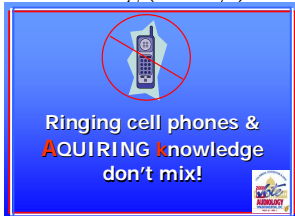


House Rules:

- If your pager or cell phone goes off during this presentation, you must stand and sing a Barry Manilow song (Loudly!)



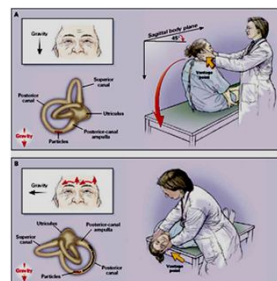
BPPV: Understanding Eye Movements & Treatment Approaches

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Otolaryngology / Head and Neck Surgery / Audiology
Mayo Clinic - Jacksonville

Benign Paroxysmal Positional Vertigo (BPPV)

- Intense but transient vertigo provoked by moving into specific head positions
 - Most common cause of vertigo
 - Accompanied by a characteristic nystagmus
 - Thought to be caused by debris in the semicircular canals

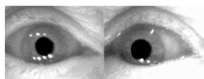
Dix-Hallpike or Nylen Maneuver



Furman and Cass "Benign Paroxysmal Positional Vertigo." NJM 1999.

Characteristic Response

- Torsional nystagmus (rolling eye movement) & vertiginous sensation
 - Onset latency (5-45 sec)
 - Crescendo then fatigues (typically within 30 sec)
 - Symptoms extinguish (adapt) over repeated trials



- Can be treated by a simple in office procedure

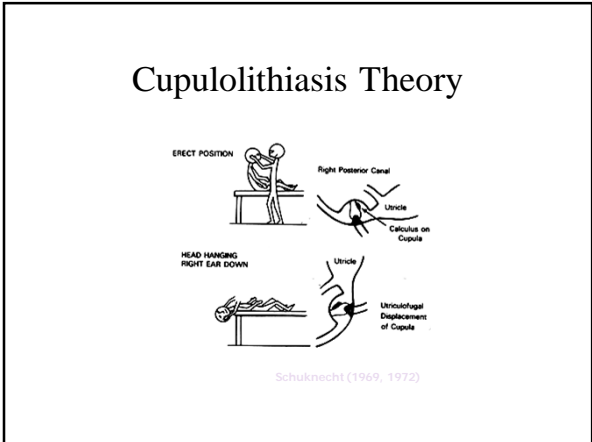
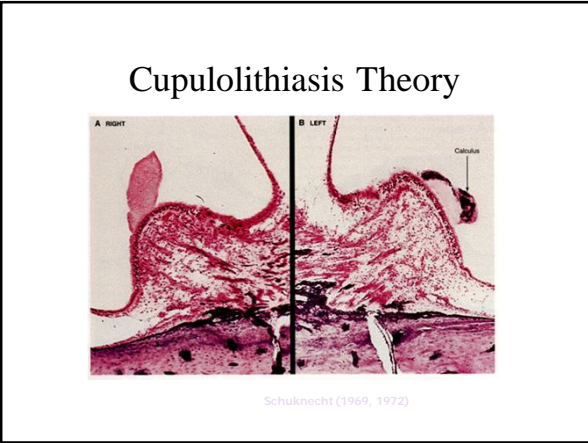
Our aim is to help sharpen your abilities to:

- Recognize and understand common subtypes of BPPV presentations and how to treat them
- Recognize when "Benign" is not benign
- Appreciate current limits of our understanding of this condition

Theories of BPPV

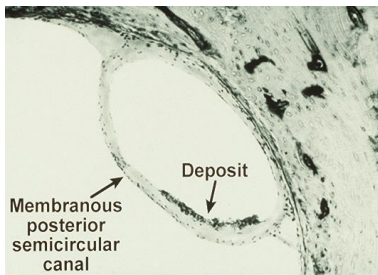
- ### Development of Theories of BPPV
- Adler (1897): First formal description
 - Barany (1921): Case report
 - Proposed degeneration of the utricle as cause of condition
 - BPPV formally defined by Dix and Hallpike (1952)
 - Described BPPV in 100 cases
 - Demonstrated utricular degeneration in one temporal bone

- ### Cupulolithiasis Theory
- Schuknecht (1969, 1972): “Heavy Cupula” explanation
 - Debris (otoconia?) adheres to cupula of the posterior semicircular canal
 - Weight of otoconia causes cupula to deflect, making it gravity-sensitive.
 - Nystagmus eventually subsides due to central vestibular adaptation



Canalithiasis Theory

Schuknecht 1974



Canalithiasis Theory

- Lim, 1973:
 - Loosened otoconia dissolves in vivo
 - (we now think this may explain the long term remission of symptoms)
- Hall et al., 1979
 - Loose debris don't necessarily adhere to cupula
- Brandt & Daroff, 1980
 - Exercises for central habituation limit duration of BPPV

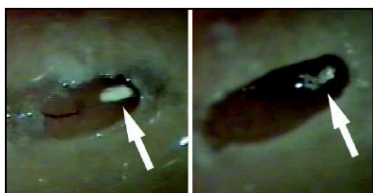
Development of Canalithiasis Theory

- Semont, Fereyys and Vitte, 1988
 - Liberatory Maneuver
 - Dislodges and repositions debris into utricle
 - 84% success rate with one maneuver, 93% success rate with two maneuvers and a recurrence rate of 4.2%

Canalithiasis Theory (cont.)

- Pagnini et al., 1989:
 - Horizontal canal conversion of BPPV
- Parnes & McClure, 1990
 - Observation of free-floating particles in PSSC during canal plug surgery

Evidence for “Canaliths”



Development of Canalithiasis Theory

- Epley JM. 1992
 - Canalithiasis
 - Canalith Repositioning Maneuvers to move loose debris into utricle

The canalith repositioning procedure: for treatment of benign paroxysmal positional vertigo. Otolaryngol Head Neck Surg. 1992. Sept;107(3):399-404.

Canalithiasis Theory

- “Canaliths,” which have a heavy specific gravity relative to endolymph, drift to lowest position in membranous labyrinth.
 - Produces movement of endolymph
 - Endolymph movement deflects the cupula, stimulating hair cells and inducing vertigo & nystagmus

Pros of Canalithiasis Theory

- Theory explains:
 - Why there is adaptation:
 - Nystagmus persists only so long as canaliths are moving toward the pull of gravity.
 - Why there is fatigue:
 - Debris spreads out in the canal with repeated movement and losing effectiveness as a “plunger”
 - Why there is spontaneous remission:
 - Debris leaves the canal

Theory Offers Treatment

- Canaliths may be repositioned using gravity to “drift” debris away from sensory epithelium



From: Baloh, R. W. (1998) "Dizzy Patients: The Varieties of Vertigo"
in: Hospital Practice, <http://www.hospipract.com/issues/1998/06/dmmibal.htm>

Neuronal Degeneration Theory

Neuronal Degeneration Theory

- Gacek, (2003)
 - Loose basophilic debris not found in temporal bones of patients with BPPV symptoms
 - Severe neuronal degeneration of the inferior vestibular nerve in these temporal bones.
 - Cupulolithiasis and Canalithiasis cannot account for posterior canal symptoms

Neuronal Degeneration Theory

- Ganglionitis disrupts otolith / semicircular canal output
 - Loss of inhibitory effect of utricle or saccule on SSC output
 - Produces aberrant nerve activity
 - Adaptation on Dix-Hallpike testing due to central suppression and adaptation.

Summary

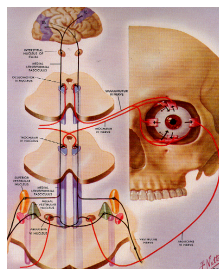
- All of these theories have something to offer.
 - Mechanical “Lithiasis” theories offer rational approach to non-surgical treatments
 - Neural theory may explain cases of more persistent positional nystagmus
- Never get too attached to your theories...

BPPV: Brief Anatomy and Functional Review

BPPV: Background Anatomy

- Ocular Motor System
- Vestibular End Organ Anatomy
- Vestibulo-Ocular Reflex (VOR)
 - *Interpretation of Eye Movements*

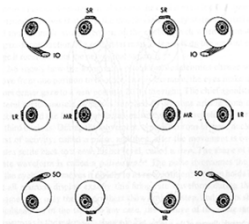
Ocular Motor Nerves & Muscles



- CN III: Oculomotor
 - Medial Rectus
 - Superior Rectus
 - Inferior Rectus
 - Inferior Oblique
- CN IV: Trochlear
 - Superior Oblique
- CN VI: Abducens
 - Lateral Rectus

Complementary Muscle Pairs

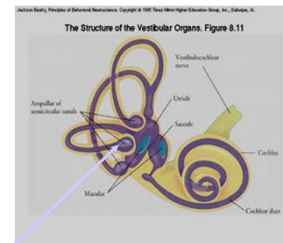
- “Cardinal” Eye Positions
 - Isolate muscle pairs
 - Failure of one eye to match its complement may betray ocular motor deficit.



Barber & Stockwell, 1980

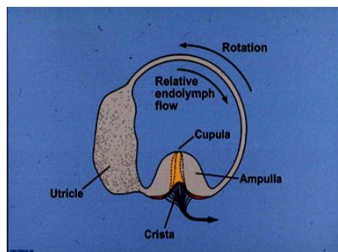
Peripheral Vestibular System

- Five sensory receptors
 - Three Cristea
 - Horizontal
 - Anterior/superior
 - Posterior /inferior
 - Maculae
 - Sacculle
 - Utricule



The Ampulla of the horizontal canal is toward the front - Remember this!

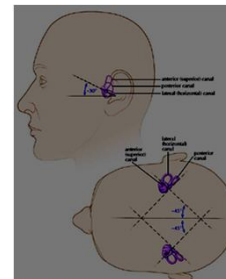
Ampulla



From: Jay W. McLaren, Ph.D., Mayo Clinic

Semicircular Canals

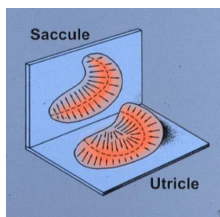
- Quasi-orthogonal canals on same side
- Coplanar canals between sides
- Law of reciprocal innervation



Parnes et al., 2003

Vestibular Macula

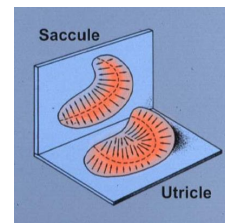
- Saccule
 - Action:
 - Translational movements
 - Vertical
 - Anterior / Posterior (A/P)
 - Linear Acceleration
 - How to remember:
 - “The Saccule is Stuck to Wall”



From: Jay W. McLaren, Ph.D., Mayo Clinic

Vestibular Macula

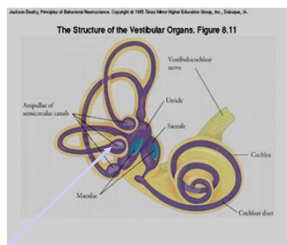
- Utricle
 - Action:
 - Lateral translations
 - Acceleration and static head tilt
 - How to remember:
 - “The Utricle is On the floor - YoU step over the Utricle”



From: Jay W. McLaren, Ph.D., Mayo Clinic

Peripheral Vestibular System

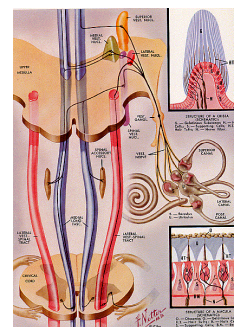
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 - Saccule
 - Utricle



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Central Vestibular System

- Four **Primary** Vestibular Nuclei
 - As many others...
- Interact with Ocular Motor System



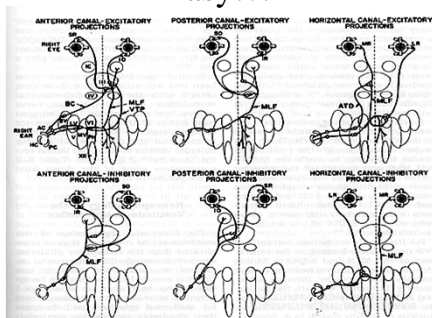
Vestibulo-Ocular Reflex

- Goal: Maintain “gaze stability” regardless of head / trunk movement
- Gaze stability means:
 - Keep the object of attention on fovea
 - *Maintain horizontal meridian orientated to horizon*

Three Ways to Understand the Vestibulo-Ocular Reflex

- Method #1: Neuroanatomy...

Easy!?!



Three Ways to Understand the Vestibulo-Ocular Reflex

- Method #1: Neuroanatomy...
- Method #2: Ewald's Laws of Semicircular Canal Dynamics

Ewald's First Law

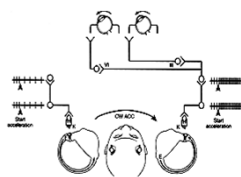
- Vestibular evoked eye movements occur in the plane of the canal being stimulated.
 - If you stimulate the horizontal canal, you get a horizontal eye movement.

Ewald's Second Law

- Vestibular nerve can encode fast (high acceleration) excitatory movements better than inhibitory movements.
 - The resting discharge rate of the vestibular nerve is just under 100 spikes/sec
 - Excitatory acceleration can drive nerve firing rate to +300 spikes/sec
 - Inhibitory acceleration, no matter how fast, can never drive nerve output below 0 spikes/sec

Ewald's Third Law

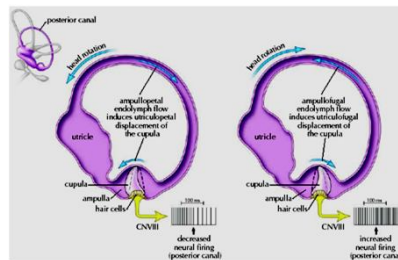
- Horizontal Canal Excitation
 - Ampullopetal endolymphatic flow stimulates crista
- Vertical Canal Excitation
 - Ampullofugal endolymphatic flow



Tellian and Shepard's Graphic

Note: "Petral" means toward, "Fugal" means "away from"

Vertical Canal Excitation



Parnes et al, 2003

Three Ways to Understand the Vestibulo-Ocular Reflex

- Method #1: Neuroanatomy...
- Method #2: Ewalds Laws of Semicircular Canal Dynamics
- Method #3: Ecological Approach

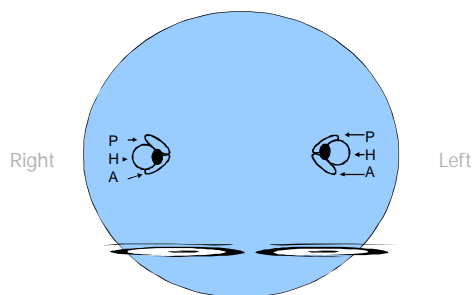
Ecological Approach to Vestibular Evoked Eye Movements

- Vestibular evoked eye movements are designed to:
 - Maintain gaze stability during unexpected head / body movements
 - Maintain eye orientation so that the horizon lines up with the horizontal meridian of the retina

A Model...



The View "Under the Hood"



SSC Planes

- Six SSCs are matched in complement pairs -three planes...
 - Two Horizontal
 - Right Anterior and Left Posterior (*RALP*)
 - Left Anterior and Right Posterior (*LARP*)

Law of Reciprocal Innervation

- Head movements that stimulate the nerve of one canal, inhibit output in the complementary canal
- *Leading Ear Excites*
- *Lagging Ear Inhibits*

Horizontal Canal Dynamics

- Q: Which way does the cupulla of the horizontal canal bend to excite the vestibular nerve?
- A: It “swings away from” the leading ear.
 - A.K.A.: “ampullopetal flow” - endolymph flows towards the utricle

Relating Horizontal SSC Output to VOR

- So with Left Head Turn:
 - The Left Horizontal SCC *Excites* Left Vestibular Nerve
 - Right Horizontal SCC *Inhibits* Right Vestibular Nerve
 - The Eyes Drift to the *Right side* of the Orbit to maintain *Gaze stability (VOR)*


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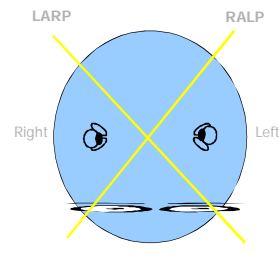
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Relating Horizontal SSC Output to VOR



- At some point, gaze stability cannot be maintained and a saccade moves the eyes to a new fixation target...
 - Nystagmus “Fast phase”
 - Not Vestibular Induced

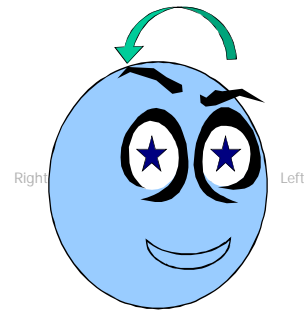
Understanding Vertical SSCs



- “Goals” of VOR
 - Maintain Gaze stability despite head movement
 - Maintain eyes oriented to the horizon
 - Horizon should line up with horizontal meridian of retina


- *What Kind of Eye Movement Is Necessary When Moving in the “Right - Anterior , Left Posterior” (RALP) Plane?*

RALP Movement




- Turn Head 45° to Left
- Tilt Forehead Down
- Look Straight Ahead
- What Do Eyes Do?

RALP Movement




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RALP Movement




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RALP Movement




- *Right Eye elevates*
- *Slight Counter Clockwise Torsional eye movement (relative to the patient)*

RALP Movement



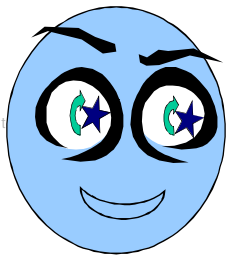
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RALP Movement



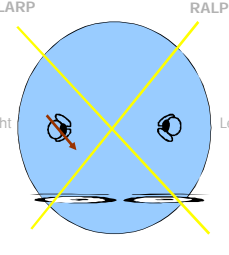
- This is the Effect of Right Anterior Canal Stimulation (When looking to the right):
 - Right Eye elevates
 - Slight Counter-clockwise Torsional “Slow phase” eye movement (relative to the patient)

RALP Movement



- When looking to the left of Right Anterior Canal Stimulation provokes:
 - Minimal vertical movement
 - Counter-clockwise Torsional “Slow phase” eye movement (relative to the patient)

RALP Eye Movements



- Vertical component changes with direction of gaze
- Eye movement remains “in the plane of” the dependent canals (Arrow)

RALP Plane Movements

Looking Right Looking Left

- Plane of rotation is the same regardless of gaze direction
- Trajectory of the pupil depends on direction of gaze

The diagram shows two circular diagrams representing the RALP plane. The left diagram is labeled 'Looking Right' and shows a blue star (pupil) moving in a clockwise direction (indicated by a green arrow) along a diagonal yellow line. The right diagram is labeled 'Looking Left' and shows the blue star moving in a counter-clockwise direction (indicated by a green arrow) along the same diagonal yellow line. A dashed line represents the vertical axis of the head.

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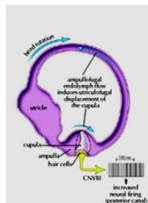
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Vertical Canal Cupula

- How does the cupula of the leading vertical canal move when the head tilts in the RALP plane?

Vertical Canal Dynamics

- It “falls” toward the head tilt.
 - A.K.A.: Ampullofugal Flow or Flow away from the utricle.



Parnes et.al, 2003

Summary Point: #1

- Vestibular Induced Eye Movements:
 - Maintain gaze stability during unexpected head / body movements
 - *Maintain eye orientation so that the horizon lines up with the horizontal meridian of the retina*

Summary Point: #2

- In Angular Head Movements
 - *The leading canal excites the vestibular nerve*
 - *lagging canal suppresses vestibular nerve firing*
 - provokes a slow eye movement in the opposite direction of the head movement (Ewald).
 - The leading canal will drive eye movements in response to fast accelerations (Ewald).

Summary Point: #3

- For horizontal or “yaw” type of excitatory movements, the cupula lags behind the leading ear
- For vertical movements (RALP or LARP planes), the cupula falls in the direction of the head movement

BPPV-Induced Eye Movements

Understanding BPPV-Induced Eye Movements

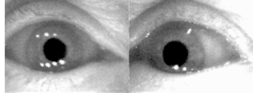
- Simple forms are easy to recognize:
 - Posterior SSC BPPV is torsional, with the top pole of the eye rolling to the floor.
- For more complicated types of nystagmus:
 - Relate the eye movement to the type of head movement that would normally drive the eyes in that direction.
 - “Analogous Equivalent Movement”

Analogous Equivalent Head Movement

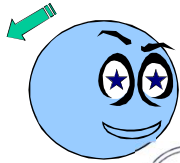
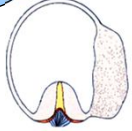
- For more complicated forms of BPPV:
 - Record and observe the eye movement
 - Visualize how the head would move such that the observed eye movement would maintain the eyes horizontal relationship to the horizon
 - Analogous equivalent head movement
 - Visualize which semicircular canals would be stimulated or inhibited during such a movement
 - This will tell you where the debris rests in the labyrinth.

Posterior Canal BPPV

- Eye movement:
 - Top of eye rolls to the floor
 - Counter clockwise (relative to the patient)
 - Up beating component, >in the contralateral eye
- Eye movement is analogous to falling in the plane of the involved posterior canal

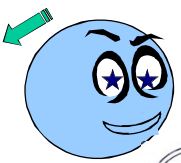



Analogous Head Movement



- Nystagmus is torsional and vertical, with upper pole of eye beating to the floor (fast phase)
 - Nystagmus is the same as if the head was going back for a Dix-Hallpike Maneuver
 - Cupula leans into the movement (excitatory)

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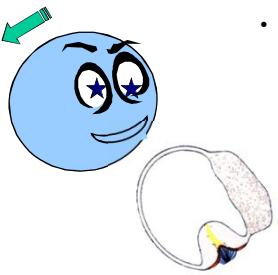
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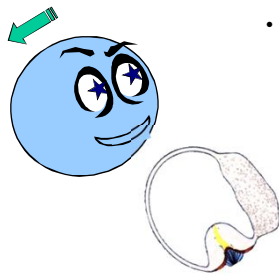
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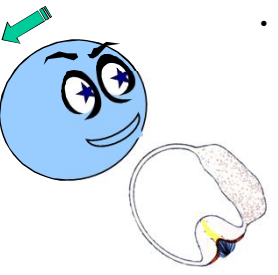
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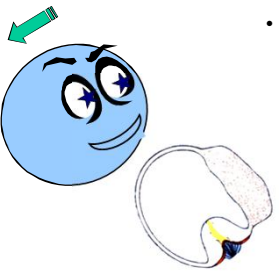
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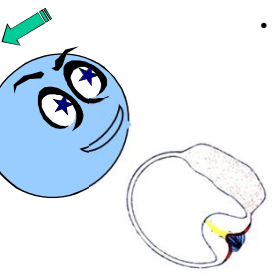
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 - Cupula leans into the movement (excitatory)

Analogous Head Movement



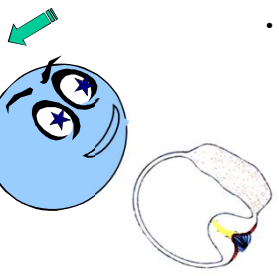
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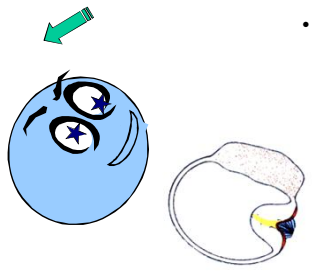
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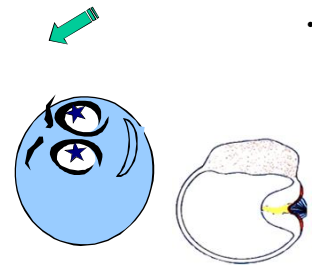
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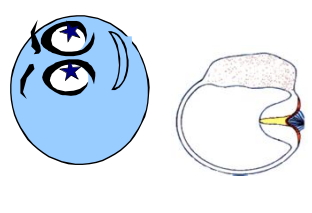
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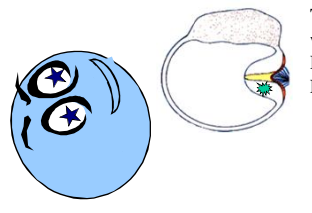
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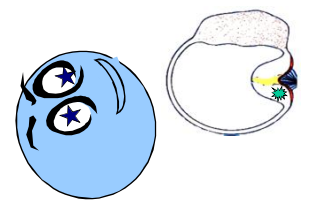
Right Posterior Canal BPPV

Head in the Dependent Position



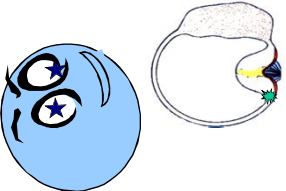
- Same Up and Clockwise (relative to the patient) Torsional Nystagmus as when moving into the Dix-Hallpike Position From Sitting.
 - Onset delay
 - Upward component greatest with gaze to the left

Debris Falls From the Pull of Gravity



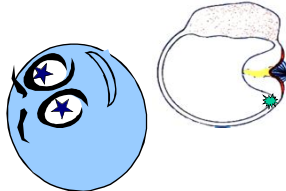
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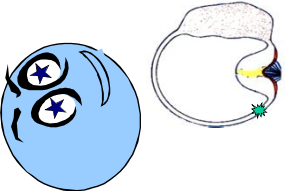
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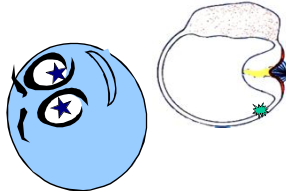
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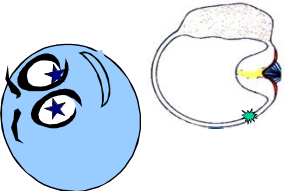
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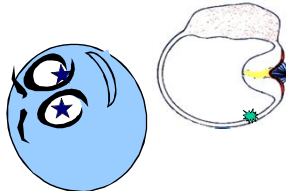
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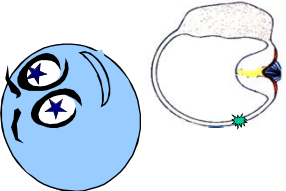
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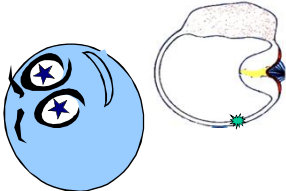
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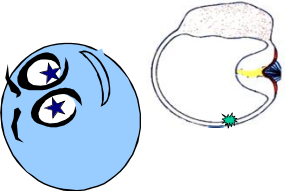
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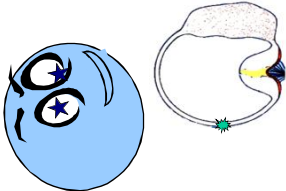
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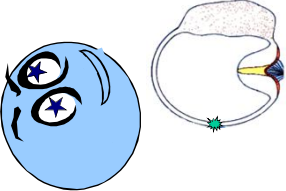
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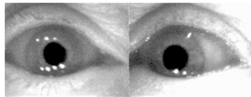

Debris Falls From the Pull of Gravity



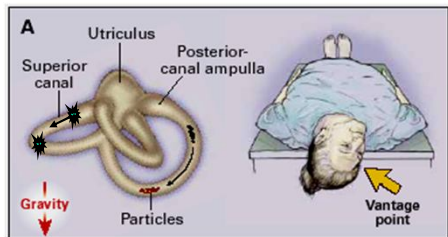
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 - Onset delay
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Posterior Canal Variety

- Eye movement is analogous to falling in the plane of the involved posterior canal
 - Top of eye rolls to the floor
 - Counter clockwise (relative to the patient)
 - Up beating component, >in the contralateral eye

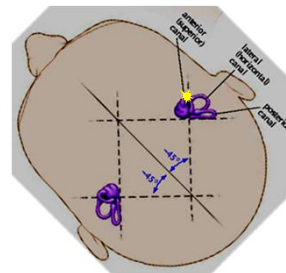



Superior Canal Variations



Modified from: Furman & Cass Benign Paroxysmal Positional Vertigo. NJM, 341:21 1999

Contralateral SC-BPPV



Quick Rules of Thumb

- For vertical / torsional nystagmus...
 - Up-beating eye implies the contralateral posterior canal
 - Down-beating eye implies the ipsilateral anterior canal

Left Anterior Canal Stimulation



- Slow Component
 - Clockwise torsional
 - Upward drift in left eye
- Fast Component
 - Counter-Clockwise torsional
 - Downward "jump" in left eye

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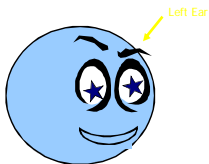
- Slow Component
 - Clockwise torsional
 - Upward drift in left eye
- Fast Component
 - Counter-Clockwise torsional
 - Downward "jump" in left eye

Left Posterior Canal Stimulation




- Slow Component
 - Clockwise torsional
 - Downward in Right eye
- Fast Component
 - Counter-Clockwise torsional
 - Upward Jump in Right eye

Left Posterior Canal Stimulation




- Slow Component
 - Clockwise torsional
 - Downward in Right eye
- Fast Component
 - Counter-Clockwise torsional
 - Upward Jump in Right eye

Left Posterior Canal Stimulation



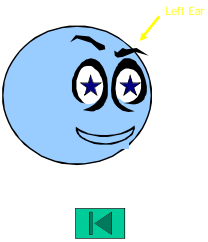
- Slow Component
 - Clockwise torsional
 - Downward in Right eye
- Fast Component
 - Counter-Clockwise torsional
 - Upward Jump in Right eye

Left Posterior Canal Stimulation



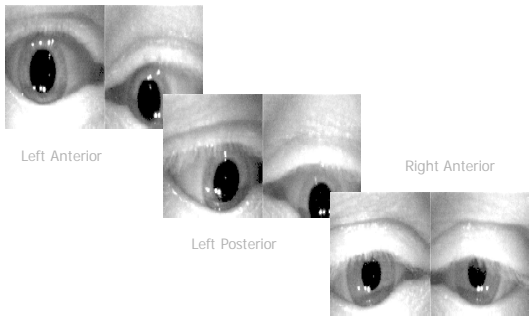
- Slow Component
 - Clockwise torsional
 - Downward in Right eye
- Fast Component
 - Counter-Clockwise torsional
 - Upward Jump in Right eye

Left Posterior Canal Stimulation



- Slow Component
 - Clockwise torsional
 - Downward in Right eye
- Fast Component
 - Counter-Clockwise torsional
 - Upward Jump in Right eye

Examples



Quick Rules of Thumb

- With vertical / torsional nystagmus (fast phase)...
 - Up-beating eye implies the contralateral posterior canal
 - Down-beating eye implies the ipsilateral anterior canal

Quick Rules of Thumb

- If you can't remember this, relate the observed eye movement to the horizon line
 - The eyes are trying to move to the "horizon line"
 - How would the head move to require this eye movement...
 - What canal is being stimulated
- This never fails with BPPV

Clinical Approach

Prevalence

- 10.7 to 107 : 100,000 cases / year
- 17 - 18% of patients in Dizzy Clinic
- Increases with age
- Common antecedents:
 - Neurolabyrinthitis in 10-15%
 - Head trauma in 15-20%
 - Surgery, particularly involving the head
- Cause is unknown in 1/2 of cases

Prevalence in Our Clinic

Vestibulopathy	N	% of Patients	Average Age
No BPPV	1123	73.8%	64.6
R PC BPPV	118	7.8%	70.3
L PC BPPV	101	6.6%	71.1
Multicanal BPPV	30	2.0%	68.9
Bilateral BPPV	26	1.7%	65.3
(+) Hx / subtle findings	101	6.6%	68.9
Atypical CNS	13	0.9%	68.5
Superior canal	4	0.3%	65.0
Horizontal canal BPPV'	6	0.4%	77.2
Total:	1522	100.0%	

BPPV and Perceived Handicap

Vestibulopathy	DHI
PC BPPV	39.9%
Horizontal canal BPPV'	62.0%
Multicanal BPPV	33.4%
Central	36.0%
Other vestibular	41.0%
Non-vestibular	36.3%

Approach

- Brief History and Focused Physical Examination
- Diagnostic Maneuvers
- Treatment Strategies
- Post Procedure Instructions
- Follow-up

Brief History

- Type of Dizziness, Time Course and Provocations
 - Movement or position provoked transient vertigo (“Positioning Vertigo”)
 - Ice!
 - Secondary features:
 - Lightheadedness
 - Disequilibrium
 - *These get better as the day goes on...*

Red Flag Neurological Symptoms

- Diplopia:
 - Double vision from ocular misalignment
 - Implies CN III, IV, VI or brainstem problem
 - Abducens failure: increased ICP
- Dysarthria:
 - Difficulty accurately moving muscles of the mouth - poor articulation
 - Implies CN IX, X, XII or low brainstem lesion

Red Flag Neurological Symptoms

- Dysphagia
 - Difficulty swallowing
 - CN IX, X, XII or low brainstem
- Sensory or Motor Disturbances
 - Change in vision
 - Weakness, numbness, tingling, or impaired ability to move any part of the body

Red Flag Neurological Symptoms

- Change in Voice
 - CN IX and X, lower brainstem
- Aphasia
 - General stroke risk
- Loss of Consciousness (Syncope)
 - Global cerebral ischemia
- History of neck injury or surgery

Other Risk Factors...

- Cardiovascular
 - Syncope or pre-syncope
 - Dizziness that increases upon exertion
- Otologic
 - Hearing
 - Aural pain, pressure, fullness
 - Tinnitus
- Ophthalmologic
 - Recent retinal bleed or retinal Sx

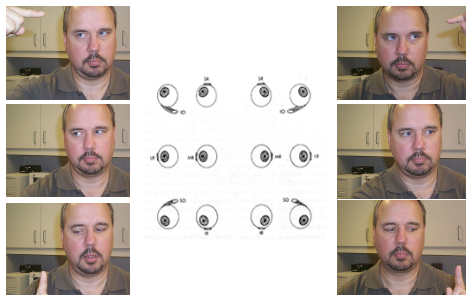
Examination

- Brief ocular motor exam
- Check for signs of persistent vestibular weakness
- Check for neck problems that may preclude typical BPPV maneuvers

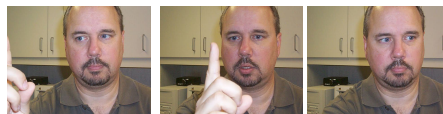
Brief Ocular Motor Exam

- Goal:
 - Check for eye muscle weakness (cranial nerves)
 - Check for gaze evoked nystagmus
- Procedure
 - Check ability to follow finger laterally less than 30° to rule out gaze evoked nystagmus
 - Check “cardinal positions”

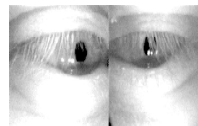
Cardinal Positions



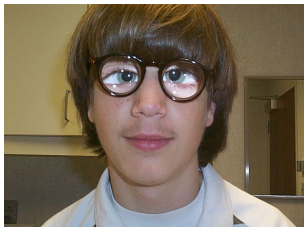
Gaze at 30 Degrees



Don't Bury the Iris!



Check for Spontaneous Nystagmus



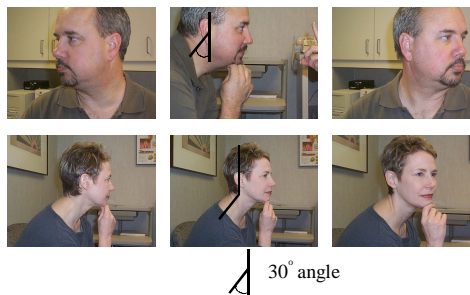
Three Common Diagnostic Errors

- Missing Underlying Vestibulopathy
- Central Positioning Vertigo
 - Lesions around the 4th ventricle
 - Minimal vertigo,
 - Possibly ++ nausea
- Third Window in Labyrinth
 - Perilymphatic Fistula
 - Superior or Posterior Canal Dehiscence
 - Large Vestibular Aqueduct

Neck Evaluation

- Goal:
 - Assess range of motion for Dix-Hallpike
 - Check for neck torsion provoked dizziness
 - Vertebral Basilar Artery insufficiency (VBI)
- Procedure:
 - Range of motion: Sitting up, turn head right and left
 - Sitting, hyperextend the neck w/o tilting head

Neck Range of Motion



Examination

- Neck torsion does not provoke symptoms of lightheadedness
- Neck range of motion is adequate for Dix-Hallpike and CRP

History and Brief Physical Exam

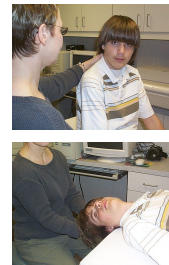
- Screened for neurological, orthopedic and otologic risk factors
- Checked to see if:
 - Ocular motor function was adequate
 - No unexpected gaze nystagmus
- Checked neck range of motion and screened for VBI

Diagnostic Maneuvers

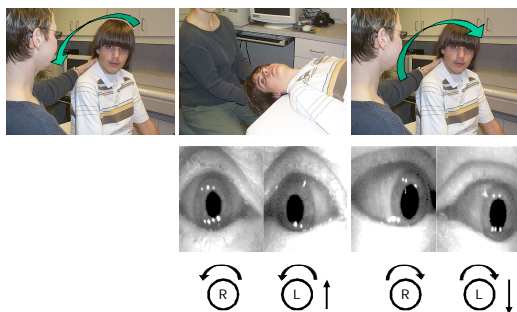
- Three Basic Maneuvers...
 - Vertical (RALP / LARP) planes
 - Dix-Hallpike or Side Lying Maneuver(right and left)
 - Horizontal “Yaw” plane
 - Head / Body Roll
- For each maneuver, assess the direction and duration of any provoked nystagmus

Dix-Hallpike Test (Nylen Maneuver)

- Do test before allowing patient to lie down
- Procedure:
 - Pt. sits with head turned 45° to the side
 - Bring supine with the head angled down about 20°
 - Pt. fixates on your nose (Frenzel lenses may help)
- Repeat if response is positive



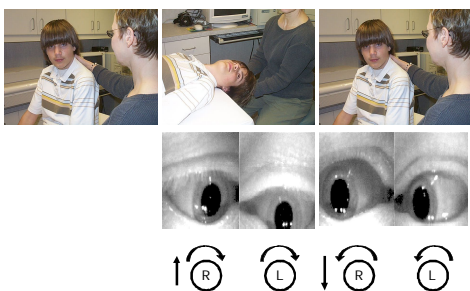
Positive Dix-Hallpike



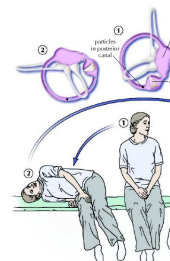
Posterior Canal (PC) BPPV...

- Brief onset latency
- Top of the eye rolls toward the ground
 - For right PC-BPPV:
 - Clockwise and vertical (> left eye)
 - For left PC-BPPV:
 - Counter-clockwise and vertical (> right eye)
- Nystagmus crescendos then fatigues
- Reverses when returned to sitting position
- Adaptation with repeated trials

Left Posterior Canal BPPV...



Side Lying Maneuver



Three Important Observations...

- #1. Duration of nystagmus is important:
 - Canalithiasis: < 1 minute
 - Cupulolithiasis: > 1 minute
 - Central Positioning Nystagmus persists

Three Important Observations...

- #2. Does it adapt over repeated trials?
 - Canalithiasis adapts quickly
 - Cupulolithiasis adapts more slowly,
 - if a fatiguing nystagmus persists, think Cupulolithiasis
 - Central Positioning Nystagmus may not fatigue or adapt appreciably.

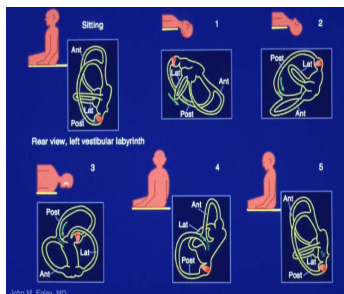
Three Important Observations...

- #3. Perception of vertigo is important:
 - BPPV can be startling, anxiety provoking and nauseating
 - Be confident of your preparation of yourself and your patient.
 - Strong nystagmus without vertigo is very unusual - suspect central positioning nystagmus (Cerebellar or Pontine lesions most common.)

PC-BPPV Treatment

- Goal: Move debris away from affected Ampulla
 - Canalithiasis:
 - Epley Canalith Repositioning Maneuver
 - Cupulolithiasis
 - Liberatory Maneuver (Semont)
- Goal: Minimize patient discomfort
 - Information pre-treatment
 - Ice on the back of the neck
 - Anti-nausea Rx as needed

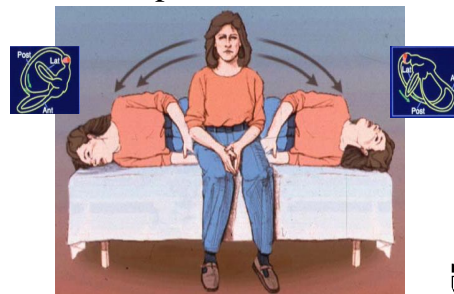
Epley Canalith Repositioning



Treatment Induced Nystagmus

- Nystagmus from PC BPPV remains the same at each point in the Canalith Repositioning Maneuver.
 - If Nystagmus changes direction, one of three things has happened:
 - Another canal is involved
 - Canaliths are not moving in the desired direction
 - Cupulolithiasis

Semont Maneuver Cupulolithiasis

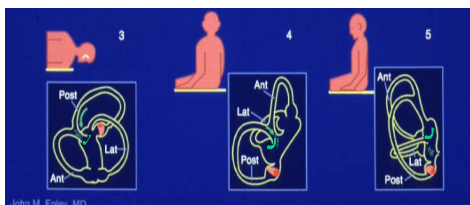


Horizontal Canal Variety

Horizontal Canal Variety

- Two subtypes:
 - Horizontal Canal Conversion
 - Starts with posterior canal symptoms
 - With movement (repositioning attempt), horizontal canal symptoms provoked
 - Spontaneous
 - Presents with horizontal symptoms
 - Rare: Horizontal canal elevated +30 degrees w/ head level, opening is on the low side.

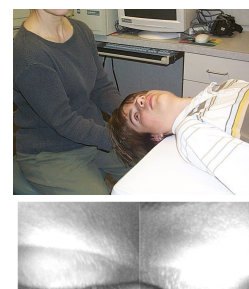
Horizontal Canal Conversion



John M. Epley, MD

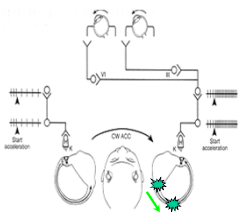
Example Conversion

- Conversion nystagmus beats to the floor (geotropic)
- You have a pretty good idea that it is in the same ear the prior PC -BPPV
- What to do?



Analogous Head Movement

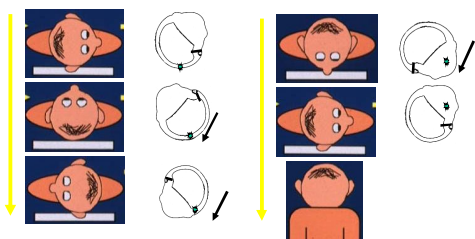
- Dix-Hallpike to the right
 - Provokes right beating horizontal nystagmus
 - “Geotropic”
 - Debris moving from opening of “long arm” to mid-point in the canal. (green arrow)



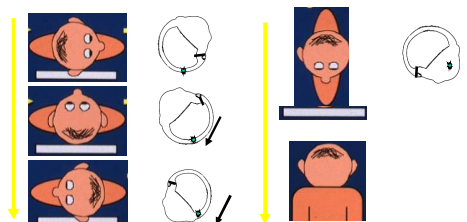
Horizontal Canal Conversion

- Treatment Options:
 - Bring the patient right up: HC-BPPV clears on its own.
 - Treat: reverse the analogous head movement.
 - Roll to the opposite ear - debris is in the opening (long arm) of the horizontal canal and should come out easily.
 - Perform a Log (Barrel)Roll
 - Perform a modified Log (Barrel) Roll

Log Roll - HC Conversion



Modified Log Roll



Modified Barrel Roll

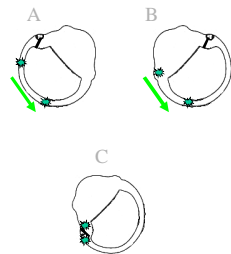


Spontaneous Horizontal Canal BPPV

- Horizontal Nystagmus (plane of the canal)
 - May be seen on Dix-Hallpike or Head Roll
 - Initially, may beat in any direction!
 - Typically provokes strong vegetative symptoms
 - Nausea, diploresis, emmissis
- Good news: Often self clears
 - +30° angle of horizontal canal is a help!

Transient Right Beating Nystagmus

- Possible Locations
 - Canalithiasis
 - Right beating as part of **geotropic** positioning nystagmus pattern (A & B)
 - Cupulolithiasis
 - Right beating as part of **ageotropic** positioning nystagmus pattern (C)

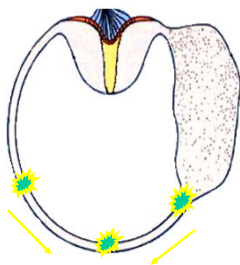


Approach

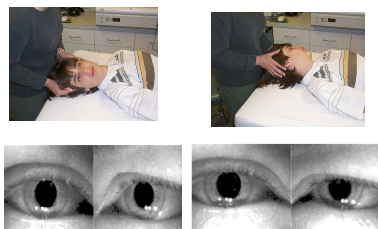
- Head Roll Test
 - First: Canalithiasis or cupulolithiasis
 - Second: Determine side?
 - Third: Diagnostic trial.

Spontaneous Horizontal Canal

- Diagnostic Head Roll Test
 - Lay in supine position until no nystagmus
 - Turn head to right smartly - measure provoked nystagmus
 - Return to supine until no nystagmus
 - Turn head to left smartly - measure provoked nystagmus



Head Roll Test

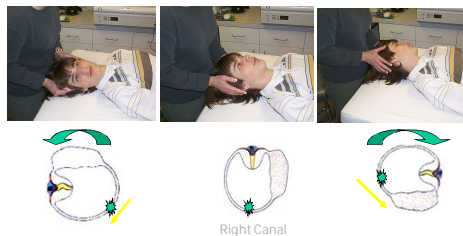


The bottom ear on the side of the greatest provoked nystagmus has the debris

Head Roll Test Results

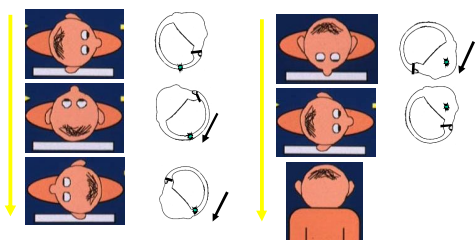
- Geotropic positioning nystagmus:
 - Canalithiasis
 - Involved ear : lower ear on side with stronger response
 - In this case, the right is involved

Diagnostic Head Roll Test



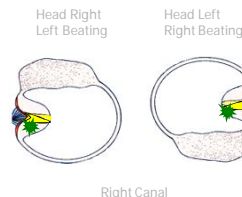
- The bottom ear on the side of the greatest provoked nystagmus has the debris

Log Roll to Left



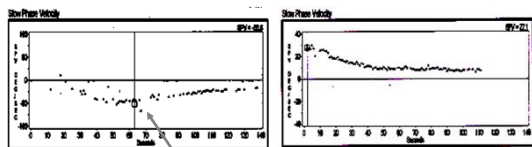
Horizontal Cupulolithiasis

- Ageotropic Positioning Nystagmus
 - Persists for "longer" time
 - Upward ear on side with greatest response the involved side?
 - May convert to geotropic variety



Cupulolithiasis Time Course

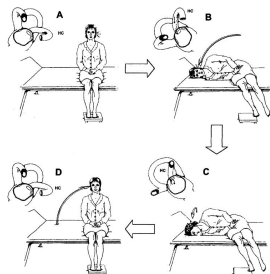
- Head Roll Left
- Head Roll Right



What to do with Cupulolithiasis?

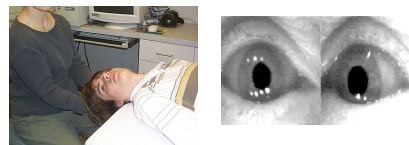
- Trial roll in direction of best guess.
 - Possibly with vestibular suppressants on board.
- Use Vibration
- Use liberatory and Brandt Darrof Exercises
- Make sure you have excluded CNS (double check)

Appiani Maneuver




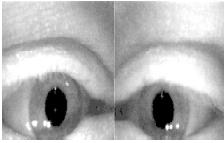
Anterior Canal Variations

- Dix - Hallpike Right
 - Should see Clockwise and Upward (>left eye)
 - Instead.....



Anterior Canal Variations

- You see Clockwise and Downward (> right eye)
 - Where is the debris?

Quick Rule of Thumb


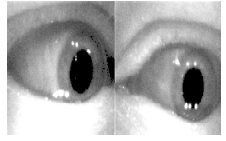
- Up-beating eye implies opposite posterior canal
- Down-beating eye implies the same anterior canal
- This is Right AC-BPPV

What to do?

- In most cases, an ipsilateral anterior canal (relative to Dix-Hallpike) will convert to posterior canal
 - ...on second Dix-Hallpike.
 - ...or during CRP
- If not, go to anterior canal treatments (forthcoming)

Anterior Canal Variations

- Dix - Hallpike Right
 - Should see Clockwise and Upward (>left eye)
 - Instead you see a Clockwise and Downward (>left eye)

Quick Rule of Thumb

- Up-beating eye implies opposite posterior canal
- Down-beating eye implies the same anterior canal
- This is left AC-BPPV

What to Do?

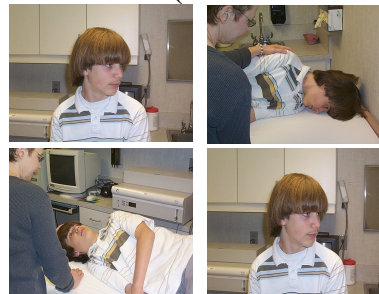
- In most cases, contralateral anterior canal (relative to Dix-Hallpike) will convert to posterior canal
 - ...on second Dix-Hallpike.
 - ...or during CRP
- If not, go to anterior canal treatments (forthcoming)

What if AC-BPPV persists

- First try a reverse Epley Maneuver
 - Example is for left anterior canal...



Reverse Semont / Liberatory Maneuver (Left AC-BPPV)



Post Treatment Care All Canals

- Limit movement and remain upright for 24 hours*
 - Patient fitted with a neck collar to assist.
 - Benefit? Not documented
- Remaining upright at night*
 - Sleep in a semi- upright (no lower than 20-30 degrees) position
- Next 6 nights avoid sleeping on side of ear treated.*

*Makes no difference: Cohen 2004

Time Course of Recovery

- Successful Treatment
 - Positional Vertigo gone
 - Residual disequilibrium (Utricular stimulation?)
 - Tilting
 - Bobbing
 - Time course
 - Disequilibrium decreases about 80% within two days
 - May take a full four weeks for disequilibrium to diminish completely
- Vestibular Rehabilitation if incomplete recovery

Short Term Outcomes

Table 2: Efficacy of the particle repositioning manoeuvre for posterior canal BPPV

Reference	No. of patients	Success rate, %	Recurrence rate, %	Treatment sessions	No. of manoeuvres per session	Post- manoeuvre instructions	Mastoid vibration
Epley ¹⁶	30	80	30	Single	Multiple	Yes	Yes
Epley ^{16a}	30	100	NR	Repeated	Multiple	Yes	Yes
Epley ^{16b}	14	93	NR	NR	NR	Yes	Yes
Li ¹⁷	10	30	NR	Single	Single	Yes	No
Li ¹⁷	10	100	NR	Repeated with vibration	Single	Yes	Yes
Li ¹⁷	27	92	NR	Single	Single	Yes	Yes
Blakley ¹⁸	16	94	NR	Single	Single	No	No
Smolha ¹⁹	27	93	NR	Multiple	Multiple	No	No
Wolf et al ²⁰	102	93	5	Single	Single	Yes	No
Herdman et al ²¹	30	90	10	Single	Single	Yes	No
Parnes and Price-Jones ²²	34	88†	17	Multiple	Multiple	Yes	No
Weider et al ²³	44	88	9	Multiple	Multiple	Yes	Yes
Saunders and Cronin ²⁴	20	85	NR	Multiple	Multiple	No	No
Welling and Barnes ²⁵	25	84	NR	Multiple	Single	Yes	No
Harvey et al ²⁶	25	68	20	Multiple	Single	Yes	No
Lynn et al ²⁷	18	61	NR	Single	Single	Yes	No

^{16a}NR = not reported. Table adapted from Toyama et al¹⁶
^{16b}Multiple sessions from the same reference (all case data extracted from a single study that used different courses for different groups of patients, including patients less than follow-up.

Long Term Outcomes

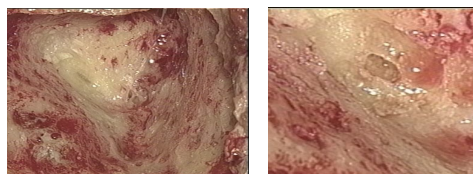
- Average recurrence rate: 37% at 60 months (5 years)
 - 50% for HC-BPPC
 - 26% for other BPPV

Sakaida M; Takeuchi K; Ishinaga H; Adachi M; Majima Y Neurology, 2003

Persistent Cases

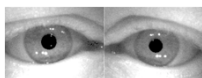
- Medications for vestibular suppression and nausea control
- Time
- Brandt - Daroff Exercises
- Canal Plug Surgery

Canal Plug Video



Diagnosing BPPV

- A Test:
 - What canal is firing?



The Eyes are Incredible!

- We hope this talk has sharpened your abilities to:
 - Recognize and understand common subtypes of BPPV presentations
 - Recognize when “Benign” is not benign
 - Understand the current limits of our understanding of this condition

The End