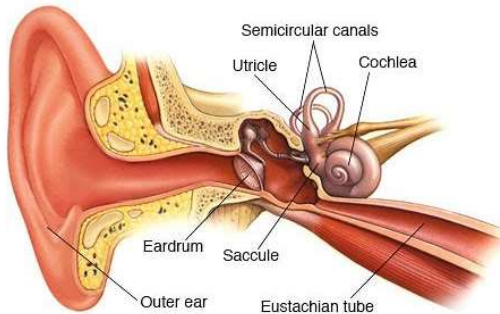


# Thinking Outside the Posterior Canal

## Atypical BPPV Presentations



**Kristen Janky, AuD, PhD, CCC-A**

Scientist II • Center for Hearing Research  
 Director, Vestibular and Balance Laboratory  
 Lead Staff Audiologist, Clinical Vestibular Services



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## Course Objectives:

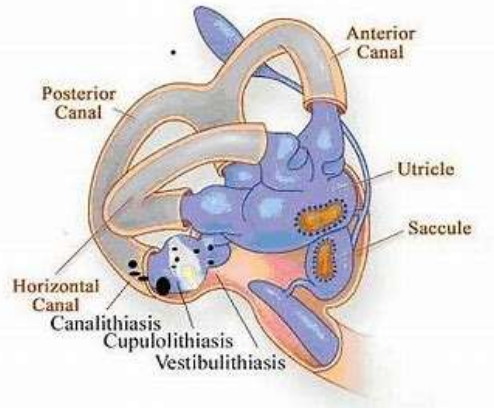
At the conclusion of this course, participants will be able to:

1. Identify the presence of BPPV and the canal involved.
2. List treatment options for anterior canal, horizontal canal, and posterior canal short-arm canal BPPV
3. List patient symptoms associated with subjective BPPV and vestibular agnosia.



2

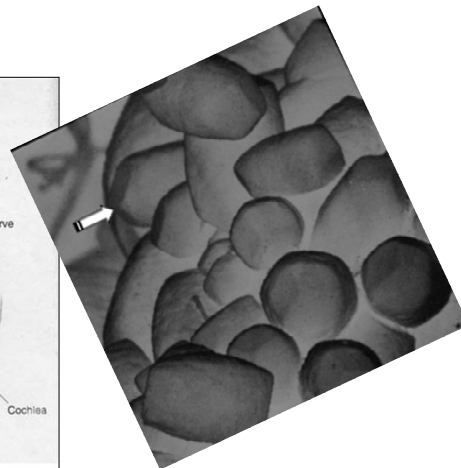
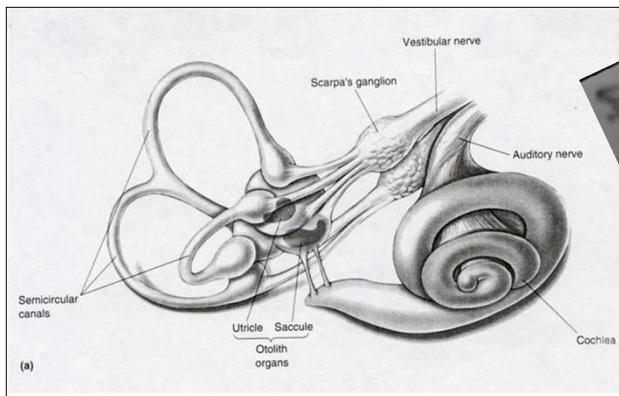
## 90+% of BPPV cases are in the posterior canal



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## Otoconial debris come from the utricle



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## BPPV Classic Characteristics

- Latency – 0 to 15 secs typical; have seen as long as 35 secs
- Duration – typically is < 15 secs up to 1.5 minutes
  - Canalithiasis lasts < 60 seconds; Cupulolithiasis  $\geq$  60 seconds
- Symptoms and nystagmus usually have a crescendo / decrescendo character
- Nystagmus –
  - Vertical canals: torsional with a vertical component due to excitation
    - Reversal of nystagmus with sitting up due to inhibition
  - Horizontal canals: horizontal nystagmus
    - Reversal of nystagmus with head turn due to inhibition
- Habituation – with repeated maneuvers nystagmus and symptom intensity decreases

5

## Diagnosing BPPV- Vertical Canals

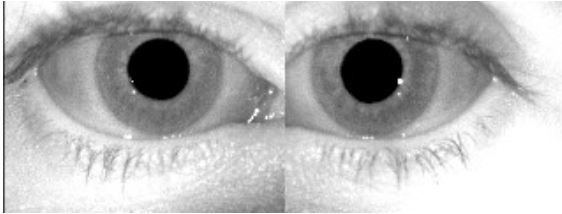
- Diagnosis is made on the **direction of eye movements**:
  - VERTICAL CANALS: Posterior/Anterior
    - Torsion (side): right torsion (right), left torsion (lef)
    - Vertical Component (canal): down (anterior) vs **up (posterior)**
    - Duration (type): short (canalithiasis) vs long (cupulolithiasis)
- All eye movements are in reference to the patient's right and left

	Right Torsion	Left Torsion
Up-Beat	Right Posterior Canal	Left Posterior Canal
Down-Beat	Right Anterior Canal	Left Anterior Canal

6

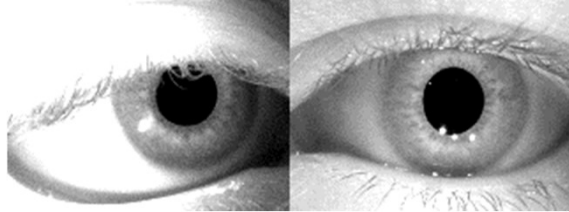
## Right Posterior Canal BPPV

- RIGHT TORSION
- UP-BEAT



## Left Posterior Canal BPPV

- LEFT TORSION
- UP-BEAT

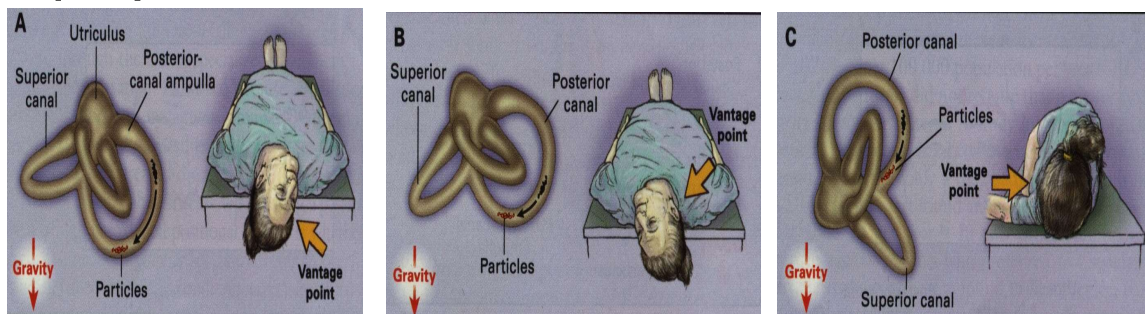


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## Epley





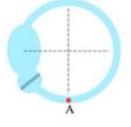


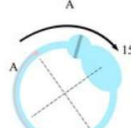


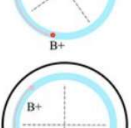


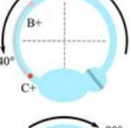


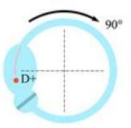
Furman, JM & Cass, SP,  
1999



- Used to treat posterior and anterior canal BPPV
  - Right Epley treats RIGHT BPPV (posterior & anterior)
  - Left Epley treats LEFT BPPV (posterior & anterior)
- Lie in each position 30 seconds

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	Sémont	SémontPLUS	
			
			
			
			
			
			


Extending patient increases efficacy of maneuver

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## Posterior Canal BPPV Pearls

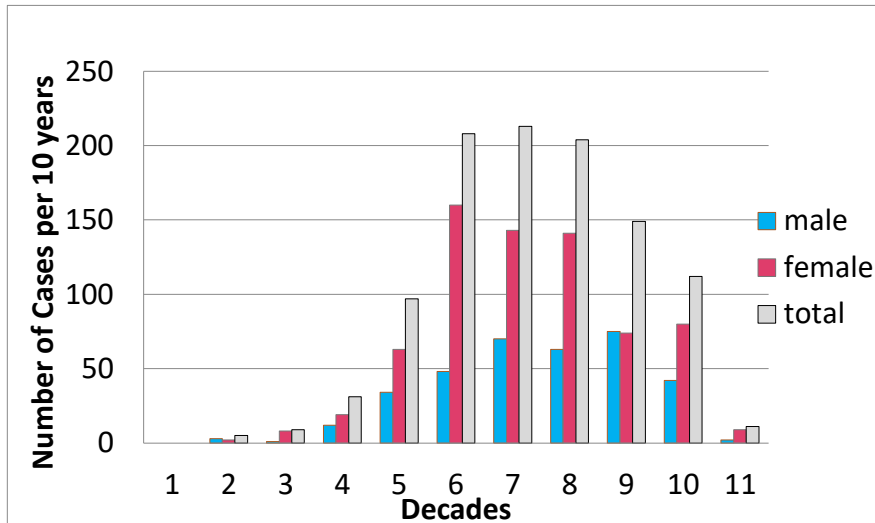
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## BPPV by age and gender - BTNRH

female:male ratio of 2.2 to 1.5:1 (*Bhattacharyya et al*)



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## Diagnosing BPPV

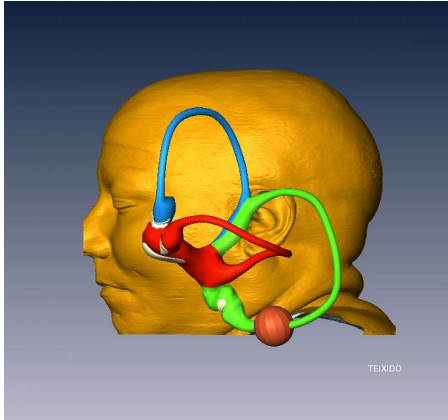
- **Can't tell which direction the eyes are moving???**
- **Changing the patient's line of gaze, can enhance the direction of torsion or beat:**
  - To enhance the direction of torsion, have the patient look toward the floor.
  - To enhance the direction of the vertical component, have the patient look toward the ceiling.



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## A Simple Model for Posterior Canalithiasis



Common  
crus



Long arm

Ampulla

Slide from Michael Texido, BPPV Viewer

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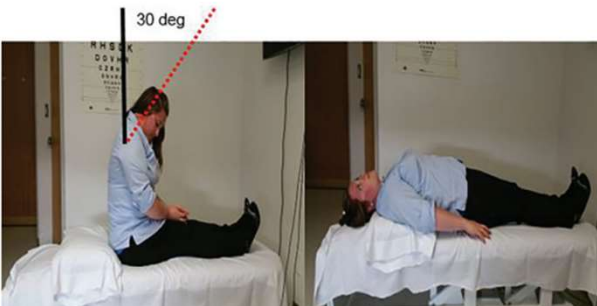
Original Article

### Optimizing Testing for BPPV – The Loaded Dix–Hallpike

Luke Andera , William James Azeredo , Joseph Scott Greene , Haiyan Sun , Jeffrey Walter 

Department of Otolaryngology Head and Neck Surgery, Geisinger Medical Center, Pennsylvania, USA (LA, WJA, JSG, JW)  
Department of Biomedical and Translational Informatics, Geisinger Medical Center, Pennsylvania, USA (HS)

The Journal of  
International  
Advanced  
Otology



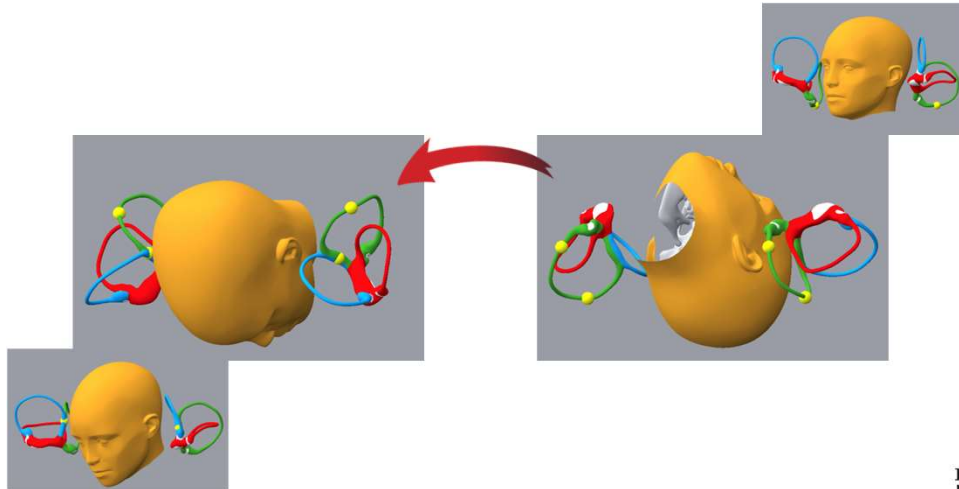
**Figure 1.** "Loaded" Dix-Hallpike (L-DH), head is flexed to 30 degrees in the plane of the right posterior canal and maintained for 30 seconds prior to placing the subject supine.

- Using the Loaded Dix Hallpike
  - Duration of nystagmus was significantly longer
  - Patient symptoms were more severe
  - The loaded Dix Hallpike was more sensitive

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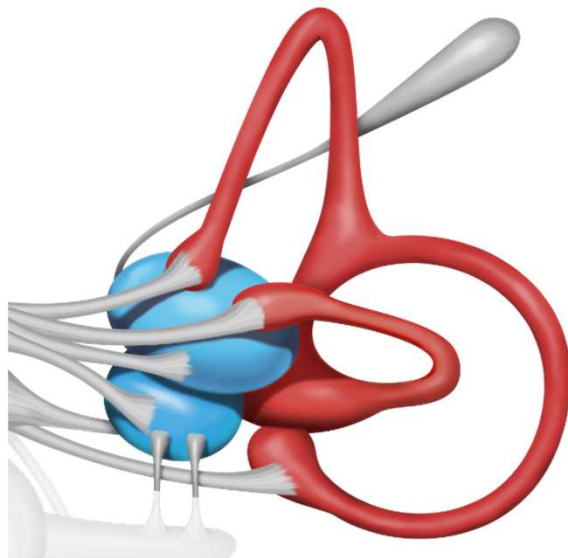
## Bilateral Posterior Canal BPPV? Rapid Sit-up Maneuver treats Both Posterior Canals



Slide from Michael Texido, BPPV Viewer

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## Thinking Outside the Posterior Canal

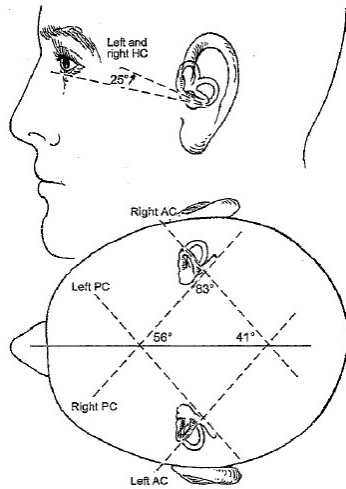
(and other variants)

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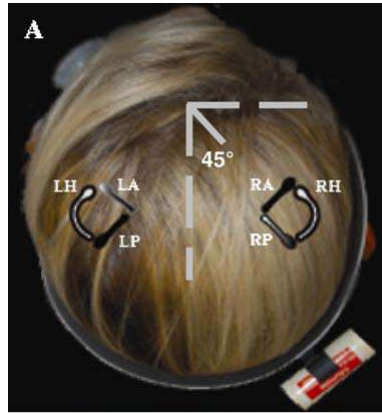
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# Orientation of Vestibular System



Furman & Cass, 2003



Schubert et al., 2006



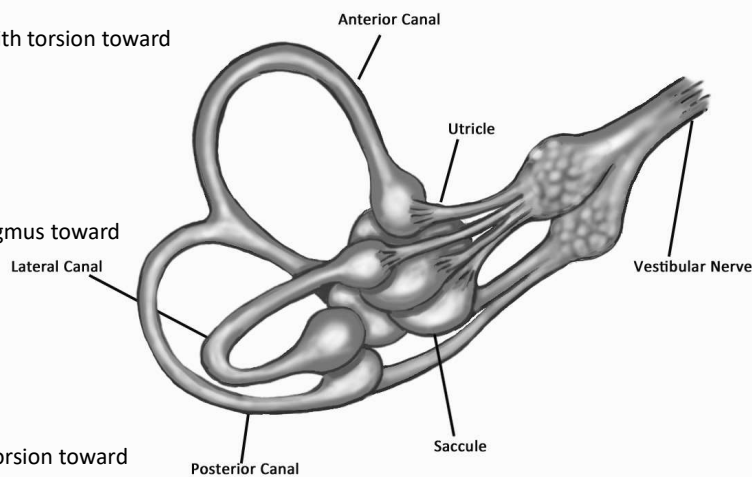
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## Ewald's Law 1: Eye movements occur in the plane of the canal stimulated

AC: down-beat with torsion toward affected side

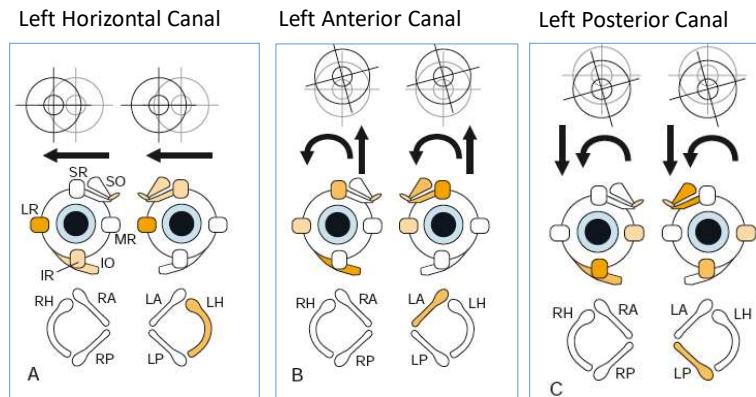
HC: horizontal nystagmus toward affected side

PC: up-beat with torsion toward affected side

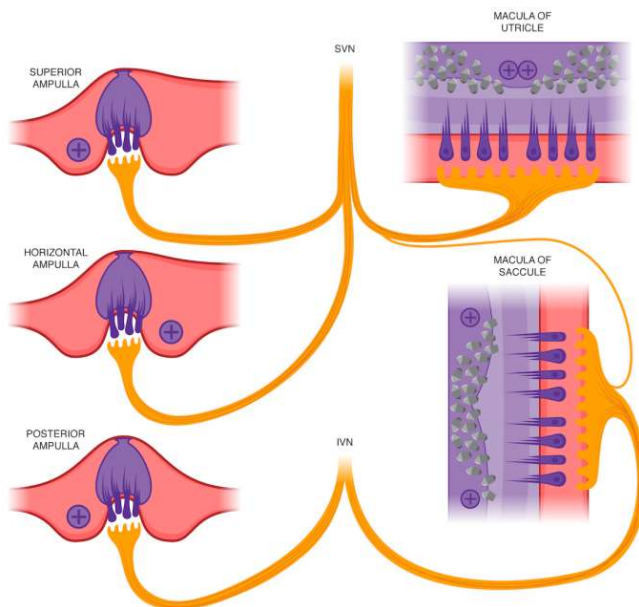


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## Stimulating Individual Canals



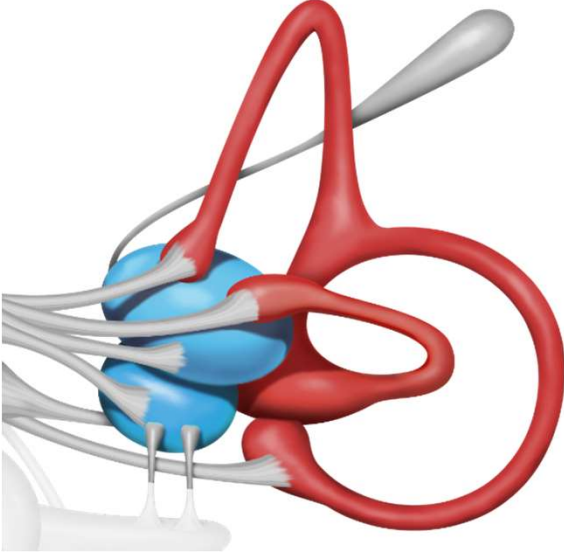
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- Ewald's Law 2 (HCs):
  - Ampullopetal (towards the utricle) flow is excitatory
- Ewald's Law 3 (VCs):
  - Ampullofugal (away from the utricle) flow is excitatory

We can excite a canal more than inhibit

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## Anterior Canal BPPV

- Occurs in about 3% of BPPV cases
- Thought to be controversial

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## Diagnosing BPPV- Vertical Canals

- Diagnosis is made on the **direction of eye movements**:
  - VERTICAL CANALS: Posterior/Anterior
    - Torsion (side): right torsion (right), left torsion (left)
    - Vertical Component (canal): **down (anterior)** vs up (posterior)
    - Duration (type): short (canalithiasis) vs long (cupulolithiasis)
- All eye movements are in reference to the patient's right and left
- Nystagmus will be evident in Straight Head Hanging position

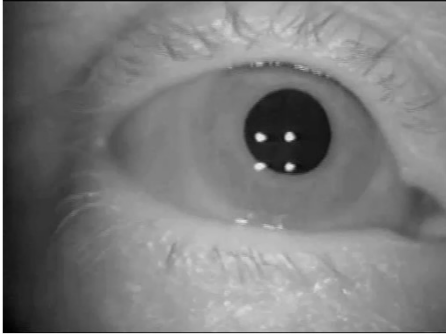
	Right Torsion	Left Torsion
Up-Beat	Right Posterior Canal	Left Posterior Canal
Down-Beat	Right Anterior Canal	Left Anterior Canal

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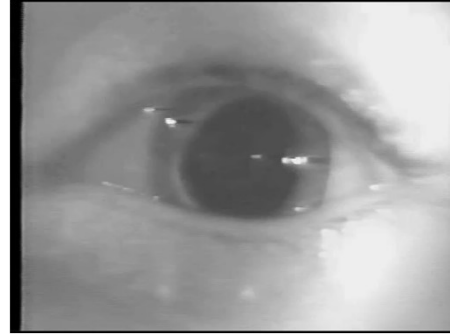
### Right Anterior Canal BPPV

- RIGHT TORSION
- DOWN-BEAT



### Left Anterior Canal BPPV

- LEFT TORSION
- DOWN-BEAT



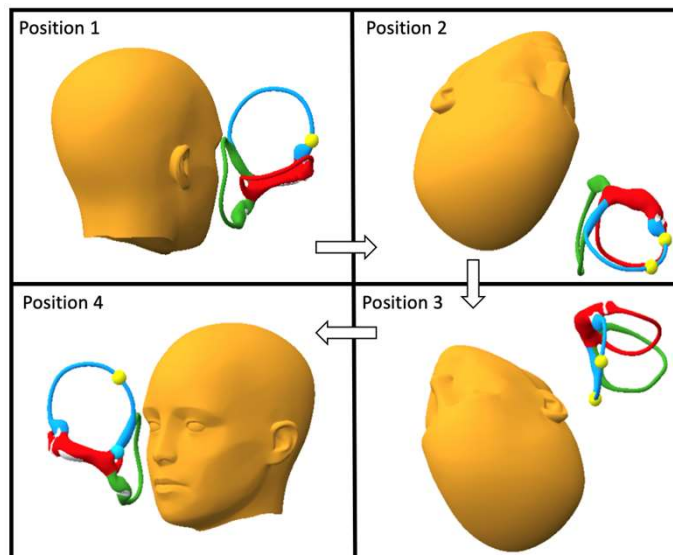
## Treatment of Anterior Canalithiasis

- Epley Maneuver
- Semont (liberatory) Maneuver
- Yacovino maneuver

## Treatment of Anterior Canalithiasis

### Short CRP Maneuver

Slide from Michael Texido, BPPV Viewer



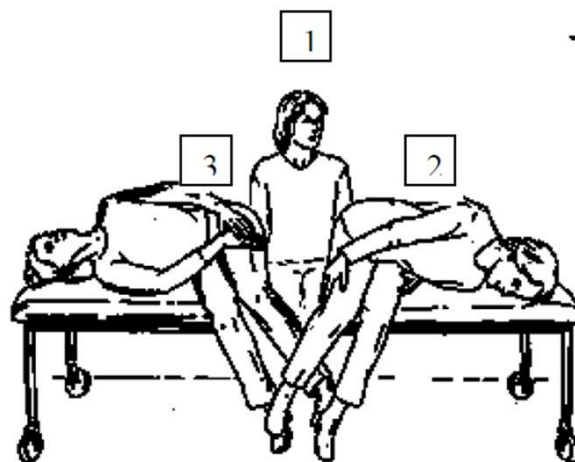
D'Albora, Teixido, et al. Short CRP for Anterior Canalithiasis: a New Maneuver Based on Simulation with a Biomechanical Model, *Frontiers in Neurology*, 2020

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## Treatment of Anterior Canalithiasis

### Semont (Liberatory) Maneuver



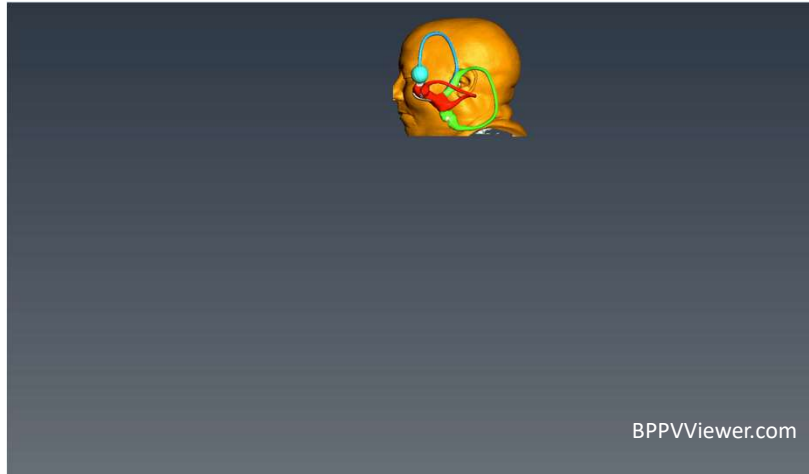
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## Treatment of Anterior Canalithiasis

### Shortened Forced Position Procedure

3 min each position. **Yacovino** Works for both sides.

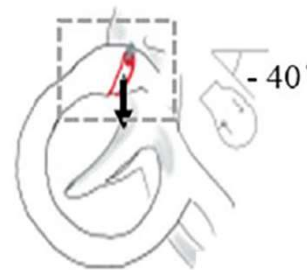


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## Other reasons for down-beat nystagmus

- Excitation of AC
- Inhibition of PC
  - Posterior Cupulolithiasis
  - Short-arm BPPV
- In the Dix Hallpike, if the short arm is connected more inferiorly and/or if the Dix Hallpike position is more pronounced, the head extends  $\sim 30\text{--}40^\circ$  below the earth horizontal, the afferent is inhibited and a constant, low amplitude DBN with or without torsion toward the unaffected side will be observed in the **contralateral** and ipsilateral Dix Hallpike and with Straight Head Hanging



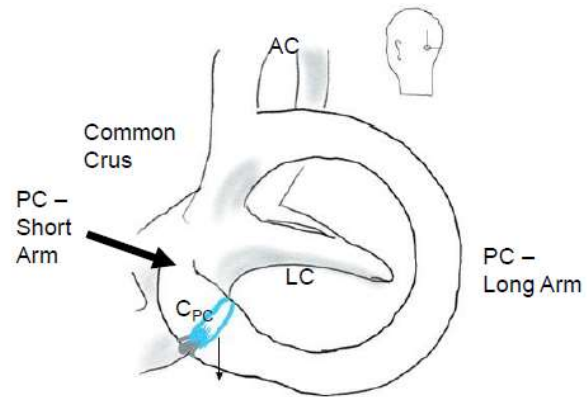
Case report: Atypical patterns of nystagmus suggest posterior canal cupulolithiasis and short-arm canalithiasis

Janet O. Helminski\*  
Department of Physical Therapy, Roosevelt Franklin University, North Chicago, IL, United States

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# Posterior Canal BPPV: Short Arm



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## Posterior Canal Short-arm BPPV: Diagnosis

Down-beat in the Dix Hallpike and up-beat with torsion toward ear involved upon sitting,

Halfway nystagmus,

Sitting up vertigo and retropulsion, or

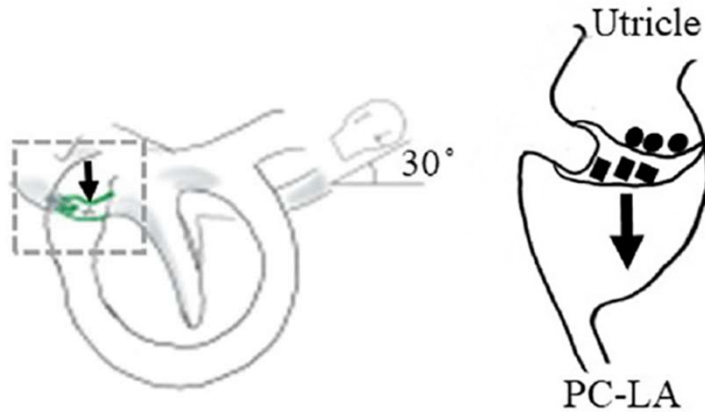
Other unexplained eye movements that don't respond to traditional treatments (i.e., only see eye movements with return to sitting)

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# Half-way Nystagmus

Case report: Atypical patterns of nystagmus suggest posterior canal cupulolithiasis and short-arm canalithiasis

Janet O. Helminski\*  
Department of Physical Therapy, Rosalind Franklin University, North Chicago, IL, United States



= excitation (up-beat with torsion to involved side)

following successful particle repositioning maneuvers, a DBN in the ipsilateral DH position suggests the movement of otolithic debris from the long arm to the short arm during the maneuver (Helminski, 2023)

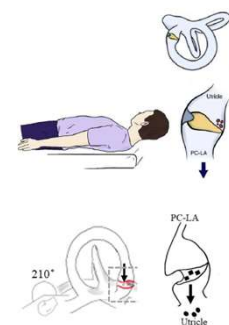


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	Right Torsion	Left Torsion
Up-Beat	Right Posterior Canal	Left Posterior Canal
Down-Beat	Right Anterior Canal Left Posterior Canal (cupulo-LA, canal-SA)	Left Anterior Canal Right Posterior Canal (cupulo-LA, canal-SA)

## Half Hallpike & inverted release to differentiate long from short arm

- Half Hallpike
  - Posterior canals: excitation = UBN with torsion toward affected side
- Inverted Release: Turn head toward unaffected side and lay on unaffected side
  - Cupulolithiasis of the long arm: inhibition = DBN and torsion away from affected side
  - Canalithiasis of short arm: debris should fall out



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## Subjective – Type 2 – BPPV

- Subjective BPPV presents all the symptoms of BPPV, but without nystagmus (short latency to onset in Hallpike, fatigues quickly, response with returning to sitting).
- Truncal instability and retropulsion with sitting up
- Research has shown successful treatment with an Epley maneuver
  - (Huebner et al., 2013, JAAA)

**This could be short-arm BPPV!**

Harmat et al., 2022; Kim et al., 2024



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Subjective BPPV revisited: identification of positional nystagmus with a new maneuver

Hyun-Jae Kim<sup>1</sup> • Young-Eun Gil<sup>2</sup> • Ji-Soo Kim<sup>1,4</sup>

## Subjective – Type 2 – BPPV

- Hypotheses for the absence of positional nystagmus.
  - A **small amount of otoconia** located in the short arm of PC may elicit the symptoms, but not generate nystagmus [12].
  - The cupula **already adapted** to the dislodged otoconia in the sitting upright position could not bring about nystagmus in the Dix-Hallpike position, but overreacts to the endolymphatic flow induced when sitting up from the Dix-Hallpike position [8].
  - Third, the otoconia located in the short arm of PC **could not deflect** the cupula **due to its location** in the inferior portion of the cupula, but may give rise to symptoms without nystagmus depending on changes in the head position [9]. Due to the gravitational effect, the otolithic debris would migrate into the lowermost dependent position [6].



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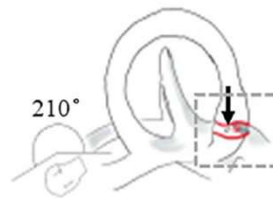
## Posterior Canal Short-arm BPPV: Treatment

- Treat first for long arm and then if not effective, try short-arm
  - Inverted Release
  - Bow and Yaw Maneuver
  - Half Somersault
  - Repeated Dix Hallpike

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## Inverted Release

- For the right PC cupula, do a left side-lying maneuver
- Head rotated left, lie on left side
- If debris are adhered, you will get nystagmus consistent with inhibition (down-beat with right torsion)



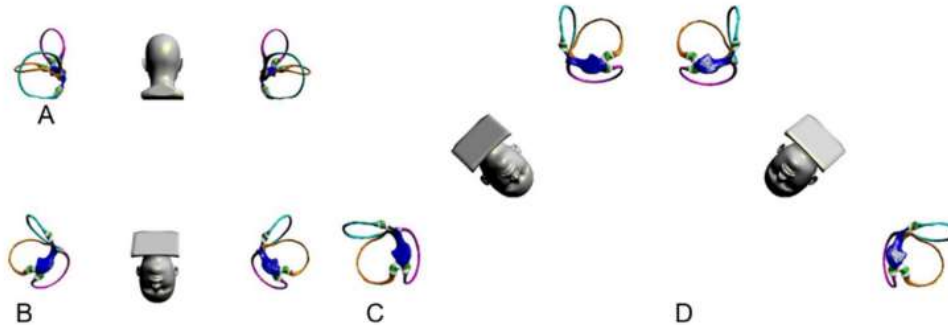
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Janet O. Helminski\*  
Department of Physical Therapy, Rosalind Franklin University, North Chicago, IL, United States

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# Bow and Yaw maneuver for possible short-arm

ORIGINAL ARTICLE  
**Diagnosis and treatment of the short-arm type posterior semicircular canal BPPV<sup>27</sup>**  
 Diagnóstico e tratamento da VPPB de braço curto do canal semicircular posterior  
 Lin Ping<sup>✉</sup>, Zhou Yi-fei<sup>✉</sup>, Wu Shu-zhi<sup>✉</sup>, Zheng Yan-yan<sup>✉</sup>, Yang Xiao-kai<sup>✉</sup>



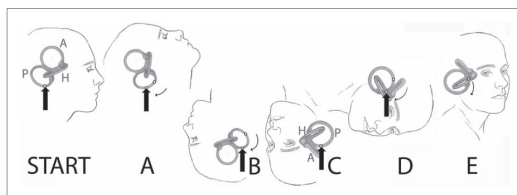
**Figure 1** Bow-and-yaw maneuver. (A) Sit/kneel upright, posterior view. The membranous semicircular canals of the left and right ears, including cupula, are shown. (B) Holds and bows the patient's head 135°. (C) Rotate the patient's head 45° to the right. (D) Rotate the patient's head 45° to the left. Shaking the head helps to shed the otolith before repeating C, D steps.

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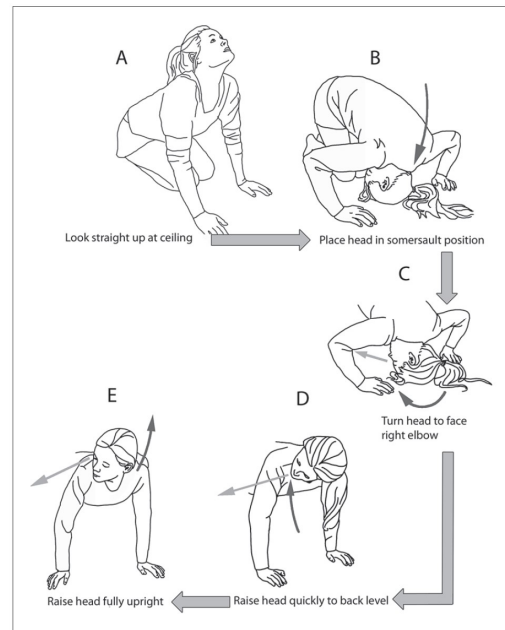
# Half Somersault

## A Comparison of Two Home Exercises for Benign Positional Vertigo: Half Somersault versus Epley Maneuver

Carol A. Foster<sup>a</sup> Annand Ponnapan<sup>b</sup> Kathleen Zaccaro<sup>c</sup> Darcy Strong<sup>c</sup>  
 Departments of <sup>a</sup>Otolaryngology and Audiology, <sup>b</sup>Otolaryngology, and <sup>c</sup>Audiology, School of Medicine, University of Colorado Denver, Aurora, Colo., USA



**Fig. 1.** Half somersault for right-sided BPPV. After each position change, any dizziness is allowed to subside before moving into the next position; if there is no dizziness, the position should be held for 15 s. **A** While kneeling, the head is quickly tipped upward and back. **B** The somersault position is assumed, with the chin tucked as far as possible toward the knee. **C** The head is turned about 45° toward the right shoulder, to face the right elbow. **D** Maintaining the head at 45°, the head is raised to back/shoulder level. **E** Maintaining the head at 45°, the head is raised to the fully upright position. Dark curved arrows show head movements. Lighter arrows near eyes show the direction one should be facing.

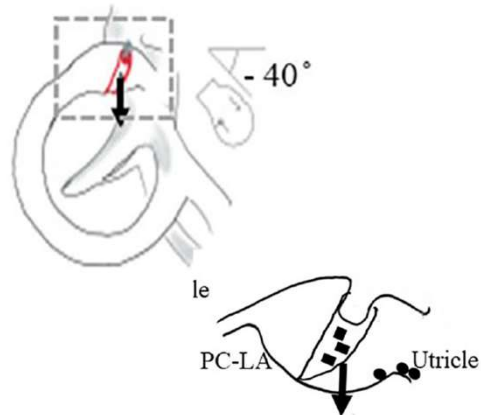


38

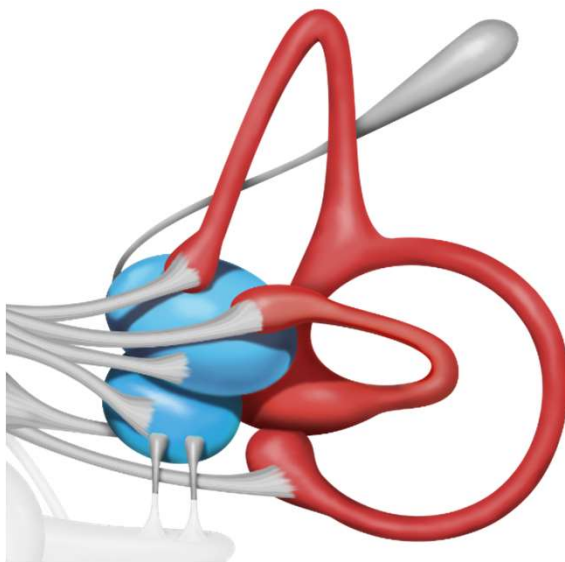
## Repeated Dix Hallpike

Case report: Atypical patterns of nystagmus suggest posterior canal cupulolithiasis and short-arm canalithiasis

Janet O. Helminski\*  
Department of Physical Therapy, Rosalind Franklin University, North Chicago, IL, United States



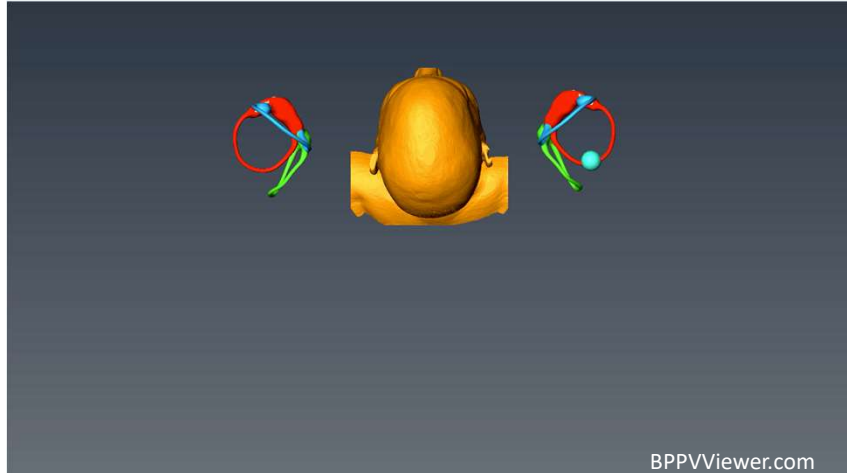
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## Horizontal Canal BPPV

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## Supine Roll Test



BPPVViewer.com

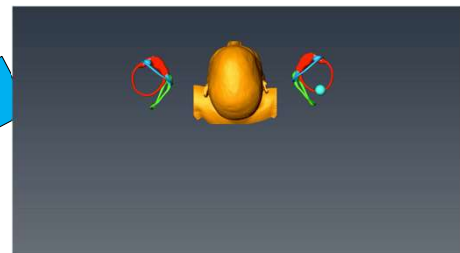
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## Diagnosing BPPV – Horizontal Canals

### CANAL INVOLVED:

- Roll Maneuver – with **canalithiasis**
  - RIGHT HORIZONTAL CANAL BPPV
    - Head RIGHT = RBN
    - Head LEFT = LBN
  - LEFT HORIZONTAL CANAL BPPV
    - Head RIGHT = RBN
    - Head LEFT = LBN
- = GEOTROPIC nystagmus
- How do you know the side involved?
  - The side that elicits the **STRONGER** nystagmus

Same Pattern



Why is that???

42

Not sure which side is stronger?

## Bow and Lean Test - canalithiasis

excitation

excitation

inhibition

inhibition

Choung et al., 2006

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## Diagnosing BPPV – Horizontal Canals

CANAL INVOLVED:

- Roll Manuever – with **cupulolithiasis**
  - RIGHT HORIZONTAL CANAL BPPV
    - Head RIGHT = LBN
    - Head LEFT = RBN
  - LEFT HORIZONTAL CANAL BPPV
    - Head RIGHT = LBN
    - Head LEFT = RBN
- = AGEOTROPIC nystagmus
- How do you know the side involved?
  - The side that elicits the WEAKER nystagmus

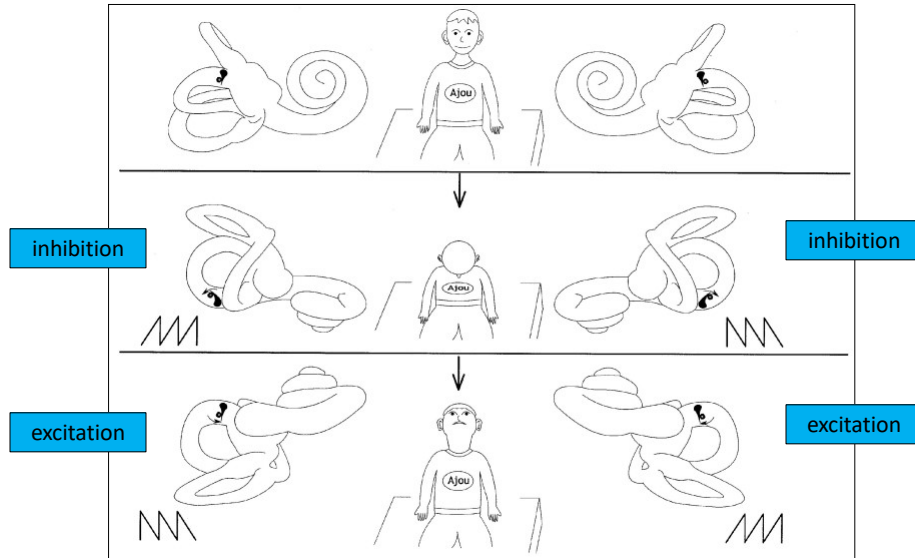
Same Pattern

Why is that???

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## Bow and Lean Test - cupulolithiasis



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## HC BPPV

- Roll test: TYPE
  - Geotropic = canalithiasis (side involved = stronger nystagmus)
  - Ageotropic = cupulolithiasis (side involved = weaker nystagmus)
- Bow and Lean Test: Side involved
  - Canalithiasis: nystagmus beats:
    - Toward affected side when bowing excitation
    - Away from affected side when leaning inhibition
  - Cupulolithiasis: nystagmus beats
    - Away from affected side when bowing inhibition
    - Toward affected side when leaning excitation

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## Lying down positioning test

- Measure nystagmus when the patient moves from sitting to supine.
- Asprella single test
  - Canalithiasis: nystagmus beats: inhibition
    - Away from affected side when leaning
  - Cupulolithiasis: nystagmus beats excitation
    - Toward affected side when leaning

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## Treatment of Lateral Canalithiasis

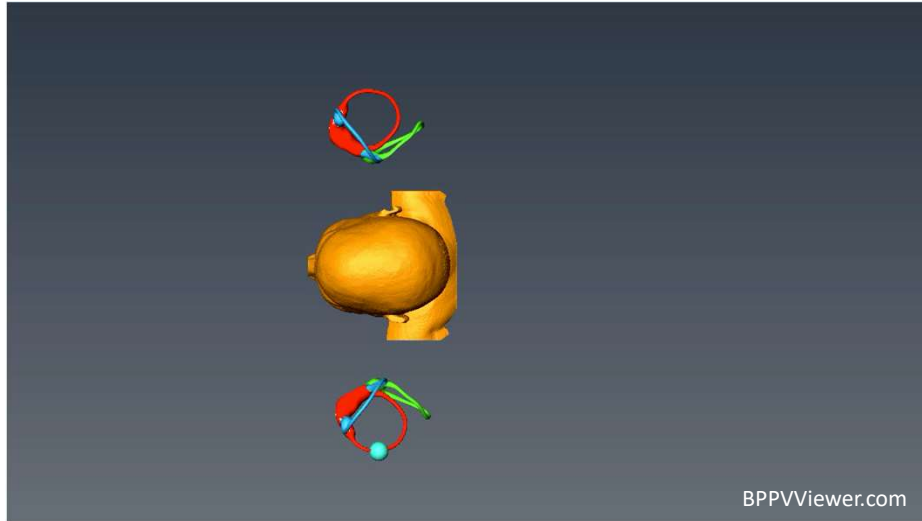
- Log Roll (away from the affected side)
  - Kim's Maneuver (away from the affected side)
- Gufoni (lay away from affected side)
- Forced Prolongation Position (lay away from affected side)
- 180 °Quick Roll Away (from the affected side) (Jinrong Li)

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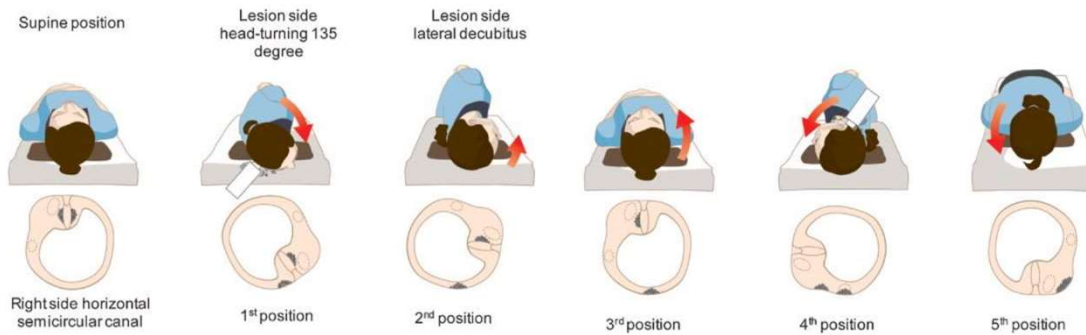
# Log Roll Maneuver (start on affected side and roll away)

## Left Lateral Canalithiasis



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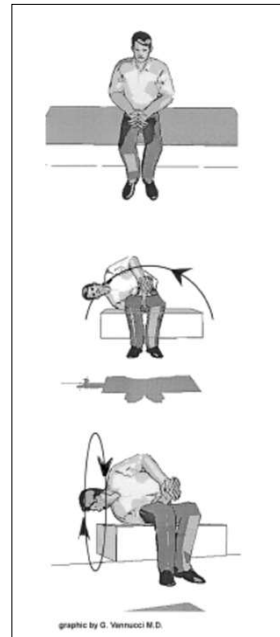
# Kim's Maneuver (start on affected sided and roll away)



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## GUFONI (appiani)

- Use to treat horizontal canal BPPV
- Lay **AWAY** from the side involved
- Lie in each position 1-2 minutes
- If cupulolithiasis, lay **TOWARD** the affected side

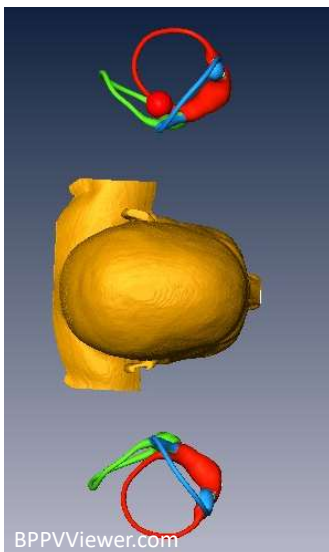


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## Forced Prolongation Position

Lay **AWAY** from the side involved



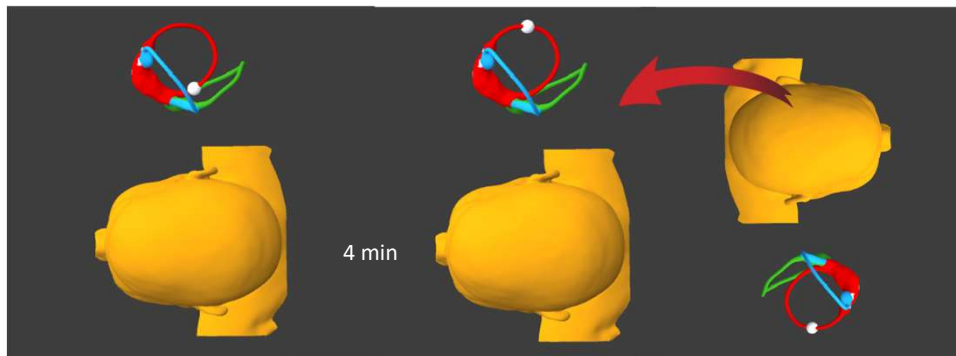
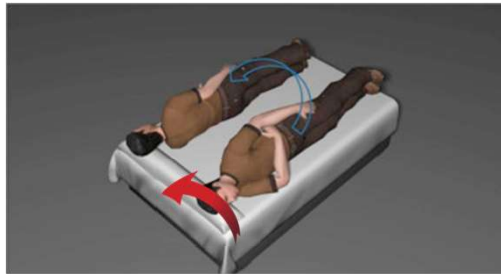
- The patient is asked to lie on the unaffected side for at least 12 h, which allows the material in the horizontal canal to gradually leave the canal and move towards the vestibule under the force of gravity.
- This technique has also been associated with the barbecue method, with an efficacy of 75–90%

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## 180 °Quick Roll away

Jinrang Li et al , Quick repositioning maneuver for lateral semicircular canal benign paroxysmal positional vertigo Journal of Otology  
[Volume 10, Issue 3](#), September 2015



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A few more  
 pearls



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## Non-fatiguing, direction-changing positional nystagmus?

- Is that BPPV?
- Consider light cupula:
  - Like positional alcohol nystagmus, where alcohol preferentially enters the cupula (light cupula, PAN-I, geotropic) and then diffuses faster from the cupula than the endolymph (heavy cupula, PAN-II, ageotropic)
  - Density of the cupula is different from the endolymph (injury, hemorrhage, hypoperfusion, inflammation, or light debris) - associated with acute Vestibular migraine, central lesions
- Clinical features:
  1. Persistent geotropic nystagmus lasting for more than one minute. This nystagmus does not fatigue.
  2. The null point can be identified.
  3. The affected side corresponds to the side where the null point is observed.
  4. There are no central nervous system abnormalities [1,9,14–16].
- Treatment
  - Gufoni, not BBQ roll, but usually spontaneously resolves – longer time course if coupled with sudden SNHL

Review

The Light Cupula Phenomenon: A Scoping Review

Dong-Han Lee, Tae Hee Kim, Minho Jang and Chang-Hee Kim

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## BPPV in children – it does exist!!



- A higher proportion of lateral canal involvement, anterior canal involvement with weaker nystagmus (An et al., 2024; Bhandari et al., 2023; Wang et al., 2023).
- One of the 5 most common peripheral disorders affecting children (Zhang et al., 2023)
- 10 - 29% recurrence rate (Saniasiaya et al., 2023; Wang et al., 2023; Brodsky et al., 2018)
- The most prevalent co-morbidities are concussion and migraine (Brodsky et al., 2019)




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## Vestibular Agnosia: a loss of vestibular perception

- Vestibular agnosia is found in ageing, neurodegeneration and traumatic brain injury, and results in dramatically increased missed BPPV diagnoses.
- Also have worse balance function
  - Impaired balance and vestibular agnosia are co-localized to the inferior longitudinal fasciculus in the right temporal lobe.
- Thus, all older adults (>60 years) with objective or subjective balance problems, irrespective of symptomatic complaint, should have positional testing to examine for BPPV.

### Vestibular agnosia in traumatic brain injury and its link to imbalance




Elena Calzolari,<sup>1,†</sup> Mariya Chepishcheva,<sup>1,†</sup> Rebecca M. Smith,<sup>1</sup>  Mohammad Mahmud,<sup>1</sup> Peter J. Hellyer,<sup>2</sup> Vassilios Tahtis,<sup>1,3</sup> Qadeer Arshad,<sup>4</sup>  Amy Jolly,<sup>5</sup> Mark Wilson,<sup>6</sup> Heiko Rust,<sup>1</sup> David J. Sharp<sup>5</sup> and  Barry M. Seemungal<sup>1,6</sup>

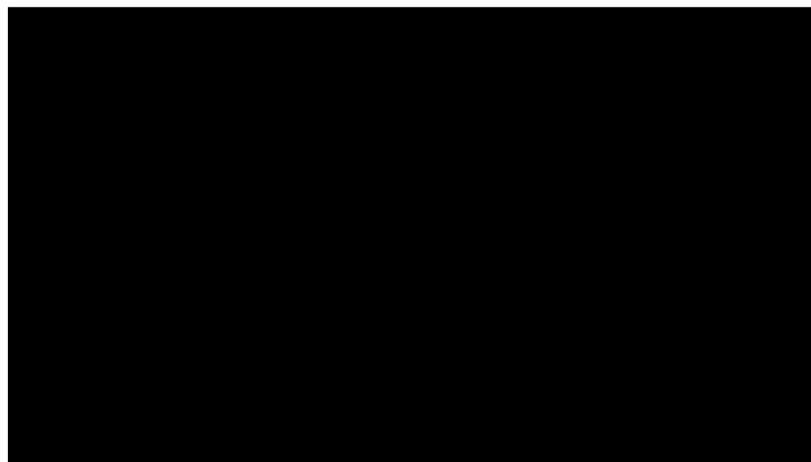
JOURNAL ARTICLE  
We should be screening for benign paroxysmal positional vertigo (BPPV) in all older adults at risk of falling: a commentary on the World Falls Guidelines [Get access >](#)

Yuxiao Li , Rebecca M Smith, Susan L Whitney, Barry M Seemungal, Toby J Ellmers 

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### Vestibular agnosia in traumatic brain injury and its link to imbalance

Elena Calzolari,<sup>1,†</sup> Mariya Chepishcheva,<sup>1,†</sup> Rebecca M. Smith,<sup>1</sup>  Mohammad Mahmud,<sup>1</sup> Peter J. Hellyer,<sup>2</sup> Vassilios Tahtis,<sup>1,3</sup> Qadeer Arshad,<sup>4</sup>  Amy Jolly,<sup>5</sup> Mark Wilson,<sup>6</sup> Heiko Rust,<sup>1</sup> David J. Sharp<sup>5</sup> and  Barry M. Seemungal<sup>1,6</sup>



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## Resources

- Downloadable BPPV Viewer for Windows and iOS at [BPPVViewer.com](http://BPPVViewer.com)



## Posterior Canal BPPV Update

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## Course Objectives:

At the conclusion of this course, participants will be able to:

### 1. Identify the presence of BPPV and the canal involved.

- PC (UBN, torsion toward affected side),
- AC (DBN, torsion toward affected side)
- HC (HN, stronger toward affected side in canalithiasis, stronger toward unaffected side in cupulolithiasis)
- PC-short arm (DBN, UBN, no nystagmus, half-way nystagmus)
- PC-cupulolithiasis (UBN, torsion toward affected side OR DBN with torsion away from affected side)

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## Course Objectives:

At the conclusion of this course, participants will be able to:

### 2. List treatment options for anterior canal, horizontal canal, and posterior canal short-arm canal BPPV

- AC = Epley, Semont, Yacovino
- HC = BBQ, Gufoni, FPP, Roll Away
- PC-short arm = Inverted release, bow and yaw, Half somersault, repeat hallpike

### 3. List patient symptoms associated with subjective BPPV and vestibular agnosia.

- Subjective BPPV (Type 2) – symptoms, no nystagmus
- Vestibular agnosia – nystagmus, no symptoms

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## Not sure what to do?? Try this "universal maneuver"

Universal Repositioning Maneuver: A New Treatment for Single Canal and Multi-Canal Benign Paroxysmal Positional Vertigo by 3-Dimensional Model Analysis

Renato Gonzaga Barreto<sup>1</sup>, Dario Andrés Yacovino<sup>2</sup>, Marcello Cherchi<sup>1,3</sup>,  
Lázaro Juliano Teixeira<sup>1,4</sup>, Saulo Nardy Nader<sup>5</sup>, Gabriel Freitas Leão<sup>6</sup>

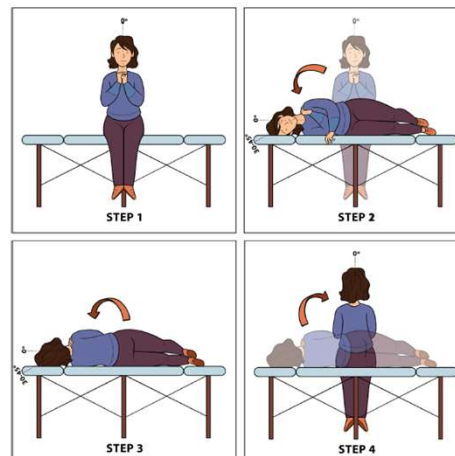


Figure 1. Universal Repositioning Maneuver for the treatment of single canal and multicanal BPPV—Canalolithiasis type, right side—4-step sequence. Step 1: Patient sitting with head neutral (0°) legs hanging down. Step 2: Patient is lying on right shoulder, with head laterally flexed 30°-45° (The head is not horizontally rotated around the patient's vertical axis). Step 3: Patient rolls 180° to the unaffected side, lying on the left shoulder, with head laterally flexed 30-45°. Step 4: Patient sits up keeping the head neutral (0°). BPPV, benign paroxysmal positional vertigo.

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(research experience not needed)



**Research Participant  
Recruitment Program  
Coordinator**



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including invited speakers.




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**KEYNOTE** **Susan Scollie, Ph.D.**  
Professor and Director of the National Centre for Audiology, Western University



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# Questions?