• If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

• This handout is for reference only. It may not include content identical to the PowerPoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
Learning Objectives

- To review the pathophysiology of BPPV
- To define test procedures for BPPV of Posterior, Anterior and Horizontal semicircular canals
- Define treatment maneuvers for BPPV of Posterior, Anterior and Horizontal semicircular canals
Disclosures

- No financial disclosures
- Vestibular EDGE task force member

Dizzy

- Vertigo – illusion of motion; typically described as spinning
- Oscillopsia – visual unsteadiness; bouncing of the visual world
- Imbalance – difficulty maintaining and upright posture
- Disequilibrium – difficulty orienting oneself in space
- Syncope/Near-syncope – sensation of passing out
- Lightheadedness - vague funny feeling in the head – not spinning
Dizziness and Vestibular System

Vestibular System in General

- Typically described as spinning
- May accompany changes in hearing
- Can be episodic (as in BPPV) or constant (as in vestibular hypofunction)

BPPV

- Episodic
- **Typically** short duration (seconds)
- Dependent on position changes

Dizziness Handicap Inventory

- Recently reviewed by Vestibular-EDGE task force of Neurology section of the APTA – Recommended for assessment of BPPV
  - Excellent test-retest reliability ($r = 0.97$, $df=12$, $P<0.0001$) (Jacobson and Newman, 1990)
  - Excellent internal consistency (alpha = 0.89) (Jacobson and Newman, 1990)

- 5-item BPPV subscale (Whitney et al, 2005)
  - developed from current DHI is a significant predictor of likelihood of having BPPV
  - looking up, getting out of bed, quick head movements, rolling over in bed, and bending for a maximum score of 20 points.
  - The BPPV five-item subscore was a significant predictor of likelihood of BPPV ($x^2=8.35; p<0.01$)

- Phone interview detected BPPV with a specificity of 92% and a sensitivity of 88% (vonBrevern, Radtke, et. al., 2008)

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CONTINUED™
Peripheral Vestibular Anatomy

- Semicircular canals—angular acceleration
  - Horizontal/Lateral
  - Posterior/Inferior
  - Anterior/Superior

- Otolith organs—linear acceleration
  - Utricle
  - Saccule

Semicircular Canals

- Fluid filled canals
- Paired system
- ~90° orientation
- Fluid motion results in cupula deflection
  - Resting firing rate of vestibular nerve ~100 spikes/second
  - Cupular deflection either excites or inhibits vestibular nerve
Otoliths

- Utricle – horizontal motion
- Saccule – vertical motion
- Sensitive to gravity

Vestibular Ocular Reflex

- **Purpose:** To maintain fovea on a STATIONARY TARGET while head is in motion
- 3 neuron reflex arc
  - Vestibular ganglion
  - Vestibular nucleus
  - Ocular motor nuclei
VOR – Horizontal SC Paths

- Horizontal Semicircular Canal
  - Contralateral lateral rectus
  - Ipsilateral medial rectus
  - Inhibitory projections to ipsilateral lateral rectus & contralateral medial rectus

- Excitation Right HSC = leftward eye movement

VOR – Posterior SC Paths

- Posterior Semicircular Canal
  - Ipsilateral superior oblique
    - Downward/intorsion
  - Contralateral inferior rectus
    - Downward
  - Inhibitory projections to ipsilateral superior rectus and contralateral inferior oblique

- Excitation PSC = downward and contratorsional eye movement
Pathophysiology of BPPV

- Otoconia ("crystals") typically present in the otolith organs break free and fall into one of the semicircular canals.
- During head movement, the otoconia float within the fluid filled SCC.
- Movement displaces endolymph causing deflection of the cupula.

Incidence of BPPV

- 64,000-100,000 cases/year (Herdman).
- Can occur spontaneously (>50%).
- Age:
  - 11-29 years = 3%
  - 30-59 years = 20%
  - 60-99 years = 30-50%
- May occur post trauma.
Canal Distribution

- Distribution of BPPV by canal has been reported as:
  - 41-90% unilateral PC-BPPV
  - 21-33% LC-BPPV
  - 17% AC – BPPV
  - 20% multi-canal BPPV


Two primary subtypes of BPPV

- Canalithiasis – the debris (canalith) is free floating within the semicircular canal
  - Symptoms will be short lived as the debris moves through the canal
  - Symptoms will cease once the debris (canalith) settles in the most dependent portion of the canal

- Cupulolithiasis – the debris may be attached/adhered to the cupula within the scc
  - Symptoms of long duration
  - Cupula becomes relatively heavy in the endolymph and will persist as long as the individual in in the provoking position
Canalithiasis

- Debris (otoconia) is free floating within SCC
- Will come to rest at most dependent part of the canal ~30 seconds

Characteristics of Canalithiasis

- Vertigo usually lasting <60 sec, associated with a change in head position (lying down, rolling over in bed, bending over, looking up)
- Latency of symptoms – occur 2-3 sec following head movement
- Symptoms fatigue with repeated movement into the provoking positions
Cupulolithiasis

- Debris (otoconia) is adhered to the cupula
- Will continue to stimulate cupula as long as the individual is in provocative position
Posterior Canalithiasis

- 41-90% of cases
- Up-beating ipsitorsional nystagmus
- Typically short duration
- Bending down, looking up, getting in/out of bed

Stimulation of the Posterior Canal → Slow Downward and Contratorsional eye movement due to stimulation of the VOR

- After that slow Downward and Contratorsional eye movement, the eye must reset itself… and generates:
  - UPWARD and IPSITORSIONAL fast phase
  - Nystagmus is named for the fast phase
  - Posterior Canal BPPV → Upward and Ipsitorsional Nystagmus
Positional Testing for BPPV

- Goal – To place the canal of interest in its most provocative position to induce movement of the canaliths within the canal

- Dix-Hallpike: The gold standard test position for the Posterior Canal

  Patient begins in long sitting
  Head is rotated 45° TOWARDS the side being tested
  Patient is assisted to supine with neck extended 20-30° beyond horizon
  Hold position x 30-60 seconds
  Observe eyes for nystagmus
Dix-Hallpike

- Reliability: **Excellent** inter-rater reliability
  - (Kappa = 0.92; 95% CI: 0.87–0.98)
  - (Burston et al 2012)
- Highly Recommended for assessment of BPPV
  - (V-EDGE 2013)

(pt in R DH test position)
Right Dix-Hallpike
Canalithiasis vs Cupulolithiasis

- Duration of the nystagmus will guide you
  - Short Duration (~<60 seconds) = Canalithiasis
  - Long Duration (>60 seconds) = Cupulolithiasis
- Determining canalithiasis vs. cupulolithiasis will guide your treatment

Posterior Canal BPPV

- Positional Test: Dix-Hallpike
- Positive Test: Upbeating, Ipsitorsional Nystagmus
- Duration of nystagmus/symptoms will tell you canalithiasis vs cupulolithiasis
  - Short duration – canalithiasis
  - Long duration - cupulolithiasis

<table>
<thead>
<tr>
<th>Canal</th>
<th>Right Dix-Hallpike</th>
<th>Left Dix-Hallpike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior</td>
<td>Up beating, right torsional</td>
<td>Up beating, left torsional</td>
</tr>
</tbody>
</table>
Modifications to Test Positions

- Factors that can influence test:
  - C-spine: pain, ROM restrictions, HALO
  - Lumbar pain

- Test relies on the position of the inner ear in space
- Can modify test position in any manner to assess inner ear
- Side-lying position, tilt table, elevate table, hospital bed (Trendelenberg)

Side-lying Test Maneuver

- The patient begins seated at side of an examination table. The head is turned 45 degrees away from side being tested to align the posterior semicircular canals with the plane of movement; patient is quickly laid onto the table onto the side being tested. The clinician observes the patient’s eyes for one minute.

- V-EDGE: 2-Reasonable to recommend

Anterior Canal

BPPV- Anterior Canal

- Stimulation of the Anterior Canal → Slow Upward and Contratorsional eye movement due to stimulation of the VOR
- After that slow Upward and Contratorsional eye movement, the eye must reset itself... and generates:
  - DOWNWARD and IPSITORSIONAL fast phase
- Nystagmus is named for the fast phase
- Anterior Canal BPPV → Downward and Ipsitorsional Nystagmus
Positional Testing for Anterior Canal

- Anterior canals on both sides of the head are provoked with Dix-Hallpike.
- The direction of the torsional component of the nystagmus will tell you the side of involvement.
- Torsion can be difficult to visualize in anterior canal.

RIGHT DIX-HALLPIKE
Supine Head Hanging Test for Anterior Canal BPPV

- Deep Head Hanging/Supine Head Hanging Test described as an alternative way to maximally provoke anterior canals
- Head is brought to 60 degrees beyond horizontal
- Both L and R AC are stimulated – note direction of torsion

Anterior Canal BPPV

- Positional Test: Dix-Hallpike/ Deep Head Hang
- Positive Test: Downbeating, Ipsitorsional Nystagmus
- Duration of nystagmus/symptoms will tell you canalithiasis vs cupulolithiasis
  - Short duration – canalithiasis
  - Long duration - cupulolithiasis

<table>
<thead>
<tr>
<th>Canal</th>
<th>Right Dix-Hallpike</th>
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</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>Downbeating, right torsional</td>
<td>Downbeating, left torsional</td>
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</tbody>
</table>
Horizontal Canals

- Horizontal Canals are paired
- Both canals are provoked during head turns
  - Right Head turn → Excite R/Inhibit L
  - Left Head turn → Excite L/ Inhibit R
- Otoconia in the Horizontal Canal may be displaced with the Dix-Hallpike Maneuver but are not maximally provoked
- Pagnini-McClure maneuver/ “Roll Test” places the Horizontal Canals in most provocative position
Rotation of the head to one side results in excitation of the ipsilateral vestibular nerve, and inhibition of the contralateral vestibular nerve.

Roll Test (Pagnini-McClure)

- Begin with patient supine
- Turn Head to the RIGHT
  Hold and Observe for Nystagmus
- Return to Center
- Turn Head to the LEFT
  Hold and Observe for Nystagmus
# Roll Test Results

- Both Horizontal Canals are provoked during each Roll – challenging to differentiate the involved canal
- Identify the direction of the nystagmus WITH RESPECT TO GRAVITY
  - Geotrophic - “with gravity”
  - Ageotrophic (apogeotrophic) – “against gravity”

Reliability and validity measures – not established at this time

## Roll Test – Canalithiasis vs Cupulolithiasis

- **Canalithiasis – Geotrophic nystagmus**
  - Right Roll → Right Beating Nystagmus (short duration)
  - Left Roll → Left Beating Nystagmus (short duration)
  - Assume involved side is the side that causes MORE symptoms/ stronger nystagmus

- **Cupulolithiasis – Ageotrophic nystagmus**
  - Right Roll → Left Beating Nystagmus (Long duration)
  - Left Roll → Right Beating Nystagmus (Long duration)
  - Assume involved side is the side that causes FEWER symptoms/ weaker nystagmus
Roll Test – Right Roll

Roll Test – Left Roll

![Image of Roll Test – Right Roll](image1)

![Image of Roll Test – Left Roll](image2)
### Nomenclature of the Horizontal Canal

- Named for the direction of the nystagmus with respect to gravity
- In Right Roll:
  - Right Beating Nystagmus = Geotropic
  - Left Beating Nystagmus = Apogeotropic
- In Left Roll:
  - Right Beating Nystagmus = Apogeotropic
  - Left Beating Nystagmus = Geotropic

### Horizontal Canal – Determining Side of Involvement

- Often times intensity of nystagmus and/or symptoms are similar during R and L rolls
- The Bow and Lean test (Choung’s test) was developed to assist with determining side of involvement for horizontal canal BPPV
Bow and Lean Test

Bow and Lean Results

- Bow → Right Beating
- Lean → Left Beating
- Nystagmus during Roll test was Geotropic and short lived

Therefore, side of involvement is Right Side

<table>
<thead>
<tr>
<th>Test</th>
<th>Geotropic Direction Changing Positional Nystagmus</th>
<th>Apogeotropic Direction Changing Positional Nystagmus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine Roll</td>
<td>Side of greater intensity = Involved side</td>
<td>Side of lesser intensity = Involved side</td>
</tr>
<tr>
<td>Head Neutral (Pseudospontaneous Nystagmus)</td>
<td>Nystagmus in direction opposite of Involved side</td>
<td>Nystagmus in direction of Involved side</td>
</tr>
<tr>
<td>Bow</td>
<td>Nystagmus in direction of Involved side</td>
<td>Nystagmus in direction opposite of Involved side</td>
</tr>
<tr>
<td>Lean</td>
<td>Nystagmus in direction opposite of Involved side</td>
<td>Nystagmus in direction of Involved side</td>
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</table>
## Bow and Lean Interpretation

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<td>Head Neutral</td>
<td>Nystagmus in direction opposite of involved side</td>
<td>Nystagmus in direction of involved side</td>
</tr>
<tr>
<td>(Pseudospontaneous Nystagmus)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bow</td>
<td>Nystagmus in direction of involved side</td>
<td>Nystagmus in direction opposite of involved side</td>
</tr>
<tr>
<td>Lean</td>
<td>Nystagmus in direction opposite of involved side</td>
<td>Nystagmus in direction of involved side</td>
</tr>
</tbody>
</table>

## TREATING BPPV

![continued](image)
## Treatment Options

- **Posterior/Anterior Canal**
  - Canalithiasis
    - Modified Epley
    - Half Somersault
    - Cupulolithiasis – Semont
  - Cupulolithiasis

- **Horizontal Canal**
  - Canalithiasis
    - Lempert Roll (BBQ Roll)
    - Appiani
    - Gufoni
  - Cupulolithiasis
    - Cassani
    - Head Shaking Maneuver

---

## Posterior/Anterior Canalithiasis
Modified Epley

- Begin Long sitting
- Rotate Head 45 deg to INVOLVED SIDE
- Assist patient into supine head-hanging position with 20-30 deg extension
- Maintain this position for duration of symptoms PLUS additional 30 seconds

Modified Epley (part 2)

- Turn Head 45 deg cervical rotation to UNINVOLVED SIDE while maintaining Cervical extension
- Maintain this position for duration of symptoms PLUS additional 30 seconds
Modified Epley (part 3)

- Assist the patient to roll onto UNINVOLVED side with chin tucked into shoulder and nose directed toward the floor
- Maintain this position for duration of symptoms PLUS additional 30 seconds

Modified Epley (part 4)

- While maintaining cervical rotation, assist patient back to seated position
- Patient may become very symptomatic during this movement, be near patient and able to guard them
Criteria for a successful CRM

- A 180° turn of the head is required to effectively clear the debris (B and D) (Rajguru, Ifediba et al., 2004).

- The head must be slightly elevated from the supporting surface in position D and the patient must return to sitting from lying on the uninvolved side to prevent canal conversion to the AC. (Rajguru, Ifediba et al., 2004).

- Each position must be held a minimum of 30 s to allow particles to settle (Hain et al, 2004).

Half-Somersault (alternative to Epley?)

- Developed by Dr. Carol A. Foster
- Begin with head tipped up toward ceiling
- Place head on floor with chin tucked
- Rotate TOWARDS side of involvement
- Lift head to horizontal (maintain head turn)
- Sit up

Reliability and validity measures – not established at this time
Brandt-Daroff

- Non-specific exercise used to treat BPPV
- Does not involve a 180-degree turn which is necessary to fully clear debris out of canal
- Not currently recommended as best treatment for BPPV

Posterior/Anterior Cupulolithiasis
Semont Maneuver – Posterior Canal

- Begin with C-spine rotated 45 deg AWAY from involved side.
- Lower patient into S/L position with C-spine extended – Hold 1-2 minutes.
- Rapidly bring patient to opposite side of mat table while maintaining C-spine rotation... Rapid deceleration at end point.
- Maintain this position x 2 minutes.

Horizontal Canalithiasis
Lemperts Roll (BBQ Roll)

- Begin with Head Rotation TOWARD involved ear
- Maintain this position for duration of symptoms PLUS additional 30 seconds

BBQ Roll (part 2)

- Roll to supine position
- Maintain this position for duration of symptoms PLUS additional 30 seconds
BBQ Roll (part 3)

- Roll Patient toward UNINVOLVED ear
- Maintain this position for duration of symptoms PLUS additional 30 seconds

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BBQ Roll (part 4)

- Assist patient to roll into prone position – may prop onto elbows keeping C-spine tucked
- Maintain this position for duration of symptoms PLUS additional 30 seconds
**BBQ Roll (part 5)**

- Can assist patient to seated position directly from the nose-down position, or complete a final roll back to the start position and then return to sit.

**Appiani Maneuver**

- Begin seated at edge of table.
- Lie onto UNINVOLVED side – wait until symptoms subside plus 1 minute.
- Rotate head down toward floor; wait until symptoms subside plus one minute.

Paper written by Gufoni
Horizontal Canal Cupulolithiasis

Cassani (modified Semont)

- Begin seated at edge of mat
- RAPIDLY lie down on AFFECTED side
- RAPIDLY rotation head NOSE DOWN
Rapid Head Shaking

- Patient begins seated at edge of mat table
- Head is rapidly shaken (Left – Right) for 30-60 seconds
- Goal is to displace otoconia from cupula

Treatment Considerations
Treatment Considerations

- Vibration
- Repeat Maneuvers during session
- Treatment position modifications
- Post Treatment Precautions
- Post Treatment Medications

Vibration

- Vibration to the mastoid was originally used by Epley
- Not currently used
Number of Cycles/ Repetitions

<table>
<thead>
<tr>
<th># of Sessions</th>
<th>Group I (1 Cycle)</th>
<th>Group II (4 Cycles)</th>
<th>p=value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51 (68%)</td>
<td>42 (89%)</td>
<td>0.039</td>
</tr>
<tr>
<td>2</td>
<td>17 (23%)</td>
<td>3 (6%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 (4%)</td>
<td>2 (4%)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2 (3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Korn, Dorigueto et.al., 2007

Treatment position modification

- Treatment maneuvers can be modified
- Consider the anatomy of the canal you are treating and move 180 degrees in the plane of that canal
Conservative Post-Treatment Precautions

- Sleep 45 degrees from horizontal (2-7 days)
- Avoid bending/ tipping head
- Cervical Collar

- Considerations: yoga, sleep position, etc.

Post-Procedure Medication

- Dimenhydrinate shown to decrease post CRP symptoms at one-week follow-up
- Decrease in self reports of lightheadedness
- No change in DHI

BPPV Recurrence

- Hain, 2000
- 25% experience recurrence within one year
- 44% experience recurrence within two years
- Teach self-CRM?

Subjective BPPV

- Balatsouras 2012 – subjective reports of BPPV with negative positional testing respond to treatment with CRM
Keep it simple

- If it’s stuck… unstick it (rapid movement)
- If it’s free floating… move it out of canal
- Successful treatment will generate a change in symptoms

THANK YOU!!!!!