Vestibular Function Testing

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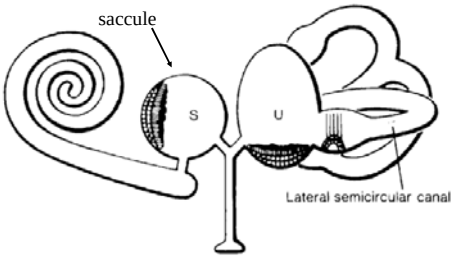
Vestibular Tests

- ENG (electronystagmography)
- VEMP (Vestibular evoked myogenic responses)
- Rotatory Chair
- Posturography

Five motion sensors – can measure two



Schematic of Inner Ear (Frenzel, 1955)

What are we testing?

- VOR (i.e. input/output, ENG/Rchair)
  - Lateral canal only
- VCR (VEMP test)
  - Saccule only
- Abnormal gravity sensitivity (positional nystagmus)
  - BPPV
- Central tracking and visual acuity (pursuit, saccade test, OKN test)
- Sensorimotor integration (posturography)
  - Documents something related to balance
  - Diagnoses Malingering

Believe in yourself ! (your own exam)

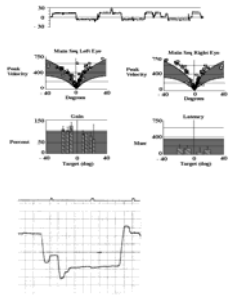
- Quality control on vestibular testing is nonexistent
- Computer software is crude
- No method exists of recording torsion (which you need for BPPV). Your eyes are better.
- There are many places where corners can be cut or things can go wrong
- **Experienced eyes (with Frenzels) are far more reliable than most ENG's.**

Electronystagmography (ENG or VENG) consists of a battery

- Calibration test (saccades)
- Spontaneous nystagmus test
- Oscillating tracking tests (Pursuit)
- Positional tests (Hallpike)
- Caloric test

Calibration Test

- Calibration (of course)
- Gaze-evoked nystagmus (cerebellar)
- Saccades
  - Oculomotor disorder
    - Gaze palsy
    - INO
  - Cerebellar disorder
    - Overshoot and undershoot



Calibration test: Bottom Line

- Can detect cerebellar disorders and oculomotor palsies (which are rare).
- Unreliable (i.e. not sensitive)
- Often misinterpreted
- **Your eyes (bedside exam) are usually more accurate.**

Spontaneous Nystagmus Test

- Record nystagmus in light and dark
  - Acute vestibular disorders have strong horizontal "jerk" nystagmus.
  - Normal people and chronic vestibular disorders have little or no nystagmus. Neural compensation for vestibular tone asymmetry is fast and effective. Most people can't "fake" nystagmus.
  - Almost everything unusual is central.

Vestibular Spontaneous Nystagmus (very abnormal, temporal bone fracture, dizzy and deaf)

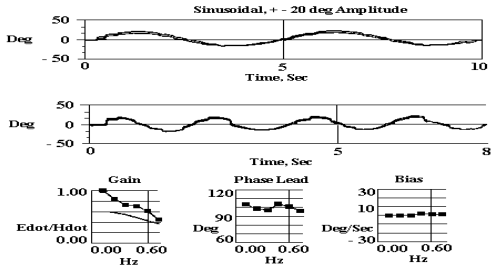
Spontaneous Nystagmus Test: Bottom Line

- If present, very useful because documents that there is either a acute vestibular disorder or central problem.
- If not present, not helpful. Disorder may be intermittent or chronic (SN goes away).
- **<u>Your own eyes (with video Frenzels) are more accurate than ENG</u>**

Oscillating Tracking Test Smooth Pursuit is impaired by:

- Central disturbances -- most cause a transient disturbance only.
- Medications (including all "dizzy" drugs)
- Age (50 and up)

Normal oscillating tracking test (Smooth Pursuit)



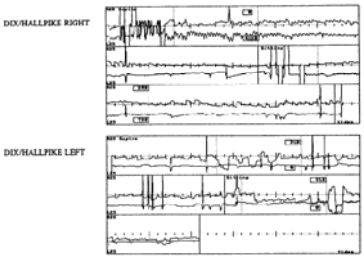
Pursuit Test: Bottom line

- Smooth pursuit testing is rarely useful for clinical diagnosis.
- ENG or your eyes- - it doesn't matter
- No implications for PT either

Positional/Positioning Testing

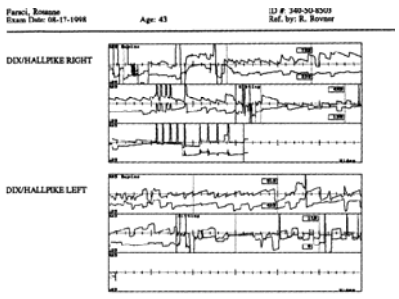
- Hallpike test for BPPV (common condition). No ENG torsion measure – **your eyes are better** !
- Positional test for non-BPPV positional nystagmus. These are extremely rare, however.
- Central positional nystagmus

Posterior canal BPPV (R)



What the ENG people see on VNG (hard to see torsion too)

Lateral Canal BPPV (R)



Central Positional Nystagmus

- Anything is possible (can resemble lateral canal BPPV and variants)
- DBN supine most common
- UBN next most common
- Generally no PT intervention will work (but worth a try anyway)

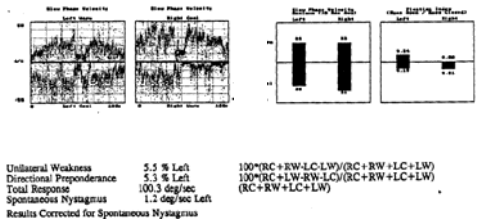
Positional Testing Bottom Line

- Positional testing is useful to diagnose classic BPPV and variant BPPV (20% of all dizziness)
- Your own eyes with Frenzels is better than ENG in most instances
- Assume any ENG positional is BPPV until you exhaust treatment

Caloric Testing – unilateral weakness: Method

- Hot and cold water in ear (a little messy)
  - Some labs use air – not a good idea
  - Some labs use balloons – not a good idea either
- Measure nystagmus
- Compare ears and total nystagmus

Normal Caloric



Unilateral Weakness	5.5 % Left	100*(RC+RW-LC-LW)/(RC+RW+LC+LW)
Directional Preponderance	5.3 % Left	100*(RC+LW-RW-LC)/(RC+RW+LC+LW)
Total Response	100.3 deg/sec	(RC+RW+LC+LW)
Spontaneous Nystagmus	1.2 deg/sec Left	

Results Corrected for Spontaneous Nystagmus

Caloric Testing

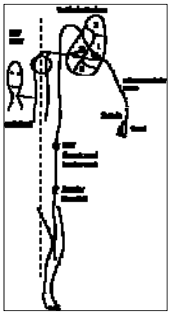
- **Paresis** compares one side to the other. Up to about 30% is OK, but takes some judgement. Most useful measurement (for unilateral loss).
- **Total response** compares all four responses to norms. Greater than 20 deg/sec is normal. Useful if water is used, useless if air is used. For bilateral loss.

Caloric Testing Bottom Line

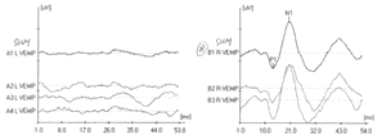
- Definitive method of diagnosing a unilateral vestibular lesion, and sensitive to bilateral too.
- Calorics are the only thing you can't easily do yourself (with Frenzels)
- You can do spontaneous, HSN and Vibration though (which are pretty good)

VEMP testing

- Exciting new test – of VCR
- Loud clicks in one ear
- Record from SCM



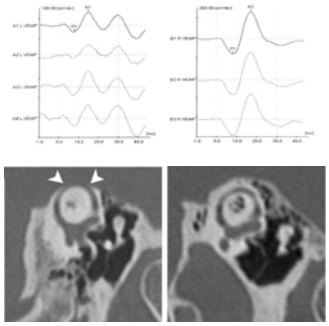
Abnormal VEMP in Vestibular neuritis (absent one side)



Good correlation between R-chair and VEMP

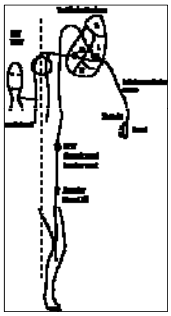
Poor correlation between Caloric and VEMP.

Superior canal dehiscence (giant on one side)



VEMP: Bottom Line

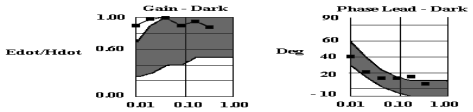
- Great new test of vestibular function
- Good test for bilateral loss (treatable by PT)
- Good test for SCD -- not treatable with PT
- Bad test for vestibular neuritis (because inferior nerve not affected in most VN)



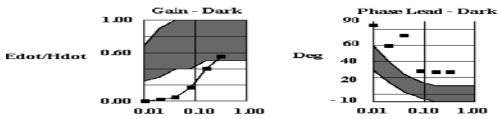
Rotatory Chair Testing

- Sinusoidal rotation in a chair over a spectrum of frequencies
- Measure gain and phase, compare with normal.

Normal Rotation Test



Rotation test after Gentamicin



Rotatory Chair Testing Bottom Line

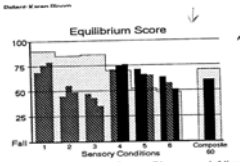
- Definitive test for bilateral vestibular loss
- Not much good for anything else
- Likely soon to become even less useful as VEMP's handle most

Moving Platform Posturography (MVP)

- Measure sway on a platform that can rotate about ankles and translate.
- 6 different sensory tests
- numerous "movement" tests measuring latency and strength of reactions

MVP for Malingerers

- Six "sensory tests"--> gradient of difficulty
- Malingerer tries to "fail" test, and adjusts sway to appear very unsteady on all tests
- Malingerer fails easy tests.
- Examiner must not tell subject how to behave.
- Cevette algorithm -- linear discriminant score



MVP: Bottom Line

- Abnormal in conditions with poor balance (about as useful as the Romberg, which takes 10 seconds to do)
- **Good test for malingerers – very useful.**
- **Bad test for diagnosis** -- no diseases detected other than malingering

Summary – what you can learn from these tests

- ENG -- unilateral loss, bilateral loss, BPPV
- VEMP test – unilateral loss, otolith disease, SCD
- Rot-chair -- bilateral loss
- Posturography -- malingering
- **Frenzels and your eyes** – unilateral loss, bilateral loss, BPPV.

More details

The Handbook of Balance Testing
(Ed. Jacobson and Newman), Mosby, 1992, 2007

www.dizziness-and-balance.com