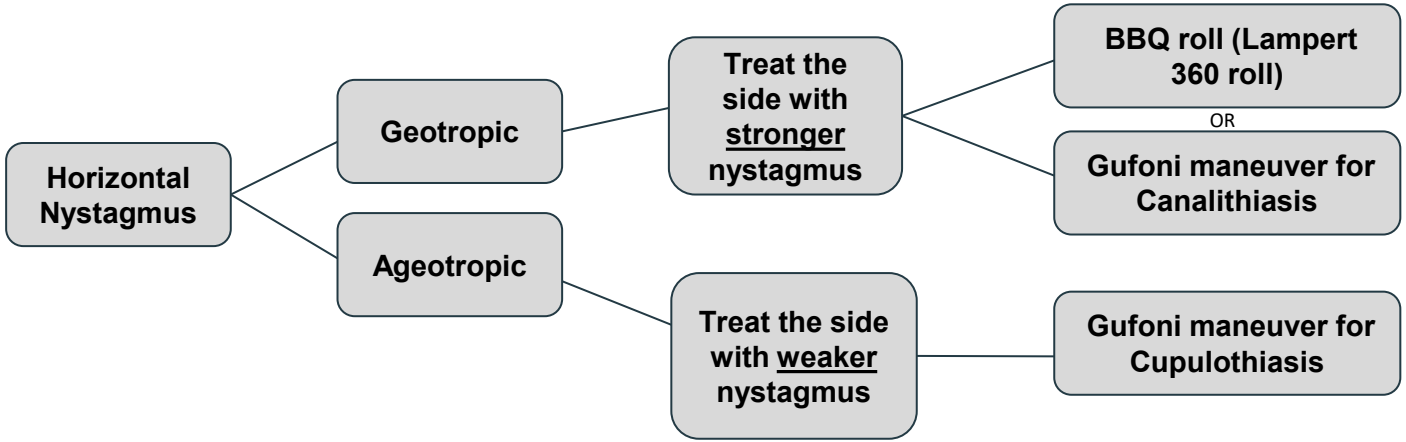
Most important thing to find out: **Which horizontal canal is the culprit?**

With Geotropic nystagmus: you treat the side with **greater** nystagmus

With Ageotropic nystagmus: you treat the side with **weaker** nystagmus

Repositioning for Horizontal Canal BPPV

Effectively treated with a few options depending on geotropic or ageotropic results:



Example:

You observe the following nystagmus during the roll test:

Really large LBN when head is turned to the right

Small but present RBN when head is turned to the left

Since both instances of nystagmus have the fast phase beating away from the ear that's down (ie: away from the earth), this would be an example of **Ageotropic nystagmus**.

Ageotropic nystagmus means cupulolithiasis (cup is up) and we treat the side with the weaker nystagmus.

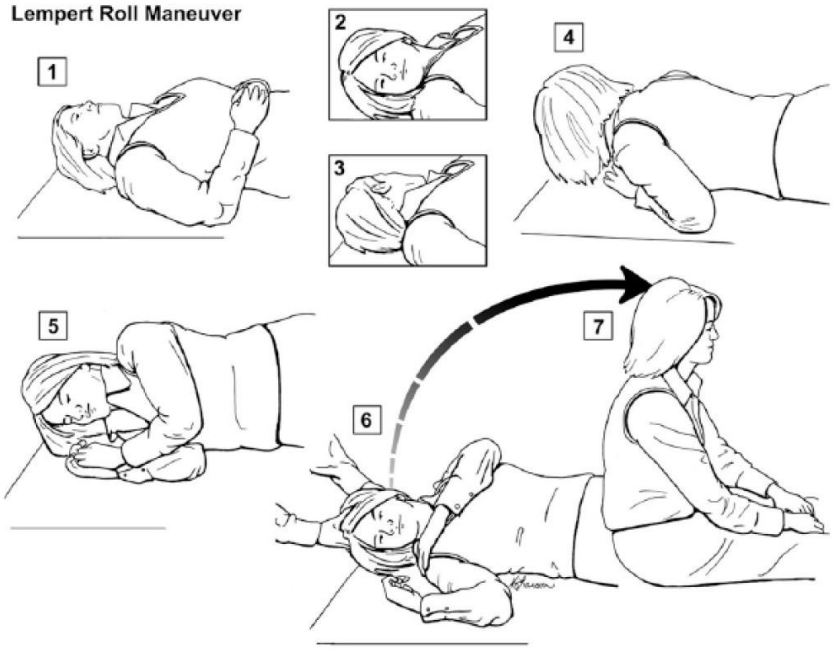
Therefore, these results indicate the patient has a **Left Horizontal Canal Cupulolithiasis** and we can treat this with the Gufoni maneuver, cupulolithiasis version.

BBQ roll maneuver for treatment of Horizontal Canal BPPV

Table 13. Stepwise Description of the Performance of the Lempert 360° Roll Maneuver (Barbecue Roll Maneuver) for the Treatment of Right Lateral Canal Benign Paroxysmal Positional Vertigo—Geotropic Type.

Step	Action[a]
1	Start from the supine position. *OR*
2	Some recommend rolling to start on the involved side.
3	Roll his or her head (or full body) to the unaffected side.
4	Keep rolling in the same direction until his or her head is completely nose down or prone. Some recommend ending the maneuver here and returning to sit (270° roll) as anatomically the debris is repositioned.
5-7	As originally published, however, complete the final roll (full 360°), and return to sitting.

[a]Each position is held for 15-30 seconds or until nystagmus stops.

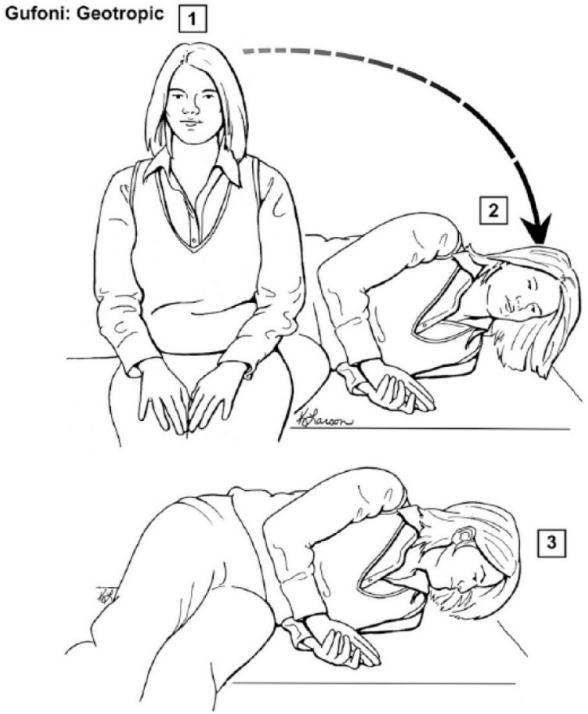


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Gufoni maneuver for geotropic nystagmus (canalithiasis)

Table 14. Gufoni Maneuver for Treatment of Right-Sided Lateral Semicircular Canal Benign Paroxysmal Positional Vertigo—Geotropic Type.

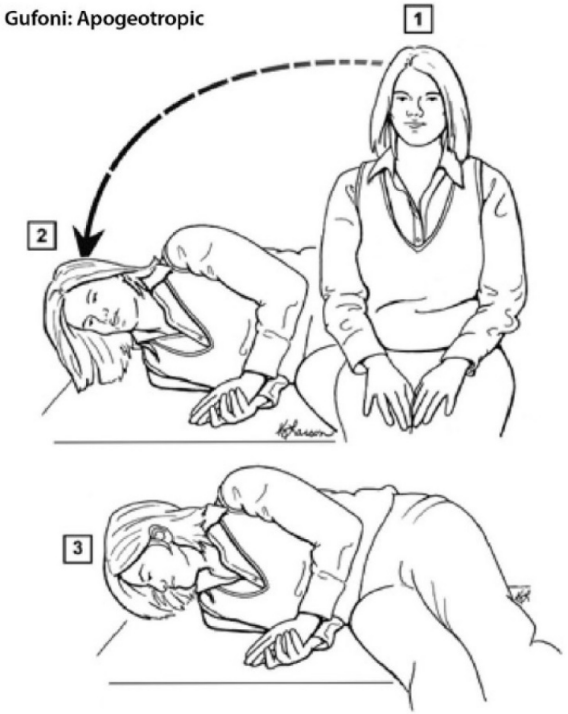
Step	Action
1	The patient is taken from the sitting position to the straight side-lying position on the unaffected side for about 30 seconds.
2	Then patient's head is quickly turned toward the ground 45°-60° and held in position for 1-2 minutes.
3	The patient then sits up again with the head held toward the left shoulder until fully upright and then may be straightened.



Gufoni maneuver for ageotropic nystagmus (Cupulolithiasis)

Table 15. Gufoni Maneuver for Treatment of Right-Sided Lateral Semicircular Canal Benign Paroxysmal Positional Vertigo—Apogeotropic Type.

Step	Action
1	The patient is taken from the sitting position to the straight side-lying position on the affected side (right side in this instance) for about 30 seconds.
2	From this point there are 2 *variations of this maneuver* that have been utilized, based on the possibility that debris can be on either the utricular *OR* the canal side of the cupula (or just lodged in the anterior arm of the lateral semicircular canal).
3	**(Pictured in Figure 7)** The patient's head is then quickly turned toward the ground 45°-60° and held in position for 1-2 minutes, which would free the debris from the utricular side of the cupula. The patient then sits up again with the head held toward the left shoulder until fully upright and then may be straightened. **(Not pictured)** In variation 2, move the patient's head, *nose up*, 45°-60° and hold in that position for 1-2 minutes, which would free the debris from the canal side of the cupula (or from being lodged in the anterior arm of the lateral semicircular canal).



Not pictured (and the more common type/ treatment imo) is the patient lays down on affected side and then the head is turned to position nose UP

What if someone has dizziness or balance complaints/identified issues but no sign of BPPV?

- We can refer them appropriately if needed!

  For instance:

  - If suspecting an unstable lesion like SSCD or Meniere's - Refer to ENT for appropriate assessment
  - If suspecting PPPD, can refer to ENT for possible SSRI start in combination with vestibular rehab
  - If asymmetrical HL identified, refer to ENT for MRI
  - If more complicated involvement, refer to Neuro, ENT, or Physio as needed. Etc.

- Then we can give them basic vestibular rehab exercises to start <u>if indicated</u> and if we feel comfortable doing so.

  *Remember: Vestibular rehabilitation has a strong safety profile! While it may temporarily provoke symptoms, appropriately prescribed exercise does not appear to worsen the underlying vestibular deficit

Introduction to Vestibular Rehabilitation Therapy (VRT)

Three core areas:

1. Gaze Stability / VOR Exercises
Improve the ability to keep vision clear while the head is moving.

2. Habituation / Visual Motion Exercises
Improve control and coordination of eye movements.

3. Balance & Postural Retraining
Challenge the sensory systems responsible for maintaining balance.

Vestibular rehabilitation uses repeated, appropriately challenging movement to promote adaptation, compensation, and improved function.

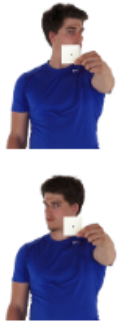
1. Gaze Stability & VOR Exercises

The VOR helps stabilize our visual world when we move our head.

<u>VOR ×1 Exercise:</u>

- Patient focuses on a stationary target (like their thumb)
- Move head horizontally or vertically while maintaining focus on target
- Start at a speed that feels difficult but allows target to remain in focus
- **Do 3 sets of 20, daily**
- Speed can be increased gradually over time as task gets easier
- Progress from sitting to standing to walking as needed
- Progress from predictable to more challenging environments

VOR X1 (horizontal head movement)



VOR X1 (vertical head movement)



Example:
“Hold your thumb out at arm's length and move your head side-to-side while keeping clear vision on your thumb”

Expected response:
Mild, temporary dizziness or visual blurring can occur. Symptoms should settle relatively quickly after stopping.

2. Habituation/ Visual Motion Exercises

'H' pattern smooth pursuit

Training the eyes to move accurately and efficiently and desensitising the brain



Smooth Pursuit:

- Patient follows a slowly moving target with their eyes
- Keep the head still
- Move the target horizontally, vertically, and diagonally (H pattern works well)
- Encourage smooth, controlled eye movements. 5 - 10 times daily
- Progress by increasing speed or incorporating more complex background



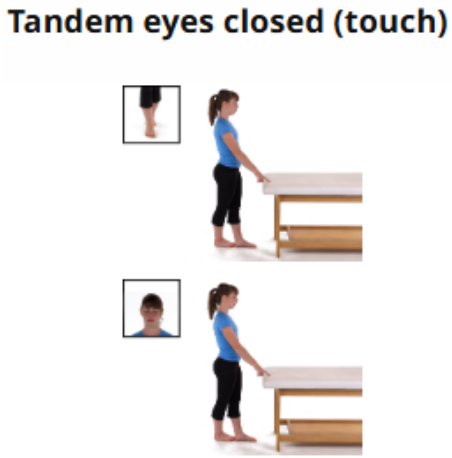
Pencil Push-Ups:

- Hold a pencil at arm's length and focus on the tip
- Slowly bring the pencil toward the nose while maintaining single, clear vision
- Stop when the image becomes blurry or doubles
- Look away from the pencil to focus on an image at a distance then re-focus on the tip of the pencil
- Slowly move the pencil back out and repeat 5 times daily



Clinical goal:
Improve eye movement control and the ability to maintain clear, single vision during visual tasks.

3. Balance Retraining



Challenge the Systems That Keep Us Upright

Remember: overall balance depends on the integration of:

-Vision
-Vestibular system
-Somatosensory input

In order to strengthen our vestibular system we need to isolate it by temporarily “eliminating” the other 2 players

Have your patient stand on a pillow (or with feet in tandem) while keeping eyes open for 1-2 minutes per day with right foot forward then 1-2 minutes per day with left foot forward.

Progress from Eyes Open to Eyes Closed (with light finger touch) to Eyes closed without touch.

***** Start with an exercise that is challenging but safe, then progressively increase the difficulty as the patient's balance improves. The goal isn't simply to stand without falling, it's to improve balance during activities that matter to the patient.

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Fall prevention + Education

Manage hearing loss

- Wear hearing aids consistently when appropriate
- Keep devices clean, charged, and functioning properly
- Good hearing helps you stay aware of your surroundings

Use your vision

- Keep glasses up to date
- Ensure hallways, stairs, and bathrooms are well lit
- Use night lights when getting up at night

Make your home safer

- Remove loose rugs and clutter
- Use handrails on stairs
- Install grab bars where needed
- Wear supportive footwear

Pay attention to dizziness

- Report new or worsening dizziness or imbalance
- Sit down if you suddenly feel unsteady
- Take your time when changing positions

*** Making a Fall Prevention brochure or poster for your waiting room is such a great project and extremely beneficial for all of your patients!**

Outcome Measures:

Self-Report

- Dizziness Handicap Inventory (DHI)
- Activities-specific Balance Confidence (ABC)

Performance

- Dynamic Visual Acuity (DVA)
- Dynamic Gait Index (DGI)
- Timed Up and Go (TUG)*
- Modified CTSIB*
- Functional Reach*



Herdman, S. J., Tusa, R. J., Blatt, P., Suzuki, A., Venuto, P. J., & Roberts, D. (1998) ; Vital et al. (2010)

Break! Then workshop stations!

Take home messages:

1. The ear is responsible for more than just hearing!
2. A full vestibular evaluation is the gold standard and referrals can be made for this!
3. However, you don't need a full vestibular lab to screen for vestibular deficits
4. Help the patients you can with:
    a. Repositioning
    b. Balance retraining
    c. VRT start
    d. Fall prevention
5. People really benefit from being heard and seen. Anxiety plays such a huge part in vestibular disorders and patients tend to calm down once they feel taken care of and taken seriously
6. Education! Vestibular knowledge is <u>not</u> common and patients can benefit from understanding so they can make educated decisions
7. Remember this is within our scope of practice as Canadian audiologists:

    "...Assessment of hearing, vestibular function and balance, which may involve screening, identification, evaluation, diagnosis and counselling…" **Scope of Practice for Audiology - www.sac-oac.ca**

Q + A
(all things vestibular)

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