

In The Name of GOD

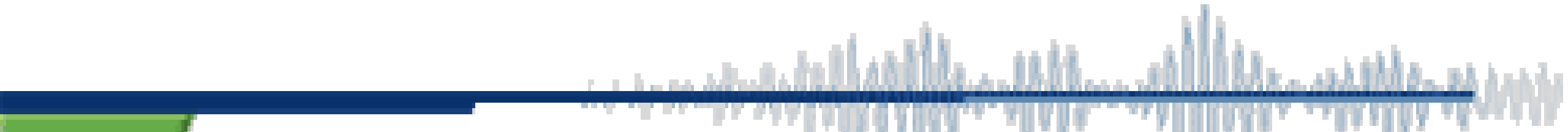
VNG:
Spontaneous Nystagmus
&
Positioning/Positional tests



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Definition – Bárány Society

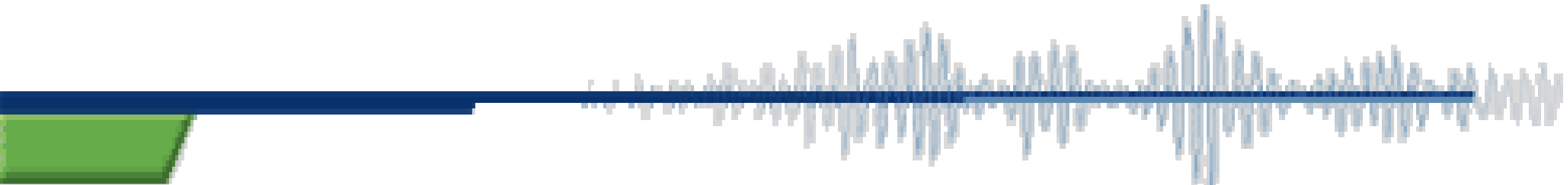
Spontaneous Nystagmus

Nystagmus present while looking in the straight-ahead (center) gaze position with the head stationary in the upright and neutral position (not turned or tilted), not triggered by positional or other provocative maneuvers.

Key Characteristics of Peripheral Spontaneous Vestibular Nystagmus

- ▶ Binocular and conjugate in head-referenced coordinates
- ▶ Beats in a single plane and direction regardless of gaze position (direction-fixed)
- ▶ Obeys Alexander's law
- ▶ Suppressed by visual fixation (enhanced by blocking fixation)
- ▶ Constant-velocity (linear) slow phases on oculographic recording

Source: Eggers et al., Classification of vestibular signs... Bárány Society, J Vestib Res / PMC (2022/2019)



Physiology of Vestibular Nystagmus

Peripheral Mechanism

Unilateral reduction (or increase) of tonic afferent activity from labyrinth or vestibular nerve creates **imbalance at vestibular nuclei**.

Slow phase is driven toward the weaker side (VOR response). **Fast phase (corrective saccade) is generated centrally toward the stronger side.**

Result: horizontal-torsional **nystagmus beating away from the lesion** (inhibitory type).

Central Mechanism

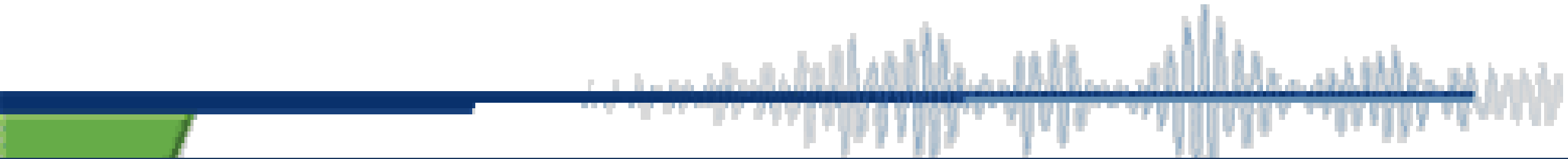
Dysfunction of **central vestibular circuits**, neural integrators (nucleus prepositus hypoglossi, interstitial nucleus of Cajal), **cerebellum** (flocculus, nodulus), **or brainstem pathways**.

May produce pure vertical, pure torsional, or direction-changing nystagmus.

Often not suppressed (or enhanced) by fixation and may violate Alexander's law.

Peripheral vs Central Spontaneous Nystagmus

Feature	Peripheral	Central
Direction	Direction-fixed (usually horizontal-torsional)	May be direction-changing, pure vertical or torsional
Fixation	Strongly suppressed	Often persists or increases
Alexander’s Law	Obeys	May violate (anti-Alexander)
Waveform (SPV)	Linear (constant velocity) slow phases	May be exponential or irregular
Associated signs	Vertigo, nausea, unidirectional	Other CNS signs (skew, pursuit deficit, etc.)
Common cause	Vestibular neuritis, labyrinthitis, Menière attack	Brainstem/cerebellar stroke, migraine, MS



How to Examine Spontaneous Nystagmus

Always examine both **WITH** and **WITHOUT** visual fixation

حساسیت در بهترین شیوه؟؟!! >50%

1. Naked Eye / Room Light

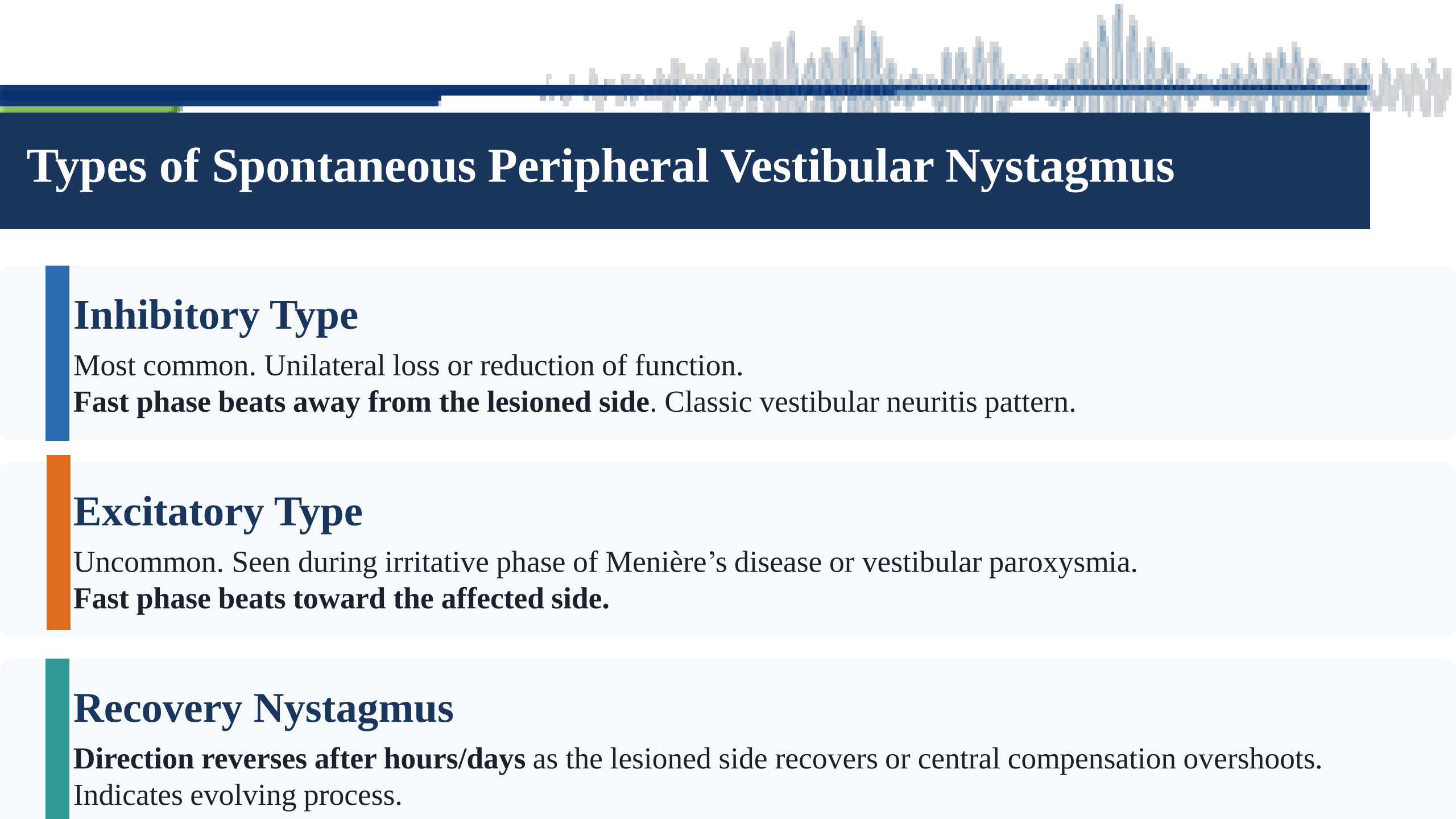
Patient looks straight ahead at a distant target. Peripheral nystagmus is often suppressed or invisible. Useful to note if nystagmus persists with fixation (central red flag).

2. Frenzel Goggles

High-diopter (+15 to +20) internally illuminated lenses prevent patient fixation while magnifying eyes for examiner. Gold-standard bedside tool for revealing peripheral nystagmus.

3. VNG / Video-Oculography

Infrared cameras in darkness (fixation removed). Quantifies SPV ($^{\circ}/s$), direction, and waveform. Essential for objective documentation and subtle nystagmus detection.



Types of Spontaneous Peripheral Vestibular Nystagmus

Inhibitory Type

Most common. Unilateral loss or reduction of function.

Fast phase beats away from the lesioned side. Classic vestibular neuritis pattern.

Excitatory Type

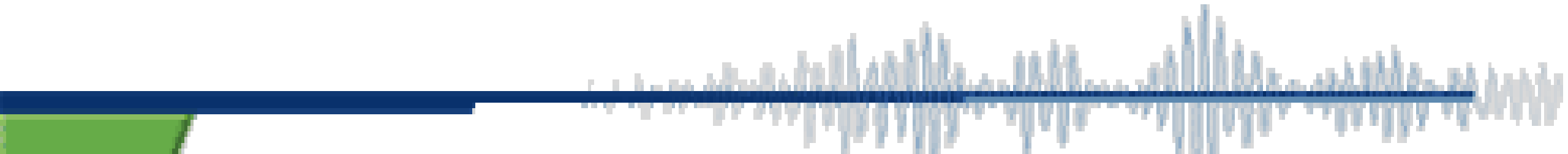
Uncommon. Seen during irritative phase of Menière's disease or vestibular paroxysmia.

Fast phase beats toward the affected side.

Recovery Nystagmus

Direction reverses after hours/days as the lesioned side recovers or central compensation overshoots.

Indicates evolving process.

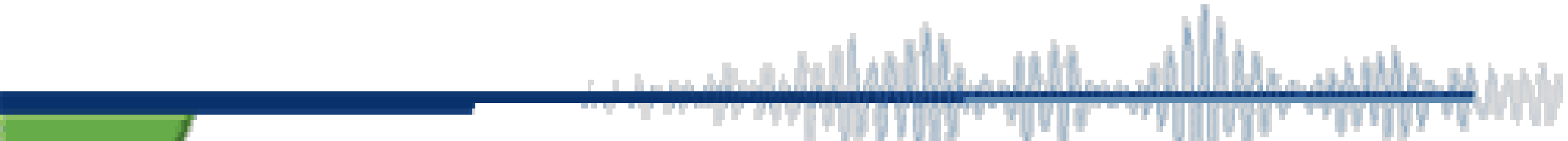


Quantification & Normative Considerations

Slow-Phase Velocity (SPV) is the primary quantitative measure ($^{\circ}/s$).

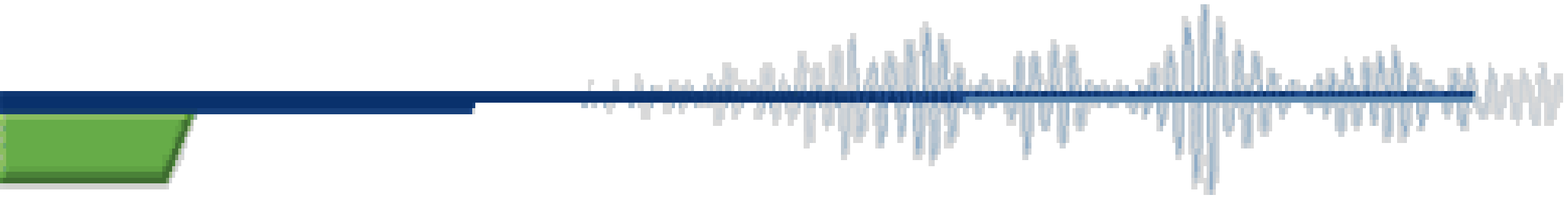
Clinical Thresholds

- Any clear spontaneous nystagmus on VNG is usually abnormal.
- Literature cut-offs for “significant” SPV range from $>4^{\circ}/s$ to $>7^{\circ}/s$ (depending on lab norms).
- Persistent SN $>2-3^{\circ}/s$ after acute phase may indicate incomplete compensation.
- Very high SPV ($>20-30^{\circ}/s$) common in acute uncompensated neuritis.

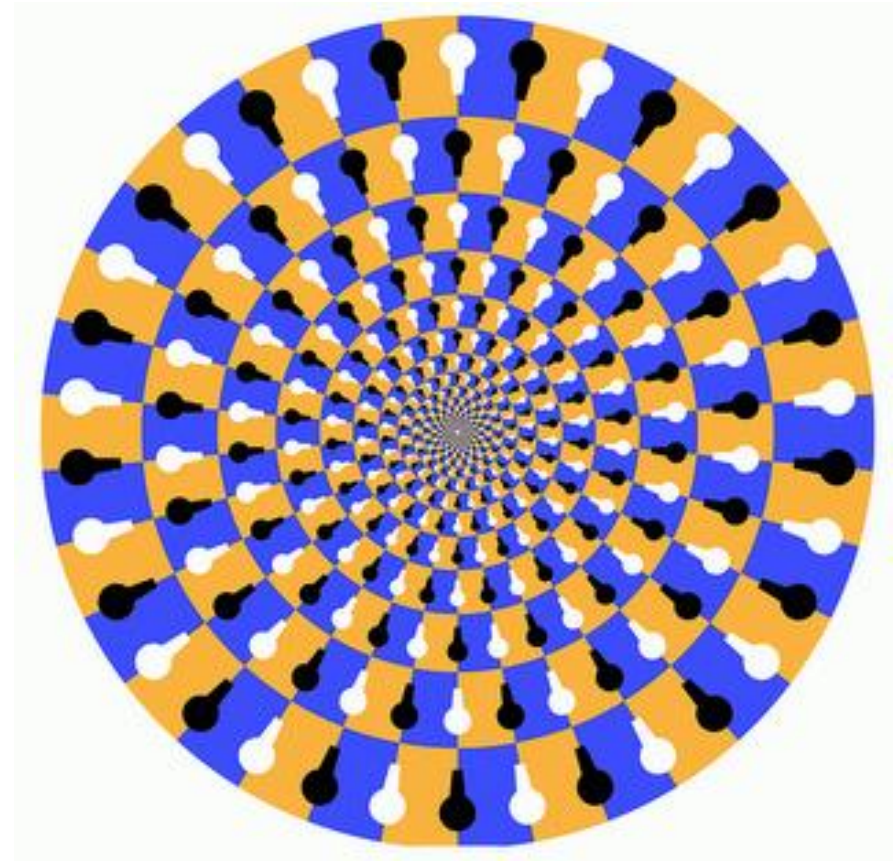


Key Takeaways

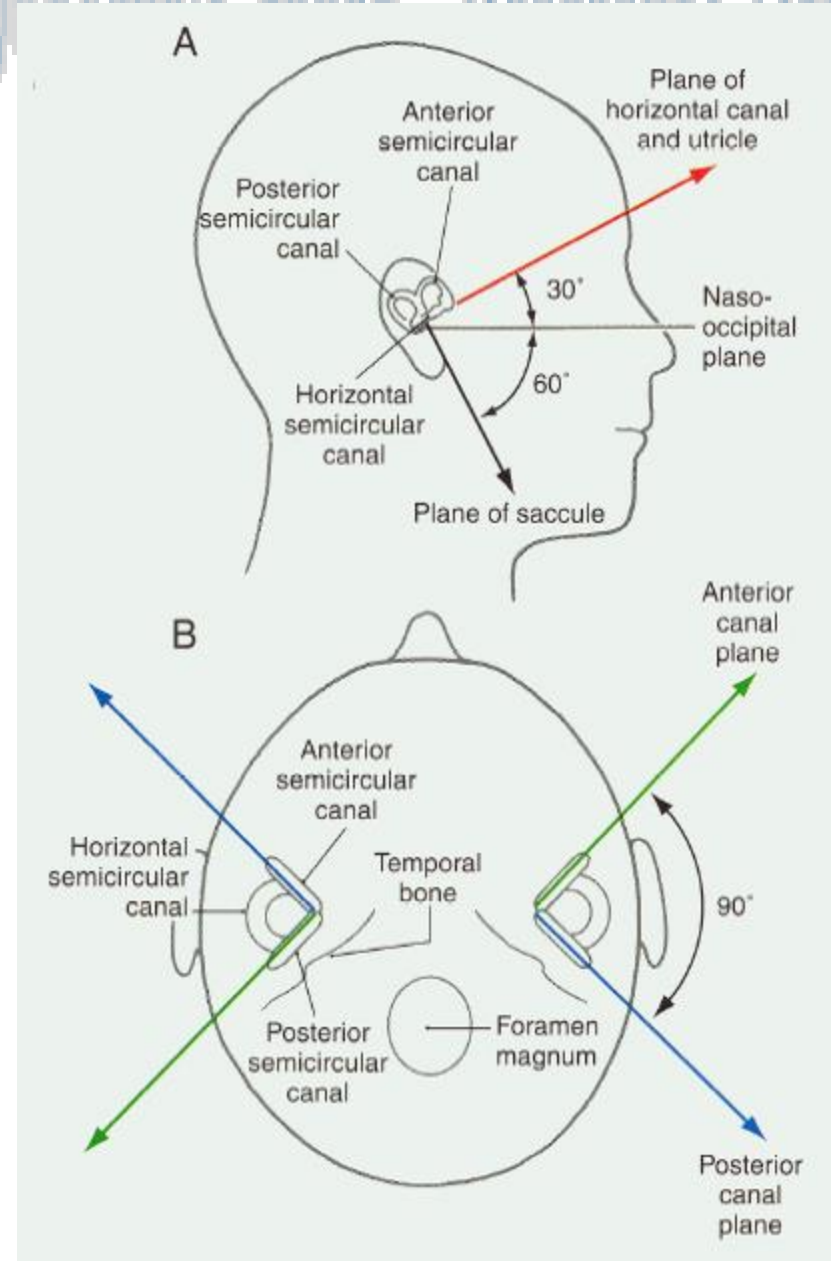
- ✓ Always compare nystagmus with and without fixation – **the difference is diagnostically powerful.**
- ✓ Direction-fixed, horizontal-torsional, fixation-suppressed, Alexander-obeying = **classic peripheral.**
- ✓ Pure vertical, pure torsional, direction-changing, or fixation-resistant = **raise central suspicion.**
- ✓ Quantify SPV when possible; interpret absolute values against lab norms and clinical timeline.
- ✓ Integrate SN findings into HINTS+ and the full audiovestibular picture – **never in isolation.**
- ✓ Document thoroughly; recovery or directional change over days is clinically meaningful.

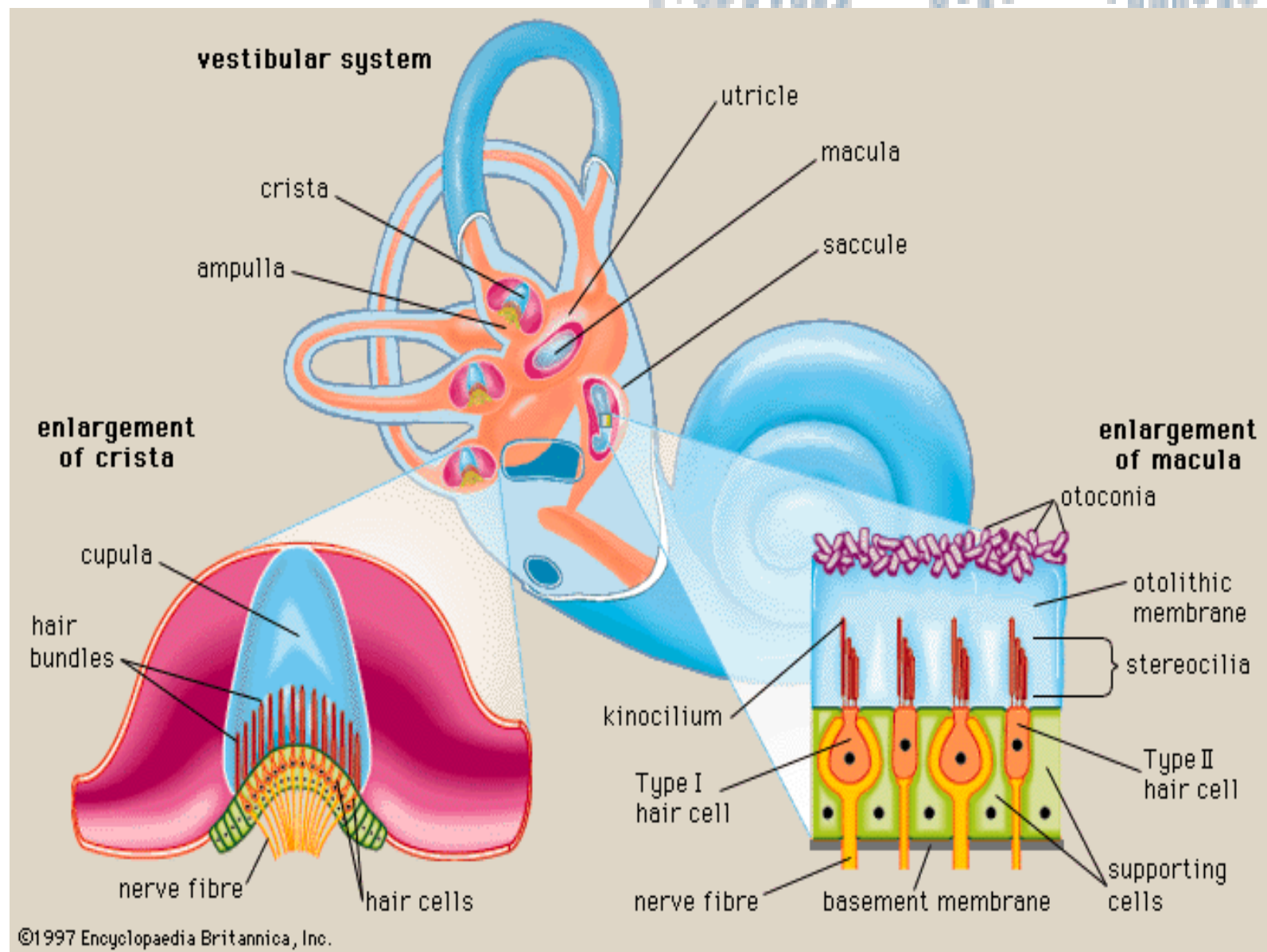


Positional & Positioning tests



Semicircular Canal Orientation





Positional vs Positioning Tests – Key Distinction

Positioning Tests

Dynamic/ Rapid movement of the head (and body) through a trajectory into a final position.

Examples:

- **Dix-Hallpike** maneuver
- Side-lying (Semont diagnostic) maneuver

Designed to generate inertial movement of free-floating otoconia (canalolithiasis).

Nystagmus typically **has latency and is transient.**

Positional Tests

Maintaining the head in a **static** position relative to gravity after slow placement.

Examples:

- **Static positional** testing (Neutral, Supine, left/right lateral, head-hanging)

Useful for detecting persistent nystagmus (cupulolithiasis or central).

Nystagmus may appear **immediately and persist.**

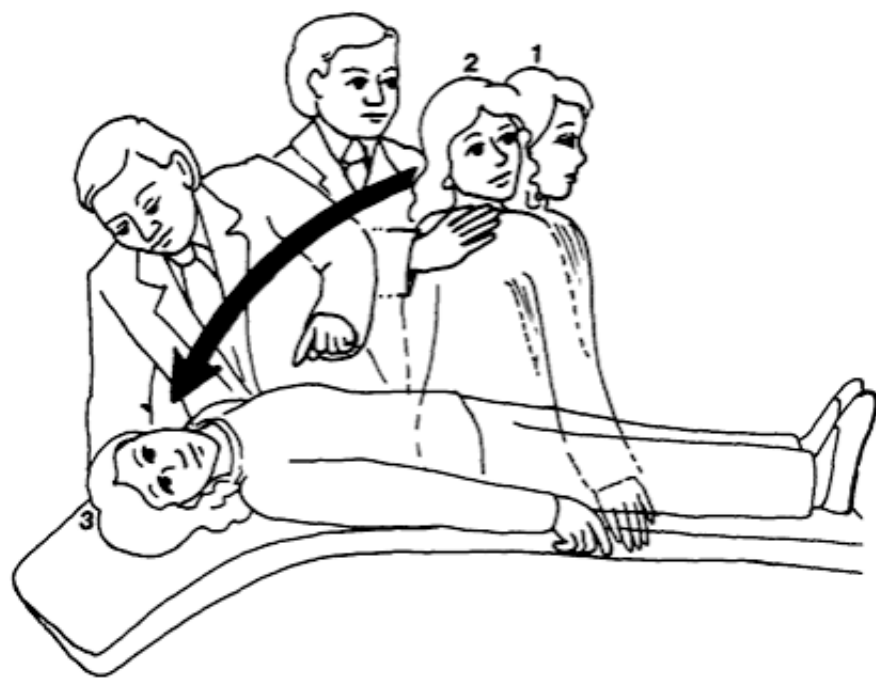
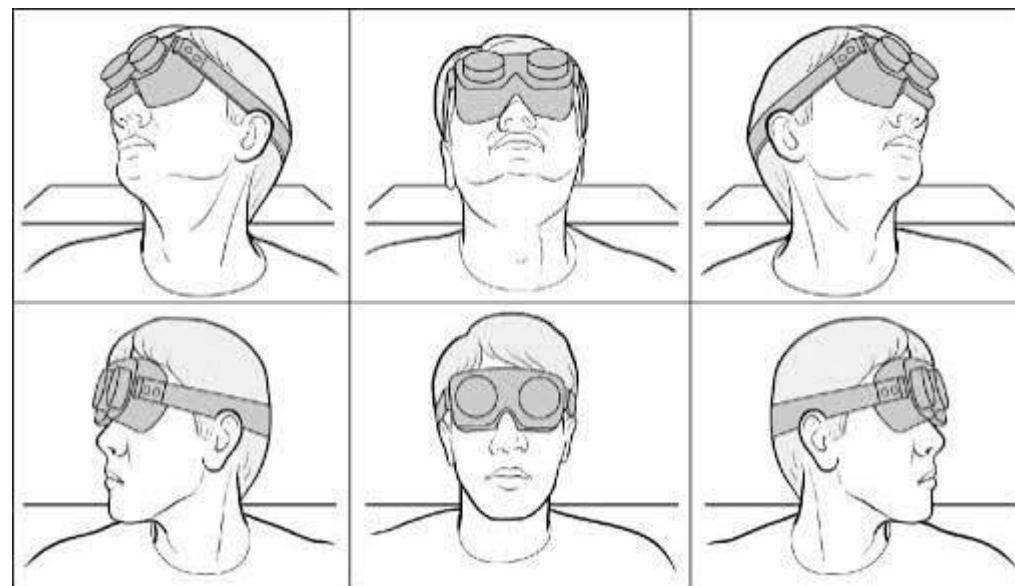
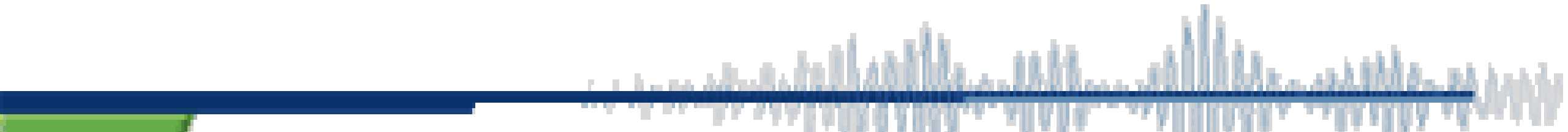


Figure 15.19. Dix-Hallpike test for benign paroxysmal vertigo. The patient is moved from the sitting to the supine-head-hanging (right and left) position. The head is turned before the patient is moved vertically.





Canalithiasis vs Cupulolithiasis – Pathophysiology

Canalithiasis

Free-floating otoconia within the canal lumen.

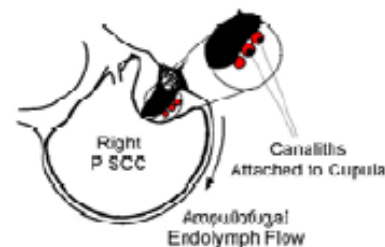
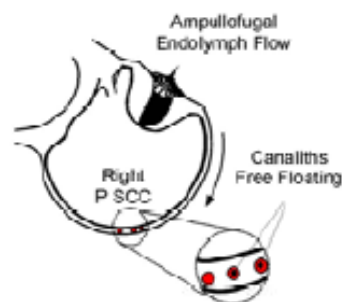
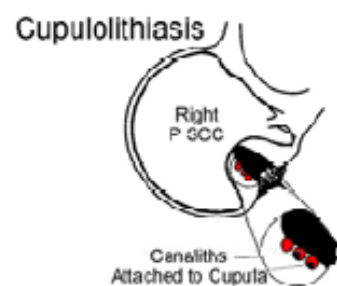
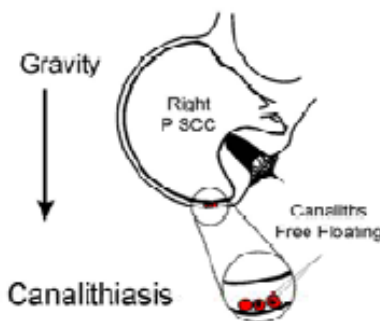
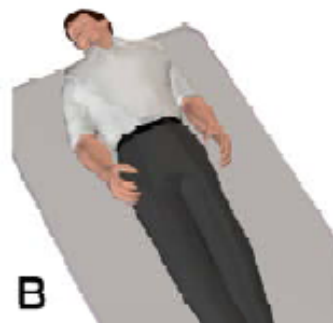
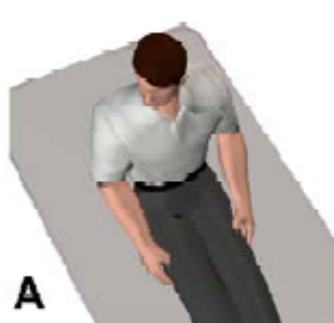
- Gravity + inertia cause particles to move → endolymph drag → cupular deflection
- Latency (time for particles to start moving)
- Transient nystagmus (particles settle)
- Fatigable on repeated testing
- Most common mechanism for PC-BPPV
- Responds well to canalith repositioning procedures (CRP)

Cupulolithiasis

Otoconia adherent to the cupula itself.

- Cupula becomes gravity-sensitive
- Little or no latency
- Persistent nystagmus while position is held
- Less fatigable
- More common in horizontal canal
- May require liberatory maneuvers or prolonged positioning; conversion to canalithiasis sometimes needed

Canalithiasis vs. Cupulolithiasis



Delayed Onset

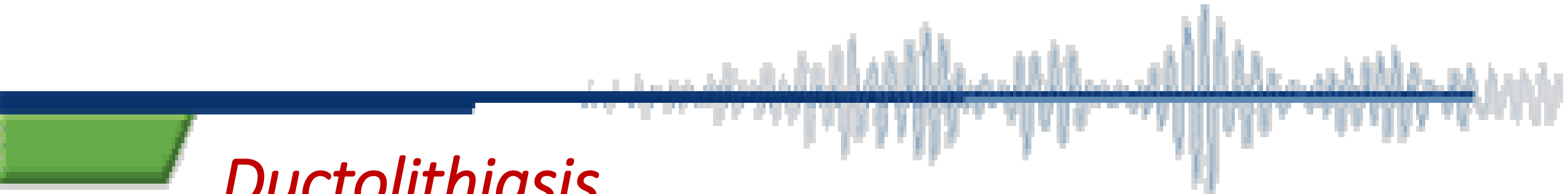
Yes

Duration

Short

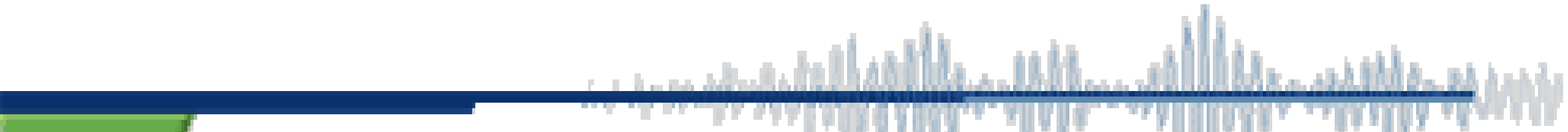
Minimal

Long



Ductolithiasis

- Otoconia particles causing blockage of the endolymphatic duct.
- Causes reduction in flow of endolymphatic fluid and increased aural pressure associated with hydrops.



Dix-Hallpike Maneuver – Technique & Interpretation

Gold-standard positioning test for posterior (and anterior) canal BPPV

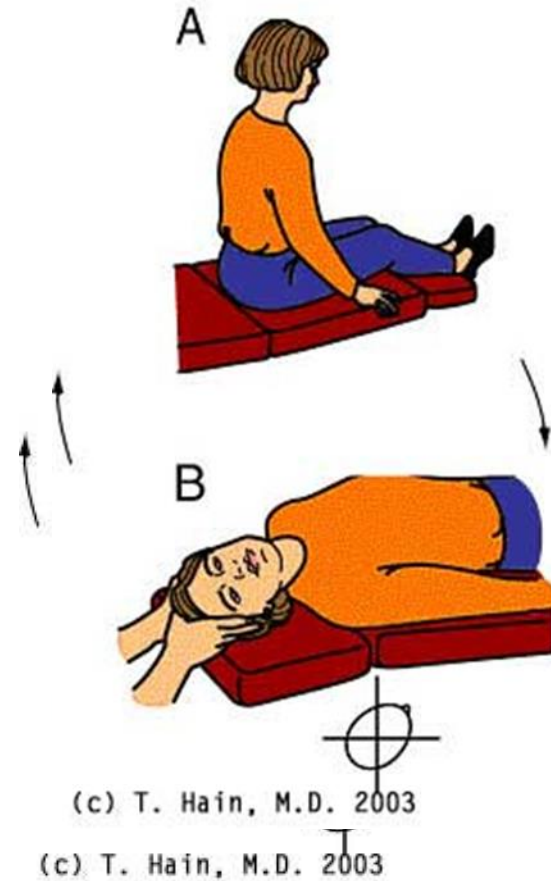
Start with VAST غربالگری شریان قاعده ای-مهره ای

- 1 Patient sits upright. Turn head 45° toward the ear being tested.
- 2 Rapidly bring patient to supine with head extended ~20–30° below horizontal (affected ear down).
- 3 Observe eyes (ideally with VNG/Frenzel) for ≥ 30 –60 s for latency, direction, duration, and fatigability.
- 4 Return to sitting and observe for reversal of nystagmus (common in canalolithiasis).
- 5 Repeat for the opposite side.

Classic positive finding (PC-canalolithiasis): Latency 1–few seconds → mixed up-beating + torsional nystagmus (upper poles beat toward lower ear) lasting <60 s, fatigable on repetition.

Dix-Hallpike Test

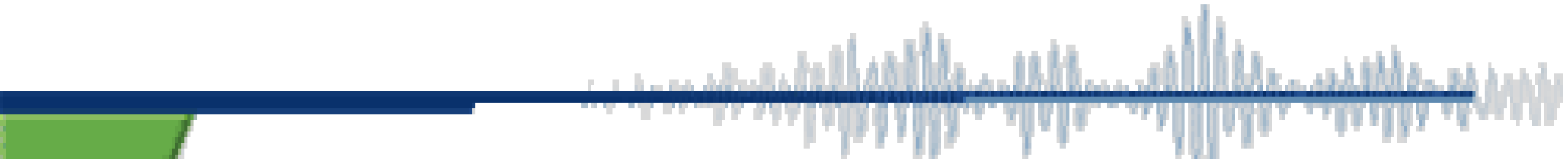
- Gold Standard for diagnosis of Anterior or Posterior Canal BPPV.
- Starting seated with the neck rotated 45°, the person is brought into supine with 30° cervical extension.
- Observe for torsional nystagmus and record the direction.





Dix-Hallpike Test Results

Test	Result	Diagnosis
Right Dix-Hallpike	Upbeat Torsional Nystagmus	Right Posterior Canal BPPV
Right Dix-Hallpike	Downbeat Torsional Nystagmus	Left Anterior Canal BPPV
Left Dix-Hallpike	Upbeat Torsional Nystagmus	Left Posterior Canal BPPV
Left Dix-Hallpike	Downbeat Torsional Nystagmus	Right Anterior Canal BPPV
Right or Left Dix-Hallpike	Lateral Nystagmus; Geotropic or Ageotropic	Perform Roll Test to check Horizontal Canal Involvement
Right or Left Dix-Hallpike	Vertical Nystagmus	Central Vertigo: Not BPPV



Supine Roll Test (Pagnini–McClure) for Horizontal Canal

Patient supine with head elevated $\sim 30^\circ$ (horizontal canals vertical). Rapidly turn head 90° to one side, observe, then to the opposite side.

Geotropic (Canalolithiasis)

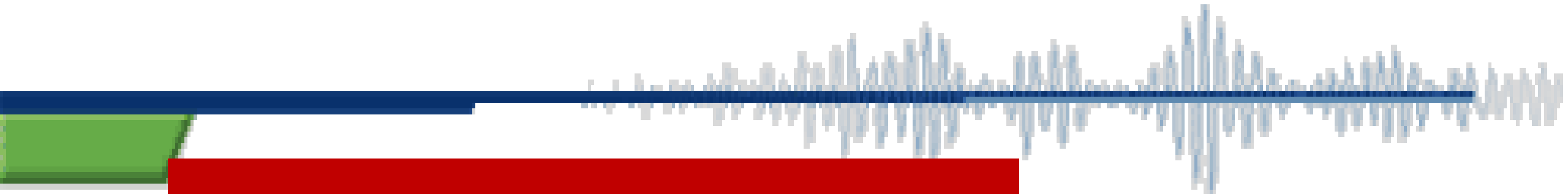
Horizontal nystagmus beats toward the undermost (ground) ear on both sides.

- Latency brief or none
- Duration usually <60 s
- Stronger intensity on the affected side
- Treat the side with stronger nystagmus

Apogeotropic (Cupulolithiasis)

Horizontal nystagmus beats toward the uppermost (ceiling) ear on both sides.

- Often no latency
- Duration >60 s (persistent)
- Stronger intensity usually on the healthy side
- Null point may help lateralize



Posterior Canal BPPV

- 78-96% of cases
- Posterior canal is a gravity dependent organ in both supine and upright positions.
- Cupulolithiasis: Immediate onset of vertigo and nystagmus with head below the horizontal; persistent nystagmus.
- Canalithiasis: Delayed onset of vertigo (15-30 second latency) and nystagmus with head movement; fatigue of nystagmus after 30-60 sec.



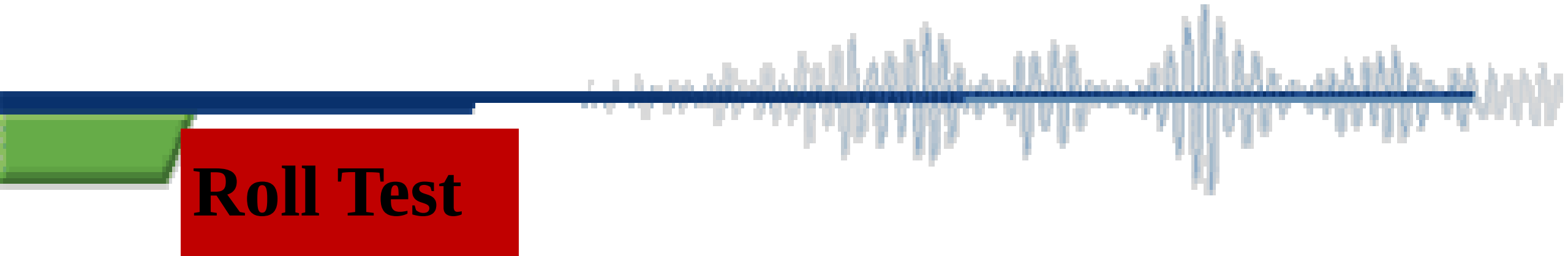
Anterior Canal BPPV

- Least often affected canal (1-3%).
- Often linked to structure changes in the canal detected on HR 3D-MRI



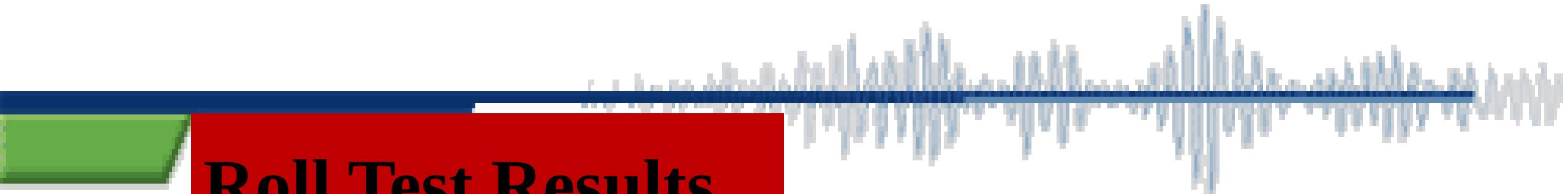
Horizontal Canal BPPV

- Affects 2-15% of cases
- Nausea and vomiting are commonly associated with episodes of the horizontal canal.
- Cupulolithiasis: Ageotropic nystagmus, beating away from the ground.
- Canalithiasis: Geotropic nystagmus, beating toward the ground.



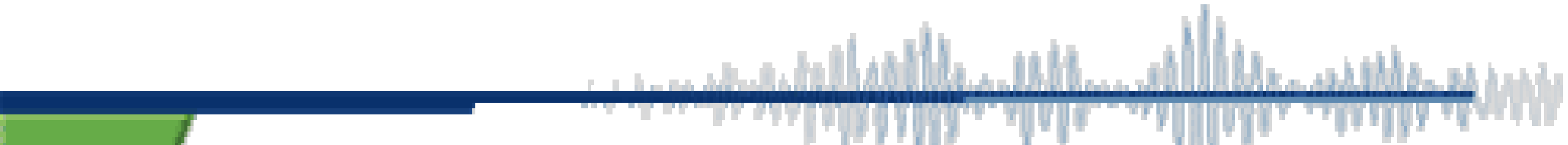
Roll Test

- Most often utilized test for Horizontal canal BPPV.
- Starting in a seated position, rotate the neck 60° toward the tested ear. The person is then assisted into supine, maintaining 20° of cervical flexion.
- Observe for horizontal nystagmus and record geotropic or ageotropic direction.



Roll Test Results

Test	Result	Diagnosis
Right Roll Test	Geotropic Nystagmus	Right Horizontal Canal BPPV; Canalithiasis
Right Roll Test	Ageotropic Nystagmus	Right Horizontal Canal BPPV; Cupulolithiasis
Left Roll Test	Geotropic Nystagmus	Left Horizontal Canal BPPV; Canalithiasis
Left Roll Test	Ageotrophic Nystagmus	Left Horizontal Canal BPPV; Cupulolithiasis
Right or Left Roll Test	Torsional Nystagmus	Perform Dix-Hallpike Test
Right or Left Roll Test	Vertical Nystagmus	Central Nystagmus; Not BPPV



Bárány Society Diagnostic Criteria – Summary Table

Subtype	Trigger Maneuver	Nystagmus Pattern	Duration
PC Canalolithiasis	Dix-Hallpike / Side-lying	Up-beating + torsional (to lower ear)	< 1 min
HC Canalolithiasis	Supine roll	Geotropic horizontal	< 1 min
HC Cupulolithiasis	Supine roll	Apogeotropic horizontal	> 1 min
AC Canalolithiasis	Dix-Hallpike / Head-hanging	Down-beating ± torsional	< 1 min

Source: von Brevern et al. Bárány Society Consensus – *J Vestib Res* 2015 / subsequent updates



Central Positional Nystagmus vs BPPV – Differentiation

Feature	Typical BPPV	Central Positional
Latency	Usually present (1–few s)	Often absent or very short
Duration	Usually <60 s (canalolithiasis)	Often persistent while position held
Direction	Canal-plane specific (torsional-up, geo/apo horizontal)	Pure vertical, pure torsional, or atypical
Fatigability	Present (especially PC)	Usually absent or limited
Response to CRP	Resolves or markedly improves	No response / refractory
Associated signs	None (isolated)	Cerebellar/brainstem signs common

Treatment Maneuvers – Posterior Canal BPPV

Epley Maneuver (Canalith Repositioning Procedure) – First-line for PC-canalolithiasis

1. Start as Dix-Hallpike (affected ear down, head extended).
2. Hold until nystagmus/vertigo stops (~30–60 s).
3. Turn head 90° toward the healthy side (still extended).
4. Roll patient onto healthy side (nose pointing down).
5. Sit up slowly. Repeat if needed. AAO-HNS: strong recommendation; no routine post-maneuver restrictions.

Semont (Liberatory) Maneuver – Useful for PC-canalolithiasis and cupulolithiasis

Patient sits, head turned 45° toward healthy side → rapidly lie onto affected side (head still turned) → hold → rapidly swing through sitting to opposite side-lying position (nose down) → hold → sit up. Uses inertia to dislodge particles.



Treatment Maneuvers – Horizontal Canal BPPV

Barbecue / Lempert Roll (Geotropic HC)

Patient supine → successive 90° rolls away from the affected ear (full 360° or until particles exit). Hold each position 30–60 s. Most widely used for canalolithiasis.

Gufoni Maneuver

Side-lying toward the healthy side (geotropic) or affected side (apogeotropic variants exist), then turn head nose-down, hold, and sit up. Quick and effective alternative.

Forced Prolonged Positioning

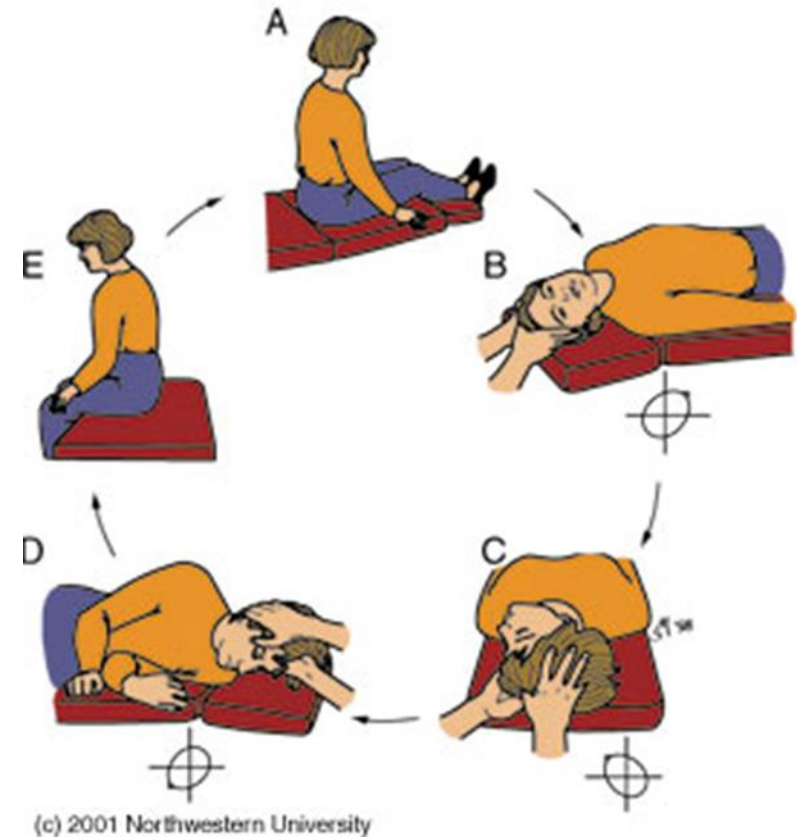
Patient lies on the healthy side for many hours (overnight). Gravity allows particles to sediment out of the canal. Useful when patient cannot tolerate active maneuvers.

Cupulolithiasis strategies

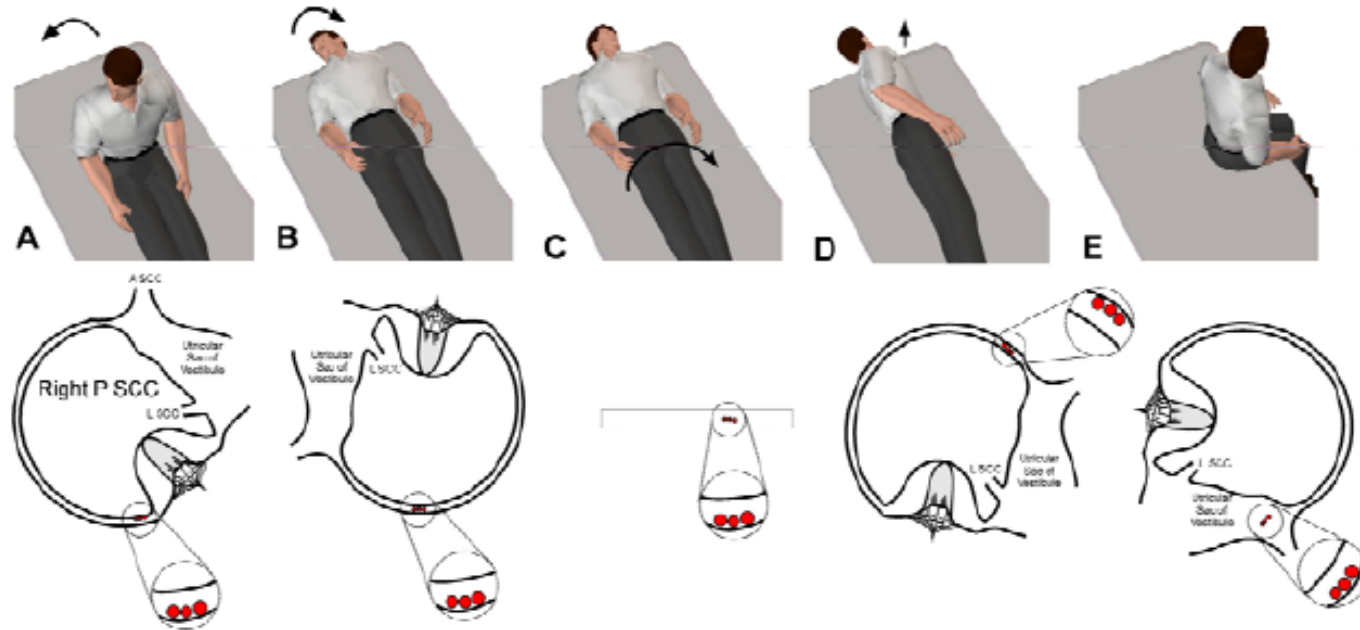
May first convert to canalolithiasis (head shaking, mastoid vibration, or specific liberatory moves) then apply barbecue/Gufoni. Null-point identification can guide treatment.

Modified Epley Maneuver (CRP)

- Positions (A) and (B) are repeated from the Dix-Hallpike exam.
- The head is then rotated 45° past midline to the opposite side with cervical extension maintained (C).
- The subject then rolls onto the side and the head is turned down to the floor (D) prior to sitting (E).



Right Canalith Repositioning Maneuver (CRM)



- A and B – Same as Dix-Hallpike toward the affected ear
- C – Rotate the head 90° toward the opposite ear
- D – Rotate the body another 90° while maintaining the head orientation (watch for secondary nystagmus in the same direction)
- E – Bring to the sitting position after responses subside (~60 sec)

Semont 'Liberatory' Maneuver

- Used to treat cupulolithiasis of the anterior/posterior canal.
- A brisk movement from sitting to sidelying with the head turned 45° toward the affected side.
- Subsequent movement to the opposite sidelying position with head maintained in 45° of rotation.





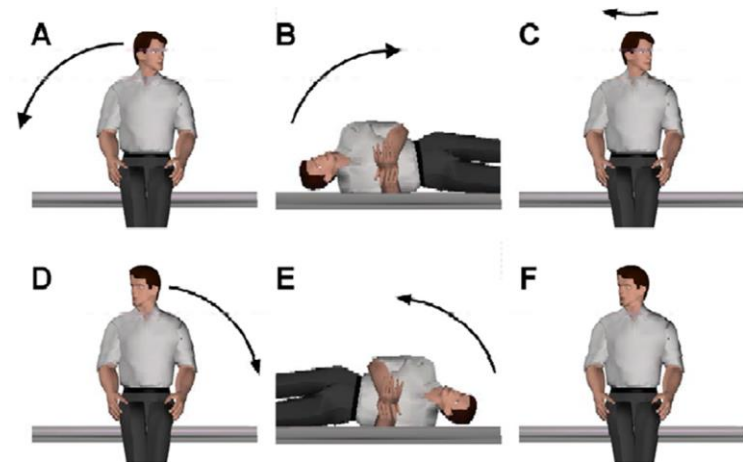
Modified BBQ Roll

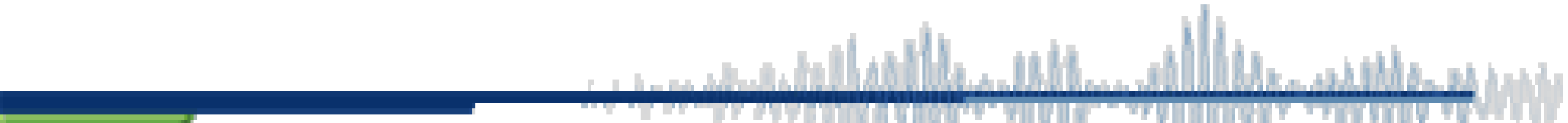
- Slight modification to technique for use with cupulolithiasis of the horizontal canal.
- Starting in sitting with the head turned to the affected side. The person is then brought swiftly into supine with the head turned toward the unaffected side and down into cervical extension.
- The person is then assisted to roll into prone with the head forward off the mat table, followed by rolling back to supine as in the BBQ Roll.

Brandt-Daroff Exercises

- Home-based exercise to reduce canal sensitivity following vertigo episodes involving ant./post. canal.
- Start sitting on the edge of the bed. Lie to one side with the head turned up to the ceiling and hold 30 sec.
- Return to sit for 30 sec., then lie to the opposite side with head turned to face ceiling for 30 sec.

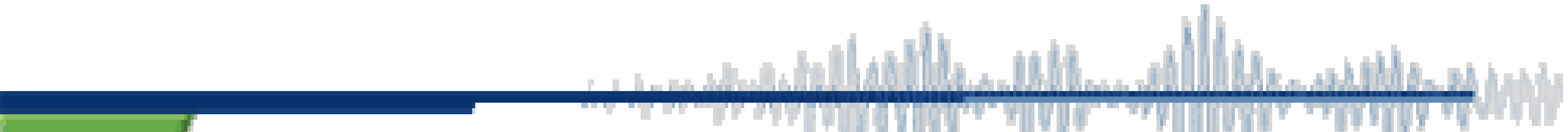
Brandt-Daroff Exercises





Recommended Clinical Protocol for Audiologists

- 1 History: confirm brief, position-triggered vertigo (lying down, rolling in bed, looking up).
- 2 Screen for red flags (neurological symptoms, hearing loss, migraine features, recent trauma).
- 3 Perform Dix-Hallpike (both sides) under VNG/Frenzel – document latency, direction, duration, SPV.
- 4 If horizontal nystagmus or negative Dix-Hallpike with suggestive history → perform supine roll test.
- 5 Identify canal + mechanism (canalithiasis vs cupulolithiasis) using the patterns above.
- 6 Select and perform the appropriate repositioning maneuver; re-test immediately after.
- 7 Counsel patient; arrange short-interval follow-up. Consider home exercises (Brandt-Daroff) only if residual or recurrent.
- 8 If atypical features or failure of appropriate CRP → consider central causes and refer.



Key Takeaways

- ✓ Dix-Hallpike + supine roll under VNG form the core diagnostic battery for BPPV.
- ✓ Always characterize latency, direction, duration, and geotropic/apogeotropic pattern.
- ✓ PC-canalolithiasis → Epley (or Semont); HC-geotropic → Barbecue or Gufoni.
- ✓ Persistent pure vertical or atypical direction-changing nystagmus → think central.
- ✓ Re-test after treatment; most patients improve with 1–2 correctly performed maneuvers.
- ✓ Document objectively; educate the patient; know when to refer.



In the middle of difficulty lies opportunity

Albert Einstein

*Thanks for your
attention*