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BENIGN PAROXYSMAL POSITIONAL VERTIGO

Karen Lambert, PT, DPT, NCS
April 2015

Learning Objectives

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

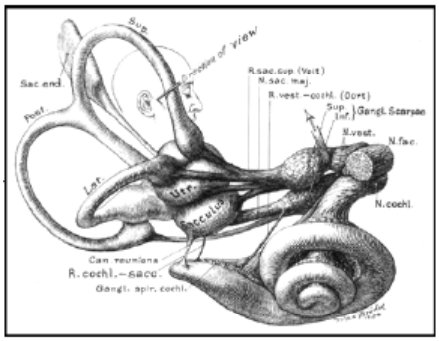
- Episodic
- **Typically** short duration (seconds)
- Dependent on position changes

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, 200)5
  - 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).

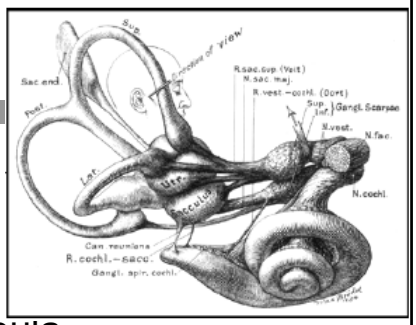
Peripheral Vestibular Anatomy

- Semicircular canals- angular acceleration
  - Horizontal/Lateral
  - Posterior/Inferior
  - Anterior/Superior
- Otolith organs– linear acceleration
  - Utricle
  - Saccule



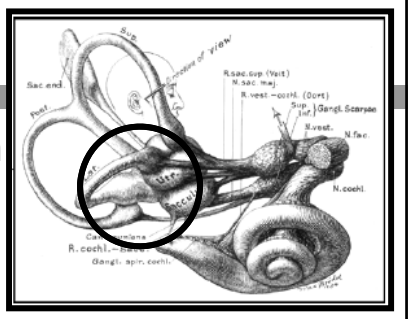
Semicircular Canals

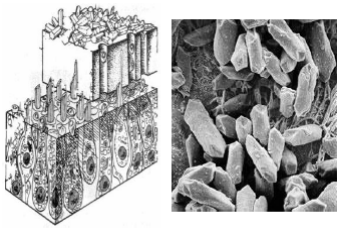
- Fluid filled canals
- Paired system
- ~90˚ orientation
- Fluid motion results in cupula deflection
  - Resting firing rate of vestibular nerve ~100 spikes/second
  - Cupular deflection either excites or inhibits vestibular nerve



Otoliths

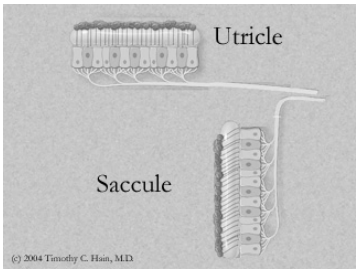
- Utricle – horizontal motion
- Saccule – vertical motion
- Sensitive to gravity





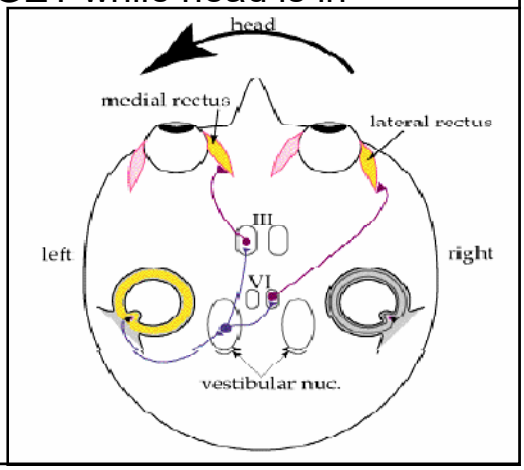
Furman JM, Cass SP. Vestibular disorders: a case study approach to diagnosis and treatment. Fig. 1–5.

http://news.sciencemag.org/sciencenow/assets/2006/01/27/20061272f1.jpg



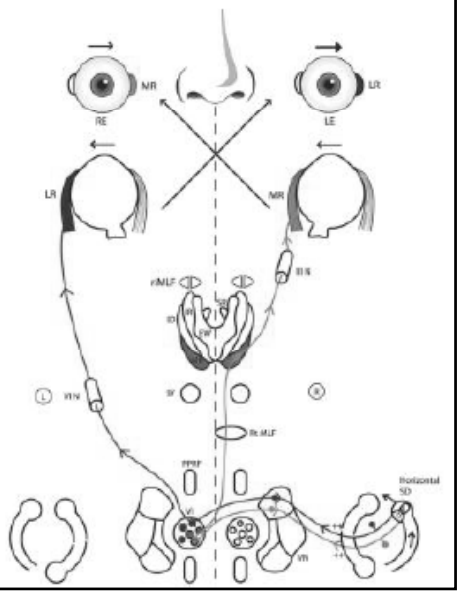
Vestibular Ocular Reflex

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



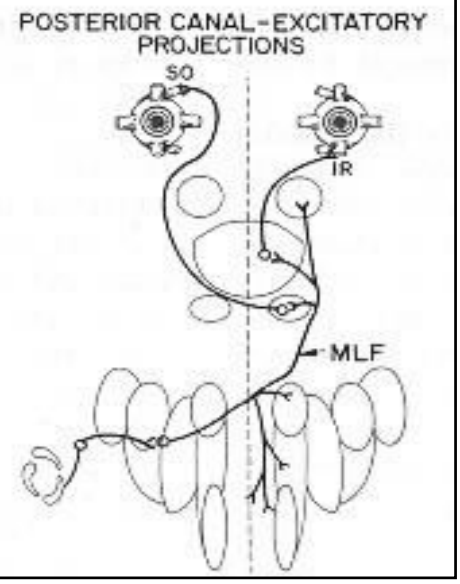
VOR – Horizontal SC Paths

- Horizontal Semicircular Canal
  - Contralateral lateral rectus
  - Ipsilateral medial rectus
  - Inhibitory projections to ipsilateral lateral rectus & contralateral medial rectus
- Excitation Right HSC = leftward eye movement

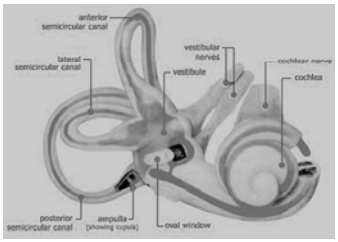


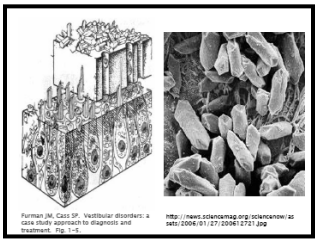
VOR – Posterior SC Paths

- 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

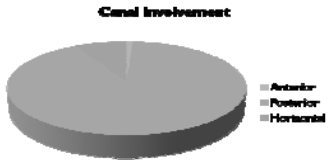
Incidence of BPPV

- Most common peripheral vestibular disorder (Mizukoshi 1988, Froehling 1991)
- 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

(Imai et al, 2005; Lopez-Escamez, et al, 2005, Battacharyya, 2005))

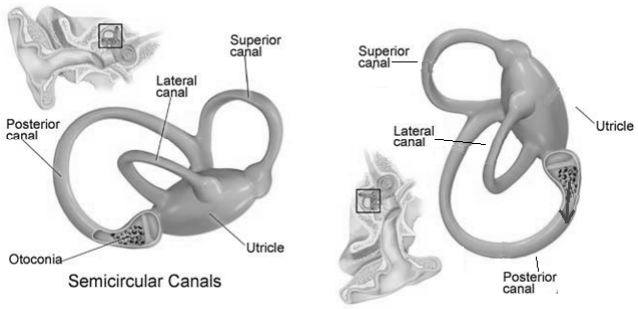


Two primary subtypes of BPPV

- Canalithiasis – the debris (canalith) is free floating within the semicircular canal
  - Symptoms with 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

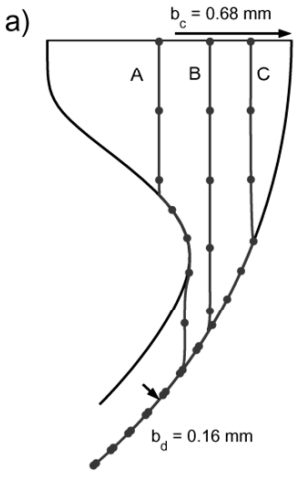
Canalithiasis

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



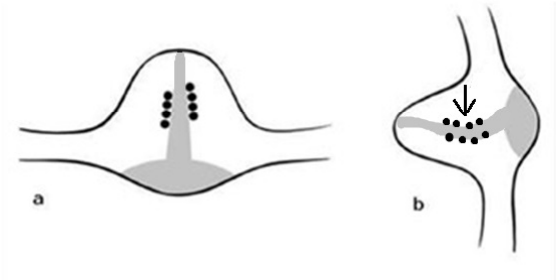
Characteristics of Canalithiasis

- 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

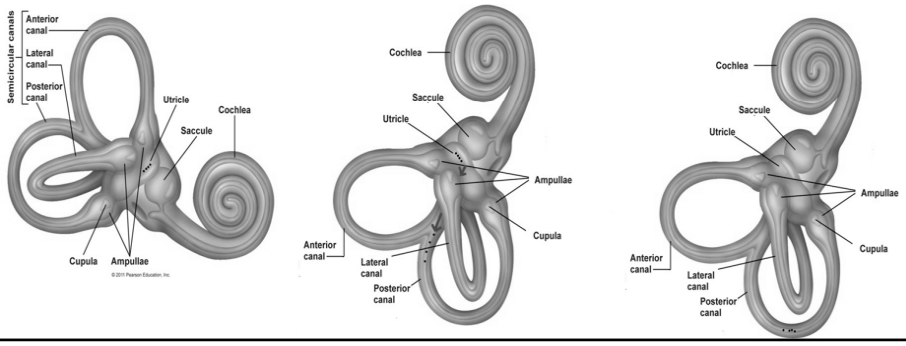
- Debris (otoconia) is adhered to the cupula
- Will continue to stimulate cupula as long as the individual is in provocative position



Posterior Canal

Posterior Canalithiasis

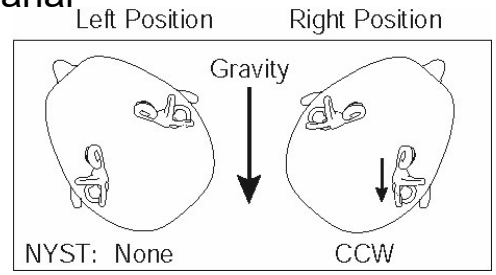
- 41-90% of cases
- Up-beating ipsitorsional nystagmus
- Typically short duration
- Bending down, looking up, getting in/out of bed



- 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



Dix-Hallpike

- 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 Recommneded for assessment of BPPV
  - (V-EDGE 2013)

(pt in R DH test position)

R

L

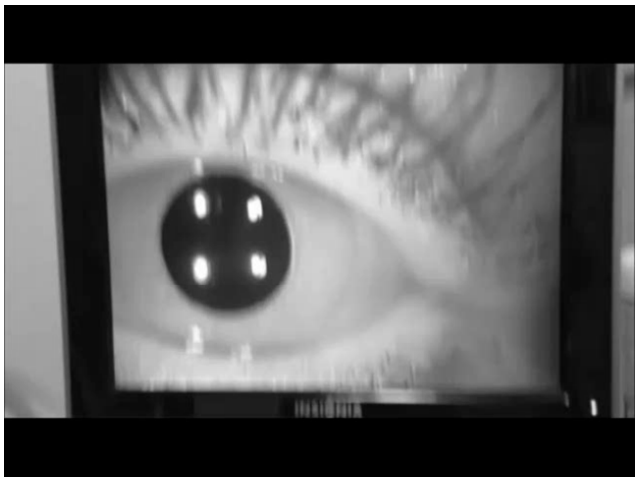
L DH

R

L

Right Dix-Hallpike

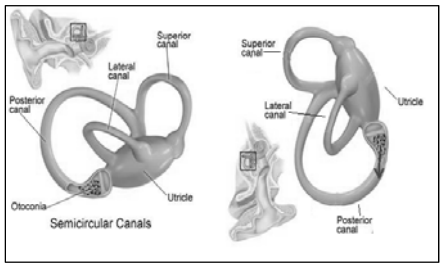
R

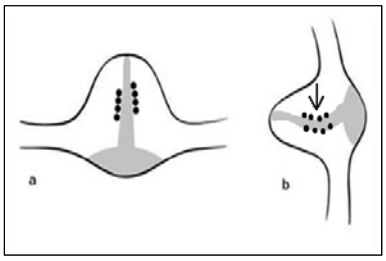


L

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





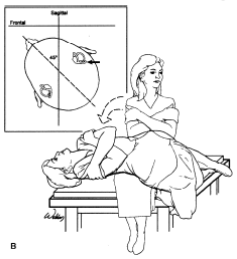
Posterior Canal BPPV

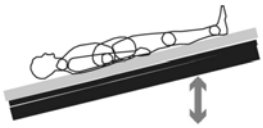
- Positional Test: Dix-Hallpike
- Positive Test: Upbeating, Ipsitorsional Nystagmus
- Duration of nystagmus/symptoms will tell you canalithiasis vs cupulolithiasis
  - Short duration – canalithiasis
  - Long duration - cupulolithiasis

Canal	Right Dix-Hallpike	Left Dix-Hallpike
Posterior	Up beating, right torsional	Up beating, left torsional

Modifications to Test Positions

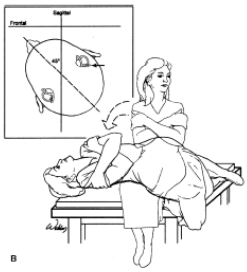
- Factors that can influence test:
  - C-spine: pain, ROM restrictions, HALO
  - Lumbar pain
- Test relies on the position of the inner ear in space
- Can modify test position in any manner to assess inner ear
- Side-lying position, tilt table, elevate table, hospital bed (Trendelenberg)





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
- Cohen HS (2004). "Side-Lying as an Alternative to the Dix-Hallpike Test of the Posterior Canal." Otology and Neurology 25:130-134.

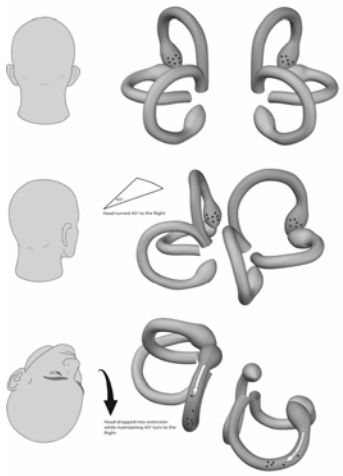
Anterior Canal

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 side of 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



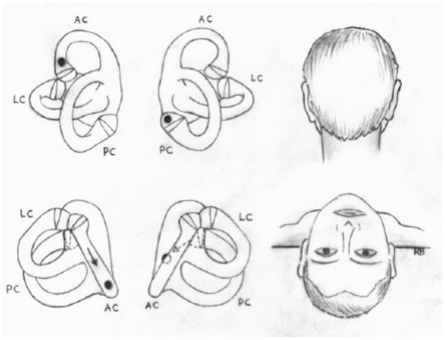
RIGHT DIX-HALLPIKE

R

L

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 60degrees beyond horizontal
- Both L and R AC are stimulated – note direction of torsion



Cambi et al J Neurol 2013. Natural course of positional down-beating nystagmus of peripheral origin.

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

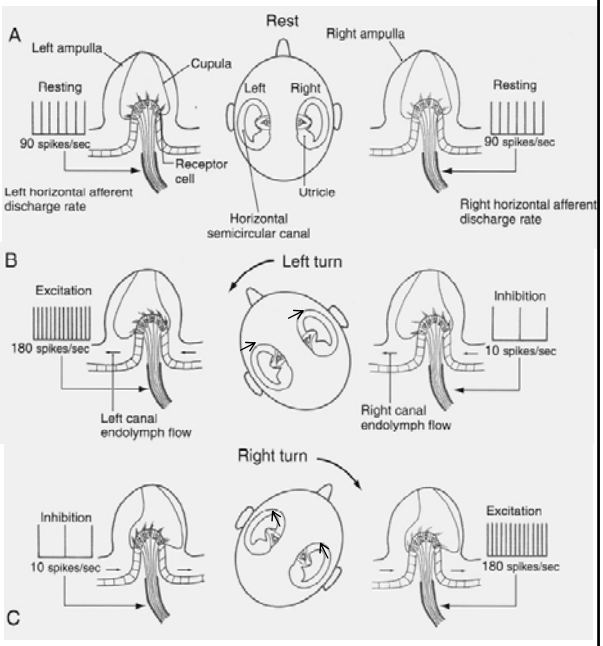
Canal	Right Dix-Hallpike	Left Dix-Hallpike
Anterior	Downbeating, right torsional	Downbeating, left torsional

Horizontal Canals

Horizontal Canal

- 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

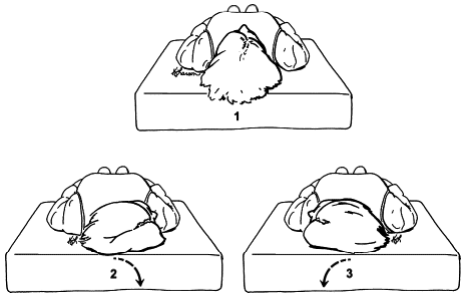
Rotation of the head to one side results in excitation of the ipsilateral vestibular nerve, and inhibition of the contralateral vestibular nerve



http://vestibular.wustl.edu/figures/figure-9a.jpg

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

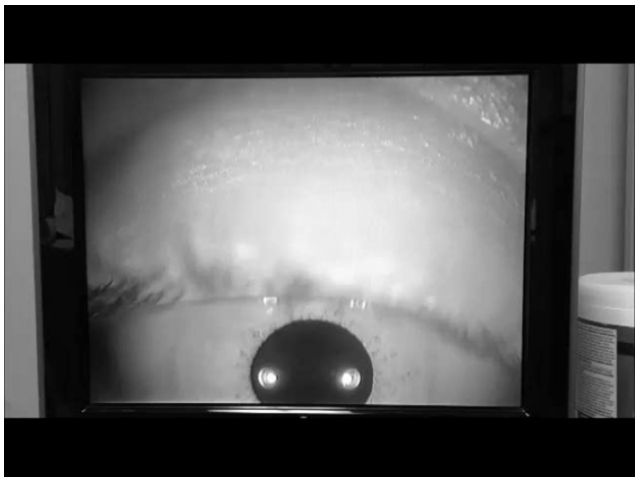
Roll Test – Right Roll

R

L

Roll Test – Left Roll

R



L

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

R

L

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

Test	Geotropic Direction Changing Positional Nystagmus	Apogeotropic Direction Changing Positional Nystagmus
Supine Roll	Side of greater intensity = involved side	Side of lesser intensity = involved side
Head Neutral (Pseudospontaneous Nystagmus)	Nystagmus in direction opposite of involved side	Nystagmus in direction of involved side
Bow	Nystagmus in direction of involved side	Nystagmus in direction opposite of involved side
Lean	Nystagmus in direction opposite of involved side	Nystagmus in direction of involved side

Bow and Lean Interpretation

Test	Geotropic Direction Changing Positional Nystagmus	Apogeotropic Direction Changing Positional Nystagmus
Supine Roll	Side of greater intensity = involved side	Side of lesser intensity = involved side
Head Neutral (Pseudospontaneous Nystagmus)	Nystagmus in direction opposite of involved side	Nystagmus in direction of involved side
Bow	Nystagmus in direction of involved side	Nystagmus in direction opposite of involved side
Lean	Nystagmus in direction opposite of involved side	Nystagmus in direction of involved side

TREATING BPPV

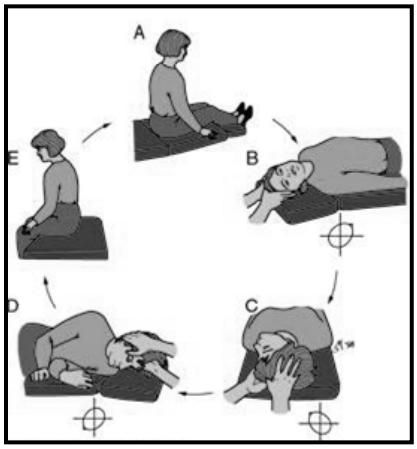
Treatment Options

- Posterior/Anterior Canal
  - Canalithiasis
    - Modified Epley
    - Half Somersault
  - Cupulolithiasis – Semont
- Horizontal Canal
  - Canalithiasis
    - Lempert Roll (BBQ Roll)
    - Appiani
    - Gufoni
  - Cupulolithiasis
    - Cassani
    - Head Shaking Maneuver

Posterior/Anterior Canalithiasis

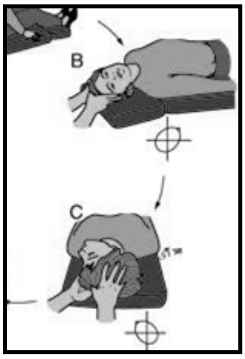
Modified Epley

- 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



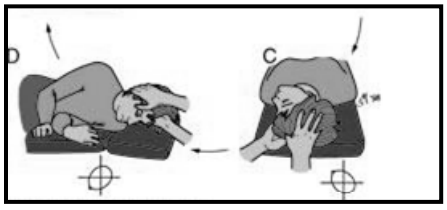
Modified Epley (part 2)

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



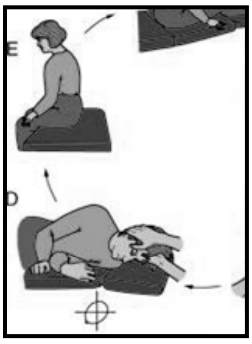
Modified Epley (part 3)

- 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

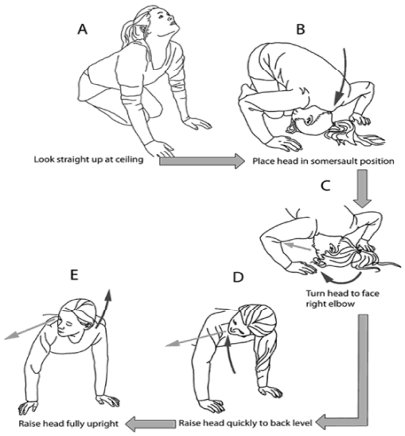


Criteria for a successful CRM

- 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

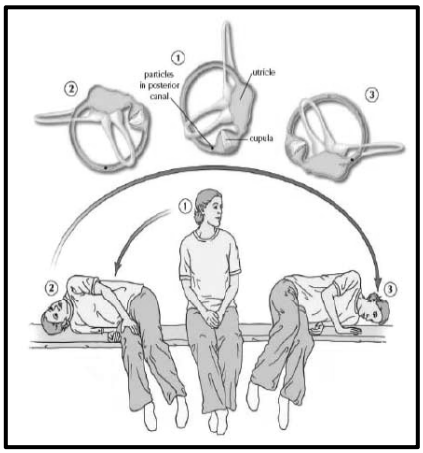
Brandt-Daroff

- Non-specific exercise used to treat BPPV
- Does not involve a 180degree 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

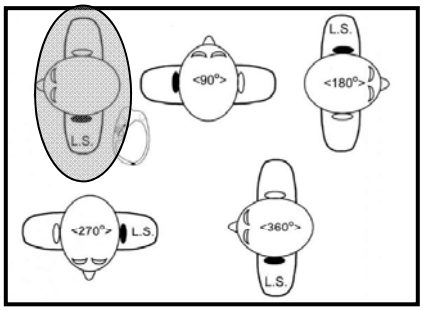
- Begin with C-spine rotated 45 deg AWAY from involved side
- Lower patient into S/L position with C-spine extended – Hold 1-2 minutes
- Rapidly Bring patient to opposite side of mat table while maintaining C-spine rotation… Rapid deceleration at end point
- Maintain this position x 2 minutes



Horizontal Canalithiasis

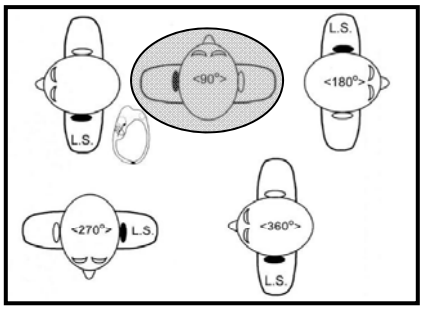
Lemperts Roll (BBQ Roll)

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



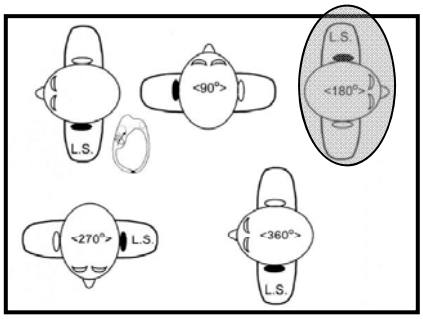
BBQ Roll (part 2)

- Roll to supine position
- Maintain this position for duration of symptoms PLUS additional 30 seconds



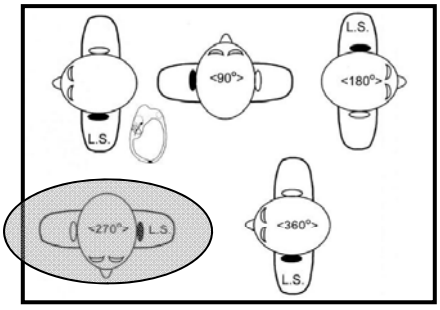
BBQ Roll (part 3)

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



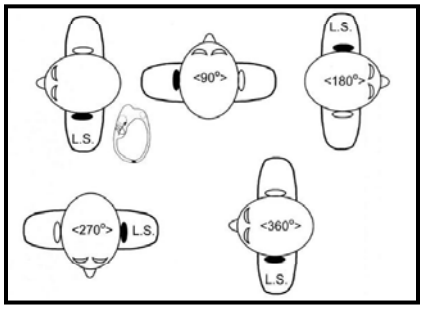
BBQ Roll (part 4)

- 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



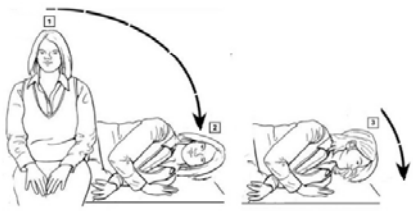
BBQ Roll (part 5)

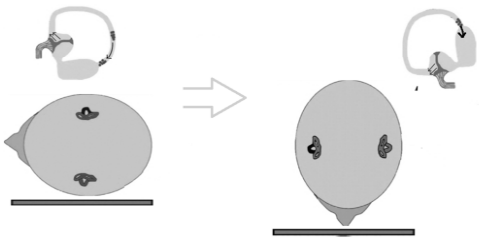
- Can assist patient to seated position directly from the nose-down position, or complete a final roll back to the start position and then return to sit



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



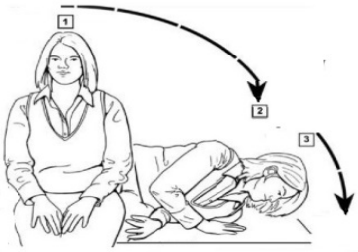


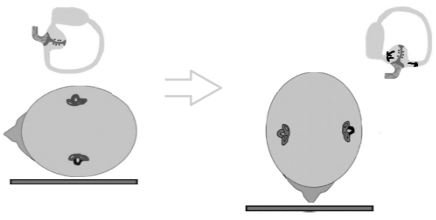
Paper written by Gufoni

Horizontal Canal Cupulolithiasis

Cassani (modified Semont)

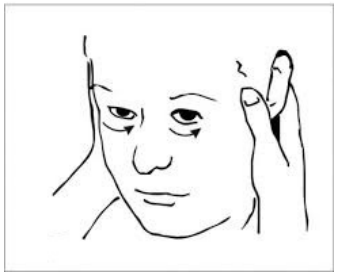
- Begin seated at edge of mat
- RAPIDLY lie down on AFFECTED side
- RAPIDLY rotation head NOSE DOWN





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

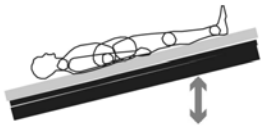
Number of Cycles/ Repetitions

# of Sessions	Group I (1 Cycle)	Group II (4 Cycles)	p=value
1	51 (68%)	42(89%)	0.039
2	17(23%)	3(6%)	
3	3(4%)	2(4%)	
4	2(3%) (3%)		
5	2		

Korn, Dorigueto et.al., 2007

Treatment position modification

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



Conservative Post-Treatment Precautions

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

- Considerations: yoga, sleep position, etc.

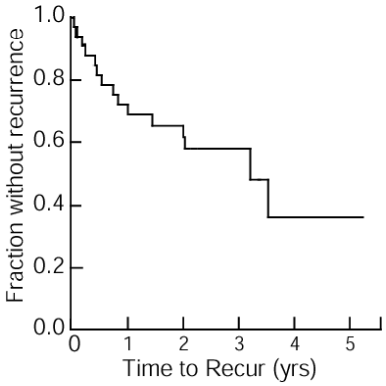


Post-Procedure Medication

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

Kim, MB. 2014. Vestibular Suppressants After Canalith Repositioning in Benign Paroxysmal Positional Vertigo. Laryngoscope. 124:2400-2403

BPPV Recurrence



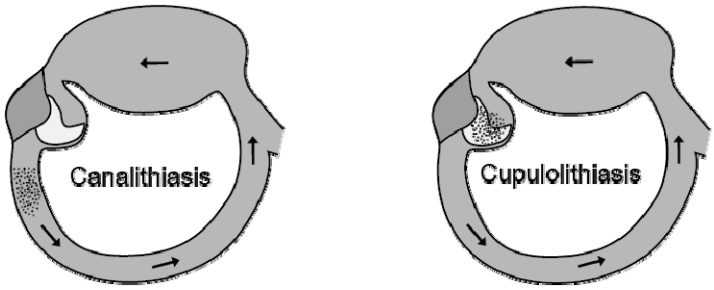
- Hain, 2000
- 25% experience recurrence within one year
- 44% experience recurrence within two years
- Teach self-CRM?

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!!!!!