Vestibular Function Testing

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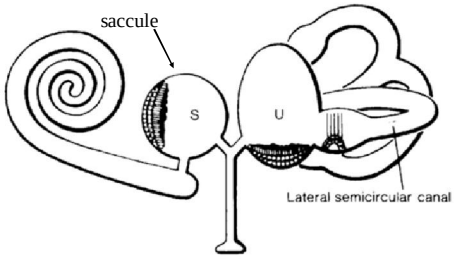
Vestibular Tests

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

Five motion sensors – can measure two



Schematic of Inner Ear (Frenzel, 1955)

Overview – your own exam is probably better than tests !

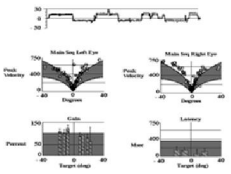
- Quality control on vestibular testing is nonexistent
- Computer software is crude and buggy
- No method exists of recording torsion (which you need for BPPV). Your eyes are better.
- There are many places where corners can be cut or things can go wrong.
- **Experienced eyes (with video Frenzels) are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

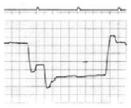
Electronystagmography (ENG or VENG) consists of a battery

- 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

- Can detect cerebellar disorders and oculomotor palsies (which are rare).
- Unreliable (i.e. not sensitive)
- Often misinterpreted (“central findings”)
- **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)

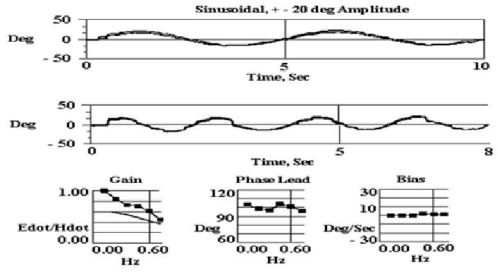
Spontaneous Nystagmus Test: Bottom Line

- 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)



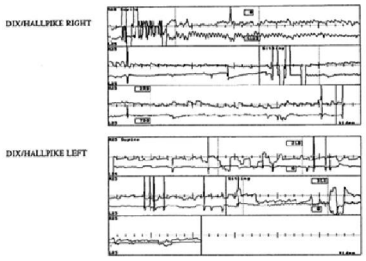
Pursuit Test: Bottom line

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

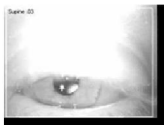
Positional/Positioning Testing

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

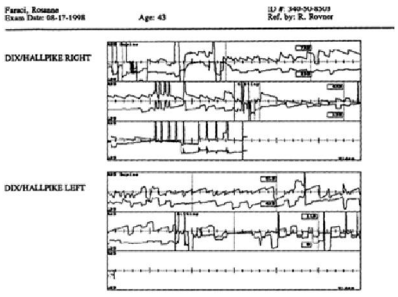
Posterior canal BPPV (R)



What the ENG people see on VNG (hard to see torsion too because the image is tiny)



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)

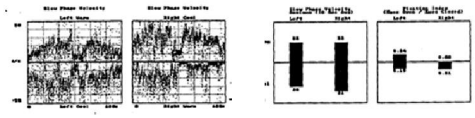
Positional Testing Bottom Line

- 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 – a bad idea as small responses.
  - Some labs use balloons – even worse than air.
- 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

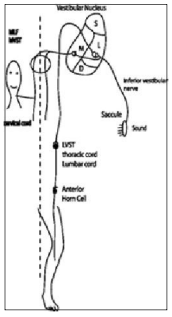
- **Paresis** compares one side to the other. Up to about 30% is OK, but takes some judgement. Most useful measurement (for unilateral loss).
- **Total response** compares all four responses to norms. Greater than 20 deg/sec is normal. Useful if water is used, useless if air is used. For bilateral loss.

Caloric Testing Bottom Line

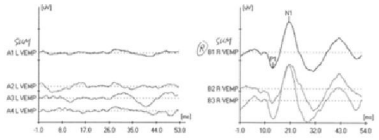
- Definitive method of diagnosing a unilateral vestibular lesion, and sensitive to bilateral too.
- Calorics are the only thing you can't easily do yourself (with Frenzels)
- You can do spontaneous, HSN and Vibration though (which are pretty good)

VEMP testing

- Exciting new test – of VCR
- Loud clicks in one ear
- Record from SCM
- Main problem is variability

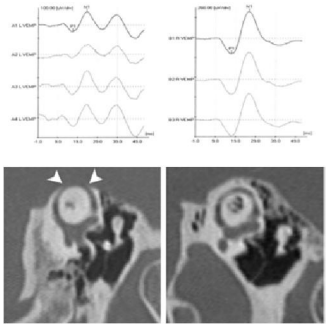


Abnormal VEMP in Vestibular loss (absent one side)



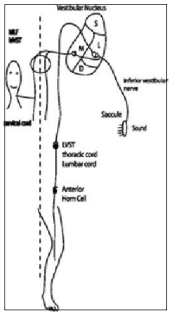
This is an exceptional case - -there is generally a poor correlation between Caloric and VEMP. The reason is that vestibular neuritis usually spares inferior vestibular nerve

Superior canal dehiscence (giant on one side)



VEMP: Bottom Line

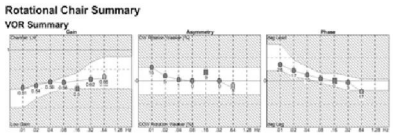
- Good new test of vestibular function
- Good test for bilateral loss (treatable by PT)
- Good test for SCD -- not treatable with PT
- Bad test for vestibular neuritis (because inferior nerve not affected in most VN)



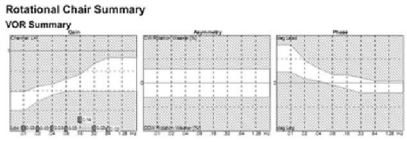
Rotatory Chair Testing

- 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

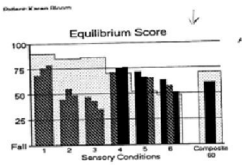
- Definitive test for bilateral vestibular loss
- Not much good for anything else

Computerized Dynamic Posturography (CDP)

- 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

CDP 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



CDP: Bottom Line

- Abnormal in conditions with poor balance (as useful as the Romberg, which takes 10 seconds to do)
- **Good test for malingerers – very useful. This is important !**
- **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 (CDP) -- malingering
- **Frenzels and your eyes** – unilateral loss, bilateral loss, BPPV, SCD. What you don't get is the unilateral loss, otolith, malingering.

More details

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

www.dizziness-and-hearing.com