Advances & Future Direction: International Vestibular Rehabilitation Conference

American Physical Therapy Association Combined Sections Meeting
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Sponsored by the Academy of Neurologic Physical Therapy

EDITORS’ NOTE
An International Conference on Vestibular Rehabilitation
Janet Helminski, Michael C Schubert, and Susan L Whitney
Special Supplement Editors

RESEARCH ARTICLES
Incremental vestibulo-ocular reflex adaptation training dynamically tailored for each individual
Chris Todd, Michael C. Schubert, Will Figtree, and Americo Migliaccio

CASE REPORTS AND SERIES
Peripheral downbeat positional nystagmus apogeotropic posterior canal or anterior canal BPPV: a case series
Janet Helminski

SPECIAL INTEREST ARTICLES
Vestibular physical therapy in individuals with cognitive impairment: a theoretical framework
Brooke Klatt, Julie Ries, Pamela Dunlap, Susan L. Whitney, and Yuri Agrawal
Approach to the examination and classification of nystagmus
Scott Eggers

Ocular misalignment in dizzy patients – something’s a-skew
Daniel Gold and Michael C. Schubert

Eye movements, dizziness and mild traumatic head injury (mTBI): emerging evidence
Susan L. Whitney and Patrick Sparto

Deranged calcium metabolism in benign paroxysmal positional vertigo
Seong-Hae Jeong and Ji-Soo Kim

Update on HINTS PLUS, PITFALLS, and PEARLS
Jorge Kattah
Conflict of Interest

• The views expressed are those of the authors and do not necessarily reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

• Drs. Helminski and Schubert receive speaker fees from the Academy of Neurology of the American Physical Therapy Association.

• Dr. Whitney receives speaker fees from Interacoustics and the Academy of Neurology of the American Physical Therapy Association.
Objectives

• Upon completion of this educational session, the participant will be able to:
  
  • Use evidence based clinical decision rules to differentiate peripheral from central vestibular dysfunction in acute vestibular syndromes.
    Susan L. Whitney, DPT, PhD, NCS, ATC, FAPTA

  • Apply principles of motor learning to optimize performance of the VOR in individuals with vestibular hypofunction.
    Michael C. Schubert, PT, PhD, FAPTA

  • Interpret unusual patterns of nystagmus observed during positional testing and implement the “ideal” particle repositioning maneuver based on biomechanics of BPPV.
    Janet O. Helminski, PT, PhD

  • Discuss technologies that are currently being developed around the world that may improve care for persons with balance and vestibular disorders.
    MAJ Carrie W. Hoppes, PT, PhD, NCS, OCS
Peripheral versus Central: How to differentiate?

Susan L. Whitney, DPT, PhD, ATC, FAPTA
Neurologic Clinical Specialist
University of Pittsburgh
Outline

- Typical peripheral and central signs and symptoms
- Describe the various peripheral and central diagnoses seen
- Eye movement characteristics of nystagmus
- Examination of eye movements in emergent situations
- Symptoms of serious pathology
- Barany Society's attempt to classify nystagmus
Typical peripheral and central signs and symptoms
Typical Peripheral Signs and Symptoms

• Acutely nystagmus will be seen

• Chronically if they have not compensated, you may still see nystagmus but not as severe as that seen acutely

• May have vertigo associated with positional changes

• May have oscillopsia

• Veering during gait

• Vomiting and nausea are common
Typical Central Signs and Symptoms

- May have down or up beating nystagmus
- May have cerebellar signs and symptoms
- May have mild to severe head aches (this could be either peripheral or central)
- May have associated head injuries/cervical dysfunction
<table>
<thead>
<tr>
<th><strong>Typical Central Signs and Symptoms</strong></th>
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<tr>
<td>Changes in pupillary size</td>
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<td>Ptosis</td>
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<td>A sense of tilting by the patient</td>
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<tr>
<td>Difficulty with swallowing</td>
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<tr>
<td>Changes in sensation</td>
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<tr>
<td>A positive Babinski, increased DTR’s, or clonus</td>
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<td>Gait ataxia</td>
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Typical Peripheral and Central Vestibular Diagnoses
Peripheral Vestibular Disorders

- Benign Paroxysmal Positional Vertigo
  - Excellent Prognosis
  - Occurs with a change of head position
  - Often causes vertigo/dizziness
  - Has a delayed onset latency
  - Usually lasts under a minute
  - See Nystagmus based on the involved canal

- Acute
  - Nausea/vomiting and vertigo/dizziness that lasts hours to days
  - Moderate gait instability/no ataxia
  - Direction fix ednystagmus
  - Positive head impulse test
  - Oscillopsia

- Chronic
  - Dizziness associated with head movement
  - Have mild gait instability
  - Difficulty seeing clearly when head is moving quickly

- Unilateral Vestibular loss (hypofunction)
  - Good Prognosis

- Bilateral Vestibular loss (Dandy's Syndrome)
  - Guarded Prognosis
  - Bilateral head impulse +
  - Wide based gait
  - Oscillopsia
  - Difficulty walking in the dark/uneven surfaces

- Other Unilateral Conditions
  - Acoustic Schwanoma
  - Meinere's Disease
  - Ramsey Hunt
  - Perilymphatic Fistula
Central Causes of Dizziness

- Vestibular Migraine (VM)
  - Concussion/Head Injury
    - dizziness
    - vertigo
    - fogginess
    - difficulty concentrating
    - headache
    - nausea
    - difficulty reading
    - easily frustrated
    - neck problems

- Stroke
  - AICA
  - PICA
  (look for hearing loss (AICA))

- Cerebellar Disorders

- Psychiatric
  - Anxiety disorders
  - Panic disorder
  - Agoraphobia
  - Acrophobia

- Multiple Sclerosis
Bisdorff AR et al., 2015
Eye Movement Observation of Nystagmus
Visually induced nystagmus
First Degree

Second Degree

Third Degree
UPBEATING NYSTAGMUS

R

L

- - -
Multiple Sclerosis can look like an acute vestibular syndrome (AVS) (Pula JH et al, J of Neurol, 2013)

- 4% of 170 AVS presentations had the diagnosis of multiple sclerosis
- Symptoms included vertigo, nystagmus, vomiting/nausea, unsteady gait and head movement intolerance
- All presented with central oculomotor signs
- They also had a NORMAL head impulse test
VOR deficits with medial longitudinal fasciculus lesions (Aw ST et al, J of Neurol, 2017)
Examination of eye movements in emergent situations
HINTS - Used to evaluate acutely to determine if there is a stroke or a peripheral problem

• **HI:** Head impulse (negative or positive)
• **N:** The direction of the nystagmus (same direction regardless of eye position or direction changing)
• **TS:** Test of skew (look for vertical ocular misalignment in the primary position of gaze)

• **HINTS plus:** Check for new hearing loss, usually on the side of the abnormal head impulse test (the hearing loss may indicate a vascular event) (Tarnutzer AA et al, 2011; Newman-Toker DE, 2012; 2013; Lee H, 2012)
Head Impulse Test

- A clinical test of the vestibular ocular reflex
- Used at the bedside
- Look for a refixation saccade following a rapid, small amplitude head rotation
Five Item ABCD2 risk score; stroke finding risk score is $\geq 4$ (Newman-Toker DE et al, 2013)

<table>
<thead>
<tr>
<th>Five Item ABCD2 risk score</th>
<th>Stroke findings: risk score $\geq 4$</th>
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<tbody>
<tr>
<td>Age</td>
<td>A $\geq 60$ years = 1</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>B Systolic $\geq 140$ or diastolic $\geq 90$ = 1</td>
</tr>
<tr>
<td>Clinical feature</td>
<td>C Unilateral weakness = 2; Speech disturbance without weakness = 1; any other symptoms = 0</td>
</tr>
<tr>
<td>Duration of symptoms</td>
<td>D Less than 10 minutes = 0; 10-59 = 1; $\geq 60$ min = 2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>D Present = 1</td>
</tr>
</tbody>
</table>
HINTS Outperforms ABCD2 to Screen for Stroke in Acute Continuous Vertigo and Dizziness
HINTS Outperforms ABCD2 to Screen Stroke in Acute Continuous Vertigo and Dizziness

Symptom Timing
segretates transient from acute, persistent vertigo or dizziness

HINTS ‘plus’ Exam
differentiates stroke suspects from vestibular neuritis

Definite Stroke
lysis candidate (early & with neuro signs)

Probable Stroke
not eligible for lysis (late or no signs)

No Stroke
vestibular neuritis*

Neuroimaging
helps determine management and disposition decisions

CT to exclude hemorrhage before lysis; MRI after
<48hrs post onset: observation or admit, delayed MRI
>48hrs post onset: MRI from ED to determine dispo

HINTS versus ABCD2

• N=190 presenting to the emergency room; mean age: 60.5; 35% had vestibular neuritis, 60% had posterior stroke; 5% had other central disorders

• With ABCD2 of ≥ 4, 61% sensitivity; 62% specificity

• With HINTS plus ABCD2, 97% sensitivity; 84% specificity

• Initial MRI was falsely negative in 14% of cases

Newman-Toker DE et al, Academic Emergency Medicine, 2013
N=98

Took an average of 10 minutes to complete the testing (done by 5 emergency room physicians)

Tested 30 people twice (2 physicians)

Overall sensitivity - 93%; specificity - 96%; Positive predictive value: 81%; Negative predictive value: 99%

Central versus peripheral—Cohen’s kappa was 0.76
Figure 1. Diagram of STANDING approach. HIT, Head Impulse Test; VN, vestibular neuronitis.
Suppression head impulse test (SHIMP) – a newer test that may have merit

• Method to examine re-fixation saccades
• Target is fixed with the head rotation like VOR cancellation or VOR suppression
• Records the ability to suppress the VOR
• Normal is showing a fast corrective saccade (abnormal is when the saccade is absent)
• This can be tested with some of the vHIT computerized goggles on the market

Van de Berg R et al, Clin Opin Neurol, 2018; Maheu M et al, Exp Brain Res, 2018; Devantier L et al, J of Vestib Res, 2018
TITRATE

**Triage**
- Identify dangerous causes by the presence of associated symptoms, altered mental status, abnormal vital signs, or ancillary test results

**Timing**
- Determine the differential diagnosis by the pattern of the dizziness: episodic, acute, chronic

**Triggers**
- Triggers: positional or exposure (trauma) in the review of systems

Targeted Exam

- Differentiate benign versus dangerous causes based on the timing and triggers using bedside findings, with emphasis on the eye movement exam

Test

- Chose the best laboratory or imaging test if there is residual uncertainty about a dangerous cause that can not be ruled out

TITRATE

- TIMing, TRiggers, And Targeted Exams

Acute Brain Imaging is mandatory if there are one or more of the following:

- Isolated vertigo of hyper acute onset (seconds) which persists
- Acute vertigo with an intact head impulse test
- Acute vertigo with new onset headache, especially occipital
- Acute vertigo with any central signs, including severe gait or truncal ataxia
- Acute vertigo and deafness without typical Meniere’s history
What doesn’t look right here?
Lateral Medullary Infarcts

• Can see horizontal nystagmus that beats away from the side of the infarct

• It may also beat during eye closure

• One can see a torsional component with lateral medullary infarcts that mimics posterior canal BPPV
What is the physical therapy diagnosis?

#1 Sensory selection and weighting deficit
#2 Force production deficit
Symptoms of Serious Pathology
Symptoms in persons with dizziness that may indicate serious pathology

- Slurred speech
- Hearing loss (sudden or gradual)
- Visual field loss
- Double vision
- Color vision loss
- Paresthesia/numbness
Symptoms in persons with dizziness that may indicate serious pathology

- Non dermatomal paresthesia or numbness
- Memory loss
- Unexplained weight loss
- Severe pain
- Numbness or paresthesia of face
Symptom behavior that may indicate serious pathology

- Constant symptoms
- Triggered only with a change in body position (sit to stand)
- Presence of prodromal symptoms (increased HR, pallor, blurred vision)
Persistent geotrophic positional nystagmus

• Geotrophic nystagmus may be a sign of a unilateral cerebellar lesion (seen in 12% of people with geotrophic nystagmus seen in the ED)

• N=58 with geotrophic nystagmus (7 had a cerebellar lesion); the nystagmus looked the same between persons with horizontal canal BPPV and central diagnosis

• **** All persons with a unilateral cerebellar lesion showed impaired horizontal smooth pursuits bilaterally

• 3 of 7 had a positional down beating nystagmus

• Imaging showed that the cause was damage to the cerebellar tonsil

Choi SY et al, Neurology, 2018
Barany Society’s consensus document about nystagmus (Eggars et al, J of Vestibular Research, in press)

Clues to horizontal central vestibular nystagmus:
- Normal HIT
- Gaze evoked nystagmus
- Skew
- Impaired vertical pursuit
- Impaired VOR suppression
- Poor suppression with visual fixation
Eggars summary of the assessment of nystagmus - Nystagmus characteristics

Describe from the subjects vantage point, including torsion

Attributes: binocularity, conjugacy, waveform, velocity, frequency, amplitude, temporal profile, gaze positions, and visual fixation
Eggars summary of nystagmus - Classification

- Spontaneous
- Triggered
- Gaze-evoked
Take home messages

- Do a thorough exam or you may miss something important
- Use the Barany descriptors for nystagmus when the paper is published in JVR
- Use HINTS, especially in acute cases
University of Pittsburgh

School of Health & Rehabilitation Sciences
Department of Physical Therapy
Translating the Biomechanics of BPPV to the Differential Diagnosis and Intervention

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Midwestern University
Downers Grove, IL

August 19, 2018

January 19, 2019
Translating the Biomechanics of BPPV to the Differential Diagnosis and Intervention

Objective
Upon completion, the participants will be able to:
1. Interpret unusual patterns of nystagmus observed during positional testing – downbeating nystagmus (DBN)
2. Implement the “ideal” particle repositioning maneuver based on biomechanics of BPPV.
Visual Perception: What do you “see”?

(Dallenback, 1951)
Perceptual Illusions
Downbeating Nystagmus. What do you “see”?
Anterior Canal BPPV, Apogeotropic Posterior Canal BPPV, or Central Etiology
Dix-Hallpike Test

Examines the Vertical Canals
• Starting position and provoking positions crucial

• Hypothesize the location and direction of movement of debris within the canals based on direction and characteristics of nystagmus.
When Hypothesizing the Direction and Movement of Debris Within the Canal...

Remember the Physiology
(1) Orientation of Canal Planes:
Comparison of Human Canal Planes Using MRI

- Orientation of vertical canal planes from sagittal plane with reference to the frontal plane bisecting the skull.
  - AC - 35°
  - PC - 51°

- Axes of rotation orthogonal to canal plane.

(Suzuki, Masukawa, Aoki, Arai, & Ueno, 2010)
Axis of Rotation Determines Vector of Ocular Nystagmus:
3-D Vector Analysis of BPPN
Illustrated for Right Membranous Labyrinth

- Average axis of rotation.

- Vector of ocular nystagmus (excitation).
  - AC (axis of rotation green)
    - primarily downbeating
    - small or no torsion towards the involved ear.
  - PC (axis of rotation blue)
    - primarily torsion towards the involved ear
    - upbeating

(Aw, Todd, Aw, McGarvie, & Halmagyi, 2005)
2. Position & Orientation of Ampulla & Cupula:
Illustrated for Right Membranous Labyrinth in the Upright Position

• Position and Orientation of Ampulla.
  - AC ampulla is 70° with respect to earth horizontal (almost vertical).

  - PC ampulla is 20° below horizontal.

• Location of ampulla/attachment of cupula is variable (Buki, 2014).

(Bertholon, Bronstein, Davies, Rudge, & Thilo, 2002)
3. Orientation of Hair Cells of the Cristae Ampullaris:

Position of Kinocilium within Cristae Ampulla and Direction of Flow of Endolymph Relative to Kinocilium Determine if Provoked Response of Vestibular Nerve Excitatory or Inhibitory

In the vertical canals
- Kinocilium positioned near long arm of canal.
- Flow of endolymph:
  - *away* from the ampulla *excites* the nerve.
  - *towards* the ampulla *inhibits* the nerve.

(Parnes, Agrawal, & Atlas, 2003)
Direction and Characteristics of Nystagmus  
Suggest Location of Debris Within Canal (Illustrated for Right Ear Involved)

**Typical or geotropic PC-BPPV**
- Canalithiasis – ampullary arm.
- *Excitatory response* of CN VIII
- Excitation ipsilateral SO and contralateral IR (slow phase component).
- *UB with torsion towards involved ear* – fast phase (red arrows)-ny named for fast phase.

**Atypical or apogeotropic PC-BPPV**
- Canalithiasis – non-ampullary arm.
- *Inhibitory response* of CN VIII
- Inhibition of ipsilateral IO and contralateral SR (slow phase component).
- *DB with strong torsion towards uninvolved ear* – fast phase (blue arrows).
Perceptual Illusions:
What do you “see”?

(Jastrow, 1899)
**Peripheral DBN Suggests:**

**Apogeotropic PC-BPPV or AC-BPPV**

uistrated right ear involvement)

### Starting Position

### Provoking Position

### Direction of Movement

#### Atypical or apogeotropic PC-BPPV
- Canalithiasis – non-ampullary arm.
- *Inhibitory response of CN VIII*
- Inhibition of ipsilateral IO and contralateral SR (slow phase component).
- *DB with strong torsion towards *uninvolved* ear* – (fast phase).

#### AC-BPPV – Excitatory
- Canalithiasis – long arm.
- *Excitatory response of CN VIII*
- Excitation ipsilateral SR and contralateral IO (slow phase component).
- *DB with slight or no torsion towards *involved* ear* – fast phase.
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<td><strong>Targeted Examination</strong></td>
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<td><strong>Characteristics of Ny</strong></td>
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<tr>
<td>Direction of Nystagmus</td>
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<tr>
<td>Strong torsion away from involved ear</td>
</tr>
<tr>
<td>(L) torsion-(R) PC; (R) torsion-(L) PC</td>
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<tr>
<td>No torsion</td>
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<tr>
<td>Predominately downbeating</td>
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<tr>
<td>downbeating</td>
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<tr>
<td>Response</td>
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<tr>
<td>Inhibitory</td>
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<tr>
<td>Excitatory</td>
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<tr>
<td>Return to Sitting</td>
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<tr>
<td>Direction of Nystagmus</td>
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<tr>
<td>Absent</td>
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<tr>
<td>Present but does not reverse direction</td>
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<tr>
<td>Reverses direction with reversal=intensity</td>
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<tr>
<td>Absent</td>
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<tr>
<td>Response</td>
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<tr>
<td>Excitatory</td>
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When does Peripheral DBN Suggest Agogeotropic PC-BPPV...
Case 1 – Change from Apogeotropic to Geotropic PC BPPV - Ipsicanal Switch

• 40 year old female with a 7 year history of recurrent BPPV referred to OP PT with new sudden onset of episodic positional vertigo.

  • **Targeted History** – in bed, rolled towards right and developed intense vertigo. Performed self-administered right CRP, experienced severe vertigo and then vomited. Following maneuver complained of persistent dizziness and episodic vertigo.

  • **Targeted Examination** - Evaluated by Physical Therapist 7 days after self administered treatment.

    • No neurological findings.

    • **Pre-medicated with Ondonsetron (Zofran)**

    • Used video oculography to avoid visual fixation.

    • During DHT positioned head 40° below horizon to evoke a response from the vertical canals (Aw, Todd, Aw, McGarvie, & Halmagyi, 2005).
Case 1 - Targeted Examination – DHT
Head Right and Left *same response* – DBN with left torsion component
Return to upright no nystagmus.
Response to head right position illustrated.
Case 1 - Targeted Examination – DHT
Straight Head Hanging Position (SHHP)
Excitatory response strong UBN with right torsion – followed by secondary inhibitory PC adaption DBN with left torsion.
Return to sitting – strong DBN with left torsion
Case 1 – Differential Diagnosis. Change from Apogeotropc to Geotropic PC BPPV - Ipsicanal Switch

Findings of positional testing

- **DBN** in both DHT, absence of nystagmus upon returning to upright and no other neurologic signs suggest vertical canal involvement.
  - AC-BPPV
  - Atypical apogeotropic PC BPPV - non-ampullary segment of PC (Vannucchi, Pecci, & Giannoni, 2012).

- **Left torsion component** suggest canal involved
  - excitation of the left AC or inhibition of the right PC (LARP) – vertical canals of co-planar pairing.
  - Large amplitude of torsion suggests right PC involvement.
  - AC involvement slight or no torsion component.
Case 1 – Differential Diagnosis. Change from Apogeotropic to Geotropic PC BPPV - Ipsicanal Switch

Findings of positional testing - SHHP

- **Strong burst of right torsion with UBN** in the SHHP suggest a reversal in the direction of nystagmus.

  - Debris moved from non-ampullary to ampullary segment of the right PC.
  
  - DBN with left torsion (inhibition of PC) reversed direction to UBN with right torsion (excitation of PC).

- Cl.


![Diagram of positional testing](image)
Symptoms consistent with Apogeotropic PC-BPPV (Vannucchi et al., 2015).

- Marked sense of dizziness/imbalance.
- Persistent dizziness – debris unstable.
- Episodic vertigo – pitch axis motions eg sit up or look up.
- Symptoms last longer than typical PC-BPPV (minutes-hours).
- Marked Neuro Vegetative.
Case 1 - Right CRP.
Premedicated. Treated 4 hours later with (R) CRP. Head (R) strong (R) torsion with UBN & no DBN – suggest (R) geotropic PC-BPPV. At 1 week follow-up, BPPV resolved.
Case 1 – Differential Diagnosis. Change from Apogeotropic to Geotropic PC BPPV - Ipsicanal Switch

Findings right CPR

- With each step of the right CRP an UBN with right torsion component was observed suggesting an orthotropic nystagmus and successful treatment of right PC canalithiasis.
Summary – Intervention for Apogeotropic PC-BPPV and AC-BPPV

- 1st step - Treat with neck extension.
  - If AC-BPPV, treat. Success rate 78.8% (Anagnostou, Kouzi, & Spengos, 2015).

- If apogeotropic PC-BPPV (DBN), try to change to geotropic PC-BPPV(UBN). Once ipsicanal switch to geotropic PC-BPPV(UBN), treat with CRP or liberatory maneuver.
  
  - Debris move freely between the ampullary and non-ampullary segment of the long arm of the PC.

  - Analogous to apogeotropic and geotropic LC BPPV variants.

  - In a clinical study of 50 consecutive pts with pDBN (n=50), 40% were diagnosed with typical PC-BPPV before or after observation of a DBN in the head hang position of the DHT (Cambi, Astore, Mandala, Trabalzini, & Nuti, 2013).
Case 2 – DBN - Canal Jam Non-Ampullary Segment of PC

• 57 year old female 10 year history of recurrent right PC-BPPV referred to OP PT due to new sudden onset of episodic vertigo.

  • **Targeted History** – 2 weeks ago tilted head back to have eye brows waxed and experienced extreme episode of dizziness.
    • Avoids changing position of the head relative to gravity and has residual imbalance.
    • Experiences a constant “floating” sensation.
    • Once woke up at 1 am with extreme vertigo and walked it off.
    • Sleeps elevated. Takes 2.5 mg of valium in evening.

  • **Targeted Examination** - DHT
    • Patient held 2 bottles of cold water in hands.
    • Used video oculography to avoid visual fixation.
Case 2 – Targeted Examination. DHT Head Right.
DHT Head Left no nystagmus or symptoms.
DHT Head Right – 60s latency DBN & (L) torsion. Immediate onset of symptoms.
Case 2 – Targeted Examination. DHT Head Right.
DHT Head Left no nystagmus or symptoms.
DHT Head Right – 60s latency DBN & (L) torsion. Immediate onset of symptoms.
Case 2 – Differential Dx. Canal Jam Non-Ampullary Segment of PC

Findings of positional testing

- **DBN** in (R) provoking position of DHT, no symptoms or ny in (L) provoking position, and no other neurologic signs suggest vertical canal involvement.

  - AC-BPPV

  - Apogeotropic PC BPPV - non-ampullary segment of PC (Vannucchi, Pecci, & Giannoni, 2012).

- **Possible causes of persistent DBN** (Buki et al, 2014).

  - Canal jam of otoconial debris located within the non-ampullary segment of the long arm of the right PC. In this case, 60s latency before onset suggest canal jam.

  - Inferiorly located cupulolithiasis of the right PC cupula. Anatomic angle of the attachment of the inferior cupula to the utricle varies.

- **Large amplitude (L) torsion with DBN** suggest right PC involved.
Case 2 – 2\textsuperscript{nd} cycle CRP for Right PC-BPPV.

- Treated 2 cycles CRP for (R) PC-BPPV.
- Head right, head left, and sidelying observe DBN with (L) torsion. Return to upright no ny.
Case 2 – Particle Repositioning Maneuvers for Apogeotropic PC-BPPV

- **Canalith Repositioning Procedure initiated from involved side.**
- Location of debris within the long arm at the time of initiation of maneuver should not impact success.
- Position and duration that each position is maintained is crucial for success (Rajguru et al, 2004; Obrist et al, 2016).
Case 2 – Particle Repositioning Maneuvers for Apogeotropic PC-BPPV

- **Demi Semont maneuver**
  (Vannucchi et al., 2015)
  - Slowly move from sitting to lying on uninvolved side with head turned 45° nose down. Move slowly down to avoid nausea/vomiting.
  - After 20-30 seconds, quickly move to sitting up.
Case 2 – Therapeutic Intervention.
DNB - Canal Jam Non-Ampullary Segment of PC

- Hypothesis - removed debris from non-ampullary segment of PC.
- CRP for (R) PC-BPPV. Treatment failure.
In Summary...
## Targeted Examination

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<td>SHHH</td>
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<tr>
<td>Direction of Nystagmus</td>
<td>Strong torsion away from involved ear (L) torsion-(R) PC; (R) torsion-(L) PC or No torsion downbeating</td>
<td>Weak torsion towards involved ear (R) torsion-(R) AC; (L) torsion-(L) AC or No torsion</td>
</tr>
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<td>Response</td>
<td>Inhibitory</td>
<td>Excitatory</td>
</tr>
<tr>
<td>Return to Sitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direction of Nystagmus</td>
<td>Absent -or- Present but does not reverse direction -or- Reverses direction with reversal=intensity</td>
<td>Absent</td>
</tr>
<tr>
<td>Response</td>
<td>Excitatory</td>
<td>-</td>
</tr>
</tbody>
</table>

**Key:** DBN – Vertical Canal Involved. Torsion – Side Involved.
### Targeted Treatment

<table>
<thead>
<tr>
<th>Apogeotropic PC-BPPV</th>
<th>AC-BPPV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neck Extension</strong></td>
<td><strong>Neck Extension</strong></td>
</tr>
<tr>
<td>(Anagnostou, Kouzi, &amp; Spengos, 2015)</td>
<td>(Helmsinki &amp; Hain, 2007)</td>
</tr>
<tr>
<td><strong>Demi-Semont</strong></td>
<td><strong>Forward CRP</strong></td>
</tr>
<tr>
<td>(Vannucchi et al., 2015)</td>
<td>(Faldon &amp; Bronstein, 2008)</td>
</tr>
<tr>
<td><strong>Canalith Repositioning Procedure</strong></td>
<td></td>
</tr>
</tbody>
</table>
When to Refer for Further Evaluation
(Bhattacharyya et al., 2017)

DBN may suggest central paroxysmal positional nystagmus (CPPN) originating from central vestibular dysfunction from intracranial pathological conditions (Choi et al, 2017).

- Induced in multiple planes caused by inhibition of the canals normally activated during positioning.
- Associated with impaired pursuit and other associated neurologic findings.

Evaluate with a thorough neurologic examination if symptoms consistent with those of BPPV and do not show improvement or resolution of symptoms after 2-3 sessions of CRP.
References


Advances & Future Direction:
International Vestibular Rehabilitation Conference

Janet O. Helminski, PT, PhD
Carrie W. Hoppes, PT, PhD
Michael C. Schubert, PT, PhD
Susan L. Whitney, PT, PhD
Conflict of Interest

• The views expressed are those of the authors and do not necessarily reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

• Drs. Helminski and Schubert receive speaker fees from the Academy of Neurology of the American Physical Therapy Association.

• Dr. Whitney receives speaker fees from Interacoustics and the Academy of Neurology of the American Physical Therapy Association.

NO CELL PHONE OR VIDEO RECORDINGS OF ANY KIND ARE PERMITTED.
Objectives

• Upon completion of this educational session, the participant will be able to:
  – Use evidence based clinical decision rules to differentiate peripheral from central vestibular dysfunction in acute vestibular syndromes
  – Apply principles of motor learning to optimize performance of the VOR in individuals with vestibular hypofunction
  – Interpret unusual patterns of nystagmus observed during positional testing and implement the “ideal” particle repositioning maneuver based on biomechanics of BPPV
  – Discuss technologies that are currently being developed around the world that may improve care for persons with balance and vestibular disorders
THE FUTURE STARTS HERE: ADVANCES IN REHABILITATION TECHNIQUES & TECHNOLOGY
Mechanism of Injury
Blast Gauge

Recessed Activation Button
Indicator Lights
Sensor Dome
Micro-USB Port
Impact Resistant Casing
Heavy-Duty Attachment Cord

FLEXIBLE MOUNTING:
HEAD
SHOULDER
CHEST

With permission of BlackBox Biometrics, Inc.
Blast Gauge: Reconstruction Scenario

Overpressure over Time

Video Head Impulse Test (vHIT)

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Sensorimotor Assessment & Rehabilitation Apparatus (SARA)

With permission of Dr. Michael Schubert
Sensorimotor Assessment & Rehabilitation Apparatus (SARA)
Vertical (VAN)  TORSIONAL (TAN)

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References


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