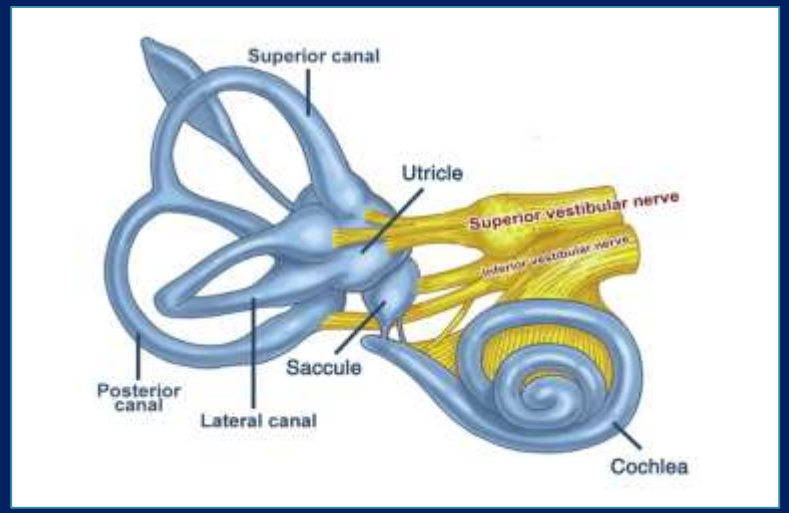
The structure of the balance system

-each part needs to be tested

- **VESTIBULAR LABYRINTHS comprising of**
  - **3 semicircular canals, saccule, utricle**
- **VESTIBULAR NERVE with the sup. & inf. vestibular nerves**
- VESTIBULAR NUCLEUS
- BRAINSTEM
- CEREBELLUM
- VESTIBULAR CORTEX
- EYES
- SPINAL CORD
- PERIPHERAL NERVES
- SKELETAL & EXTRA-OCULAR MUSCLES



The Reflex Pathway

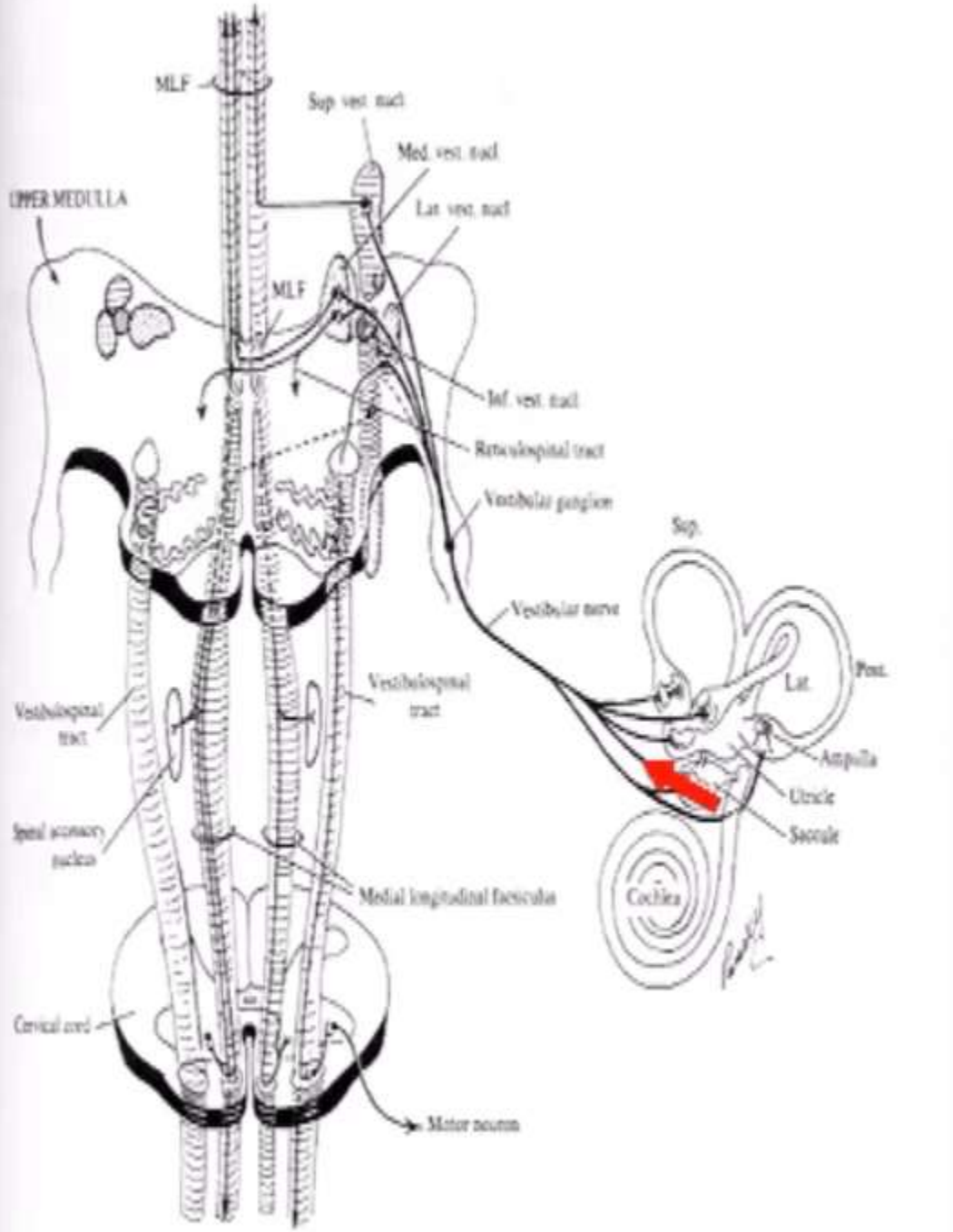
Afferent sensory organ
vest.labyrinth/ eyes/ proprioceptors

Afferent neural pathway
vestibular nerve/ optic nerve/ ascending column in spinal cord

Center of the reflex
Vestibular nucleus

Efferent motor pathway
MLF to oculomotor nuclei 3/4/6h cr nv
Descending vestibulo-spinal tract
Ant. horn cells – peripheral

Effector motor organ
Extra-ocular / skeletal muscles



Diagnostic tools available today

Vestibular function tests:-

- ENG
- VNG
- oVEMP
- cVEMP
- SVV
- VHIT
- DVAT
- Posturography
- CCG

Allied tests:-

- P T Audiometry with localising tests
- BERA
- ECochG
- NCV and SSEP
- Imaging studies

Specific tests for each anatomical part

ANATOMICAL PART TESTED

-
-
-
-
-
-
-
-
-
-
-

ON

q)

s of VNG

Sob. visual vertical (SVV)

- NCV, SSEP

1)Whatever be the test there is NOTHING to beat a thorough history taking , a proper clinical examination and the clinician's clinical judgment

2)All vestibulometric tests are only as good as the man-behind-the-machine and the clinician interpreting the test

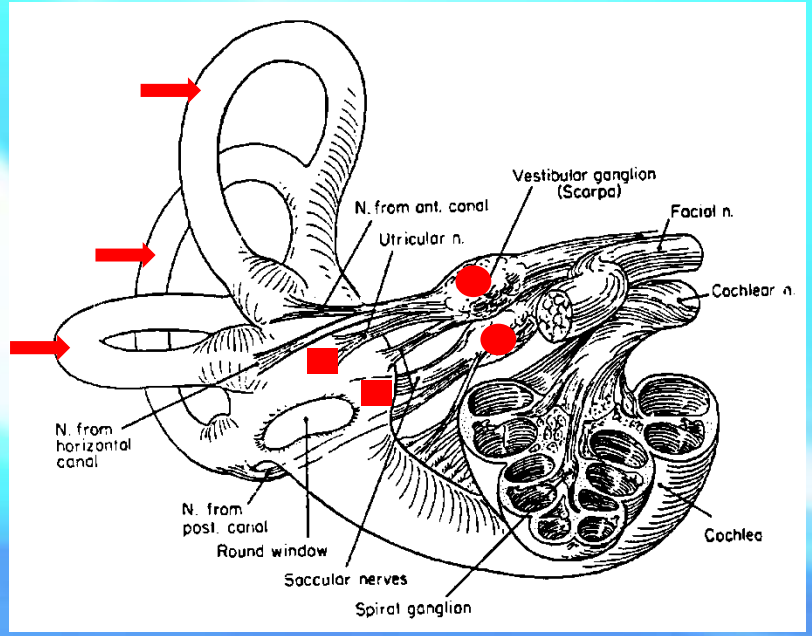
A modern Vertigo clinic

More pictures at vertigoclinic.in

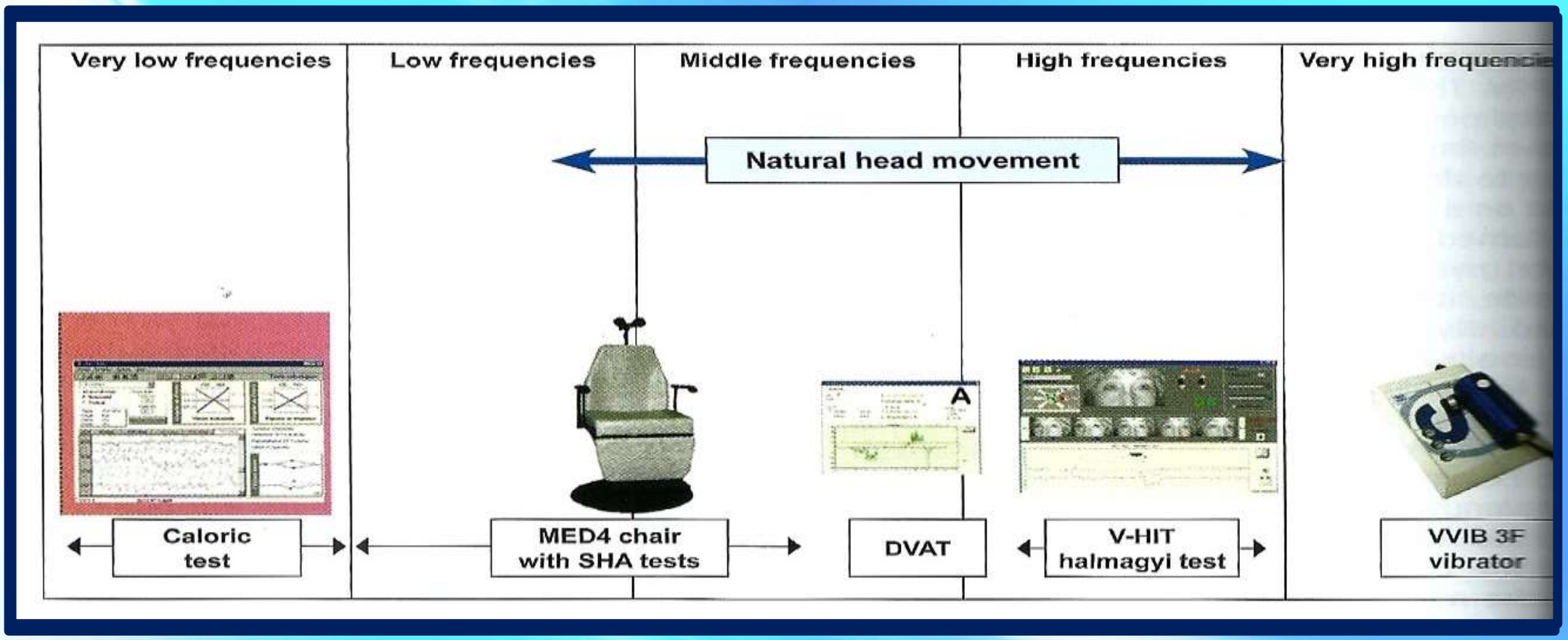
Ideal Vestibular Testing?

- An ideal vestibular test should be able to test the following independently in each ear:
- Three semicircular canals – lateral, anterior, and posterior
- Two otolith organs – utricle and saccule
- Two branches of vestibular nerve – superior and inferior

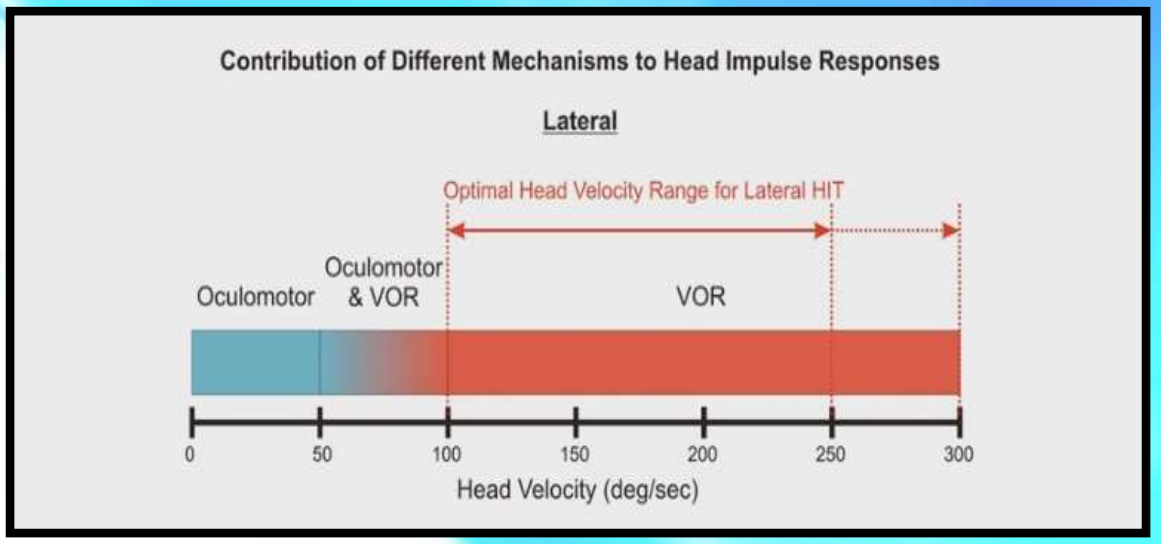
VHIT
& VEMP



Different tests evaluate vestibular response at different frequencies of stimulation



Relationship of *Oculomotor and VOR at different frequencies of head movement*



Gain of VOR is =

$$\frac{\text{Velocity of eye movement}}{\text{Velocity of head movement}} \times 100$$

- Head impulse responses for head velocities below 50^{o}/sec are mediated entirely by the tracking (smooth pursuit) mechanism of the oculomotor system
- Both oculomotor and VOR mechanisms contribute to eye movement responses for head velocities between 50-100^{o}/sec (the ratio varies by age and other factors)
- Head impulse responses for head velocities above are mediated entirely by the VOR
- So to evaluate pure VOR, head movement has to be above 100^{o}/sec

Standard VNG/ENG test battery

VNG / ENG Test evaluates:-

1) Oculomotor system (higher precision in VNG than ENG)

2) Sensitivity of lateral semicircular canal only

3) Structures tested are LSCC, Sup Vest nv,

Does not evaluate:-

Utricle , Saccule , anterior & posterior semicircular canals, Inf. Vest nv

Tests LSCC at very low freq of vestibular stimulation

VNG /ENG equipment and setup

The combined ENG/VNG /VEMP setup

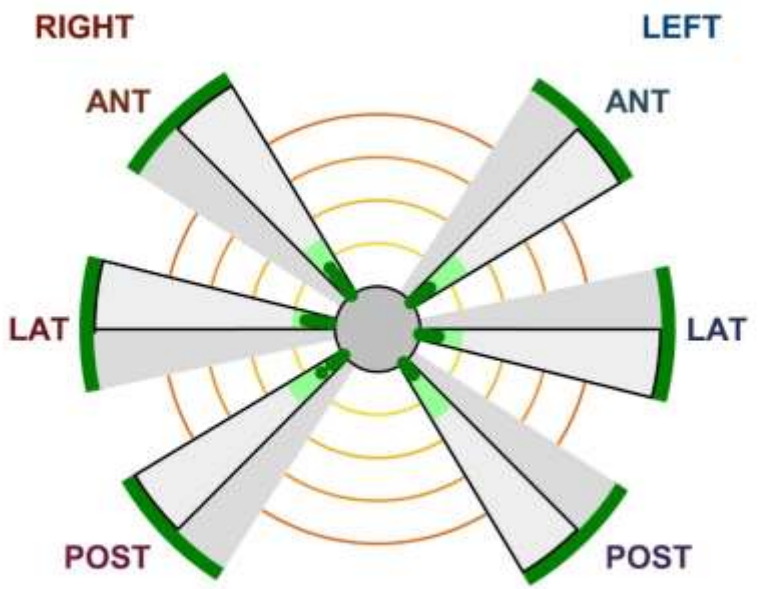
Air caloric irrigator from Otometrics

Video Head Impulse Test (VHIT)

- Tests the function of the Vestibulo-Ocular Reflex (VOR) of all 3 semicircular canals of both sides
- Identifies which of the 6 canals has a lesion
- Very helpful in quickly and accurately diagnosing peripheral vestibular lesions
- Can be carried out in 10 minutes even by non –medical persons with a bit of training

Video Head Impulse Test (VHIT)

(VHIT of marketed by Synapsys)



Impulses		VOR		Early saccades		
Canal	n	Mean gain	σ	Ratio	Mean latency	Mean apparent gain
RA	10	0.98	0.09	0 %		
LA	10	0.98	0.06	0 %		
RL	8	0.91	0.03	0 %		
LL	10	0.98	0.04	0 %		
RP	12	1.02	0.09	0 %		
LP	13	0.98	0.04	0 %		

nt of the

detect

C USB port

e patient, no

Video Head Impulse Test (VHIT)

(VHIT of otometrics)

Camera over the patient's eyes unlike Ulmer VHIT

Dedicated software to detect Halmagyi sign

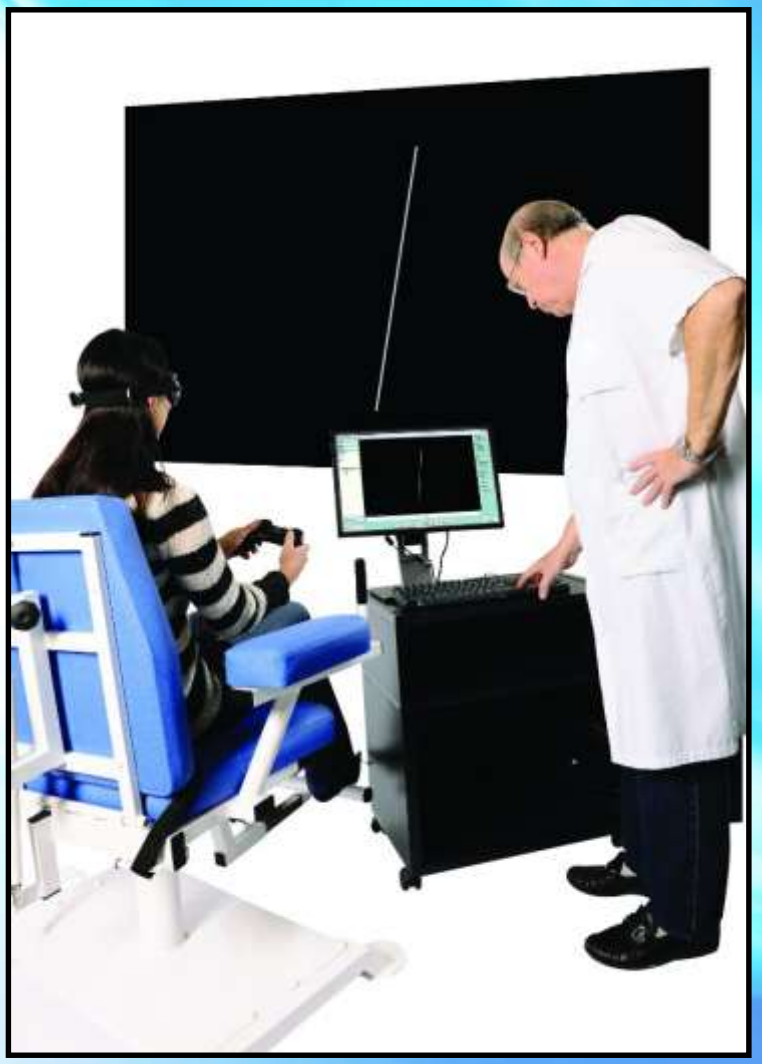
5 minutes protocol

Directly connected to PC USB & fireware port

Very comfortable to the patient, no vertigo

Subjective Visual Vertical (SVV) test

-the set-up and the hardware



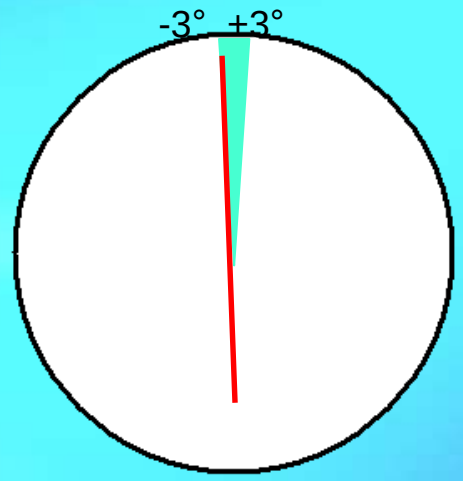
Any horizontal or vertical visual reference has to be completely suppressed

The Subjective Visual Vertical

- Very simple, easy to perform, very fast, very reliable test for evaluation of otolithic (primarily utricular) function
- Non –invasive test entertaining for the patient and hassle free for the doctor
- Does not cause vertigo / nausea / vomiting
- Very sensitive test to assess acute /uncompensated vestibular lesions
- Dynamic subjective visual vertical can identify *compensated* unilateral vestibular lesions

Protocol & Results of the SVV

- **Protocol:** alternate the directions, make at least 8 measurements, and calculate the average of the values at the end of the test

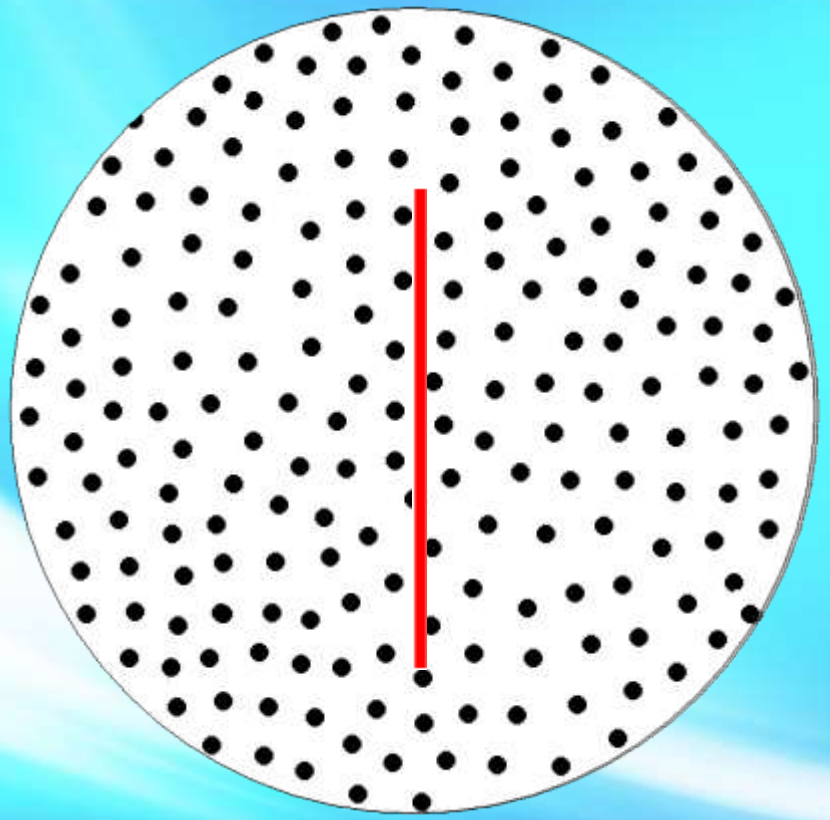


- **Results :**
  - Normal if<2.5°
  - Intense deviation if >10°
- **Interpretation :**
  - Deviates on pathological side in case of acute unilateral vestibular lesions

The SVV measurement is a very important part of vestibulometry , as it assesses the perception of verticality which is an otolithic function

Dynamic Subjective Visual Vertical

Optokinetic stimulation of 40°/sec. (CW and CCW) creates a symmetric deviation of the SVV



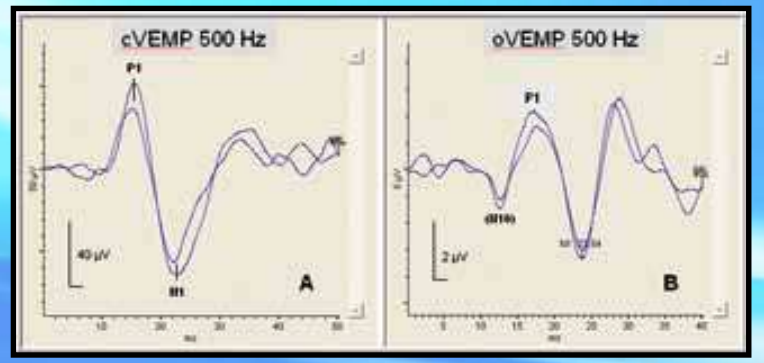
If the total deviation (R+L) is more than 12°, we can conclude to a sign of visual dependance.

VEMP test

A myogenic response from muscles of the neck or eyes, in response to loud acoustic stimulation.

VEMP is primarily the result of stimulation of otolith organs (the saccule and utricle)

Otolithic sensitivity can be evaluated very simply by the VEMP test



AC- Ocular VEMP

- **Stim-** *AC sound in ear*
- **Response-** *in contralat inferior oblique ms*
- **Type of response-** *excitatory response*
- **Nature of response-** *contraction of inf. oblique muscle of contralateral side*
- **Evaluates-** *ipsilateral* **URTICLE**
- **Also tests** - *ipsi. superior vestibular. nv*

Loud sound stimulates utricle ⟶ vestibular labyrinth activated
⟶ vestibulo-ocular reflex stimulated ⟶ contraction of eye muscles

AC- Cervical VEMP

- **Stim -** *AC sound in ear*
- **Response -** *in ipsilat SCM muscle*
- **Nature of response-** *cessation of contraction of a tonically contracted ipsilateral SCM muscle of same side*
- **Evaluates -** *ipsilateral* **SACCULE**
- **Also tests -** *ipsi. inferior vestibular. nv*

Loud sound stimulates saccule ⟶ vestibular labyrinth activated
⟶ vestibulo-collic reflex stimulated ⟶ response in ipsi SCM muscles

VEMPs are

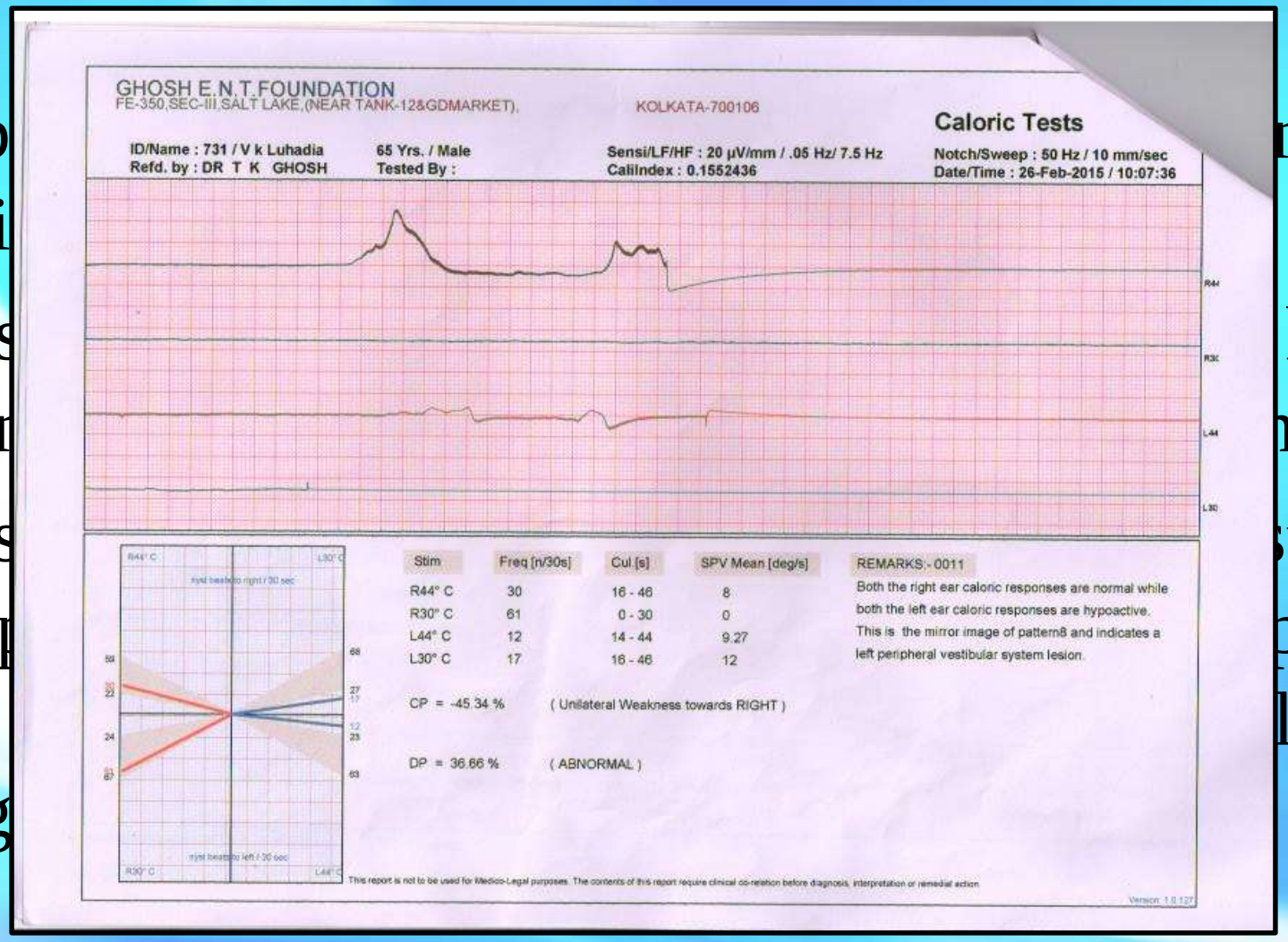
Very reliable, non-invasive, non-nauseogenic non-vertigenic test of utricular and saccular function.

While VNG / ENG, subjective visual vertical testing, evaluate the ampullary function of the vestibualar labyrinth, VEMP evaluates the macular function of the otolith organs

Routine combined use of ocular and cervical VEMP with VHIT and VNG helps to evaluate labyrinth more completely

However

- All vestib … n behind the machi
- Most tests … has made vestibulor … ns today
- Clinicians … st until it has been p … person with sufficient … lar physiolog



GHOSH E.N.T.FOUNDATION
FE-350,SEC-III,SALT LAKE,(NEAR TANK-12&GDMARKET), KOLKATA-700106

Caloric Tests

ID/Name : 731 / V k Luhadia | 65 Yrs. / Male | Sensi/LF/HF : 20 µV/mm / .05 Hz/ 7.5 Hz | Notch/Sweep : 50 Hz / 10 mm/sec
Refd. by : DR T K GHOSH | Tested By : | CaliIndex : 0.1552436 | Date/Time : 26-Feb-2015 / 10:07:36

Stim	Freq [n/30s]	Cul.[s]	SPV Mean [deg/s]
R44° C	30	16 - 46	8
R30° C	61	0 - 30	0
L44° C	12	14 - 44	9.27
L30° C	17	16 - 46	12

REMARKS:- 0011
Both the right ear caloric responses are normal while both the left ear caloric responses are hypoactive. This is the mirror image of pattern8 and indicates a left peripheral vestibular system lesion.

CP = -45.34 % (Unilateral Weakness towards RIGHT)

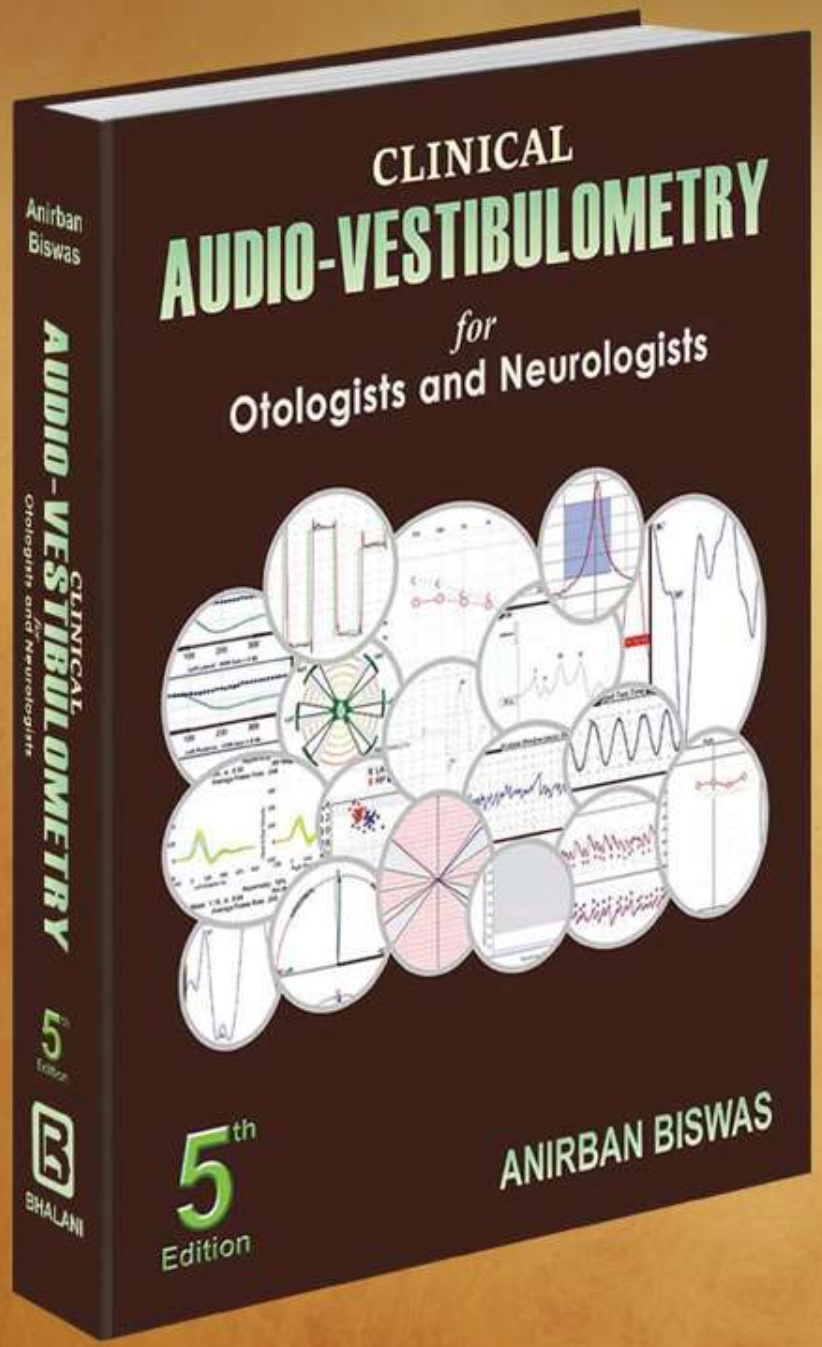
DP = 36.66 % (ABNORMAL)

This report is not to be used for Medico-Legal purposes. The contents of this report require clinical co-relation before diagnosis, interpretation or remedial action.

Take home message

- In vestibulometry, a test battery approach is mandatory.
- Only tests carried out or at least supervised by a trained clinician with sufficient knowledge should be accepted.
- Vestibulometry of today can diagnose the site and nature of a lesion with utmost precision and accuracy *provided it is done by the right person*

Vestibulometry - the current scenario


CLINICAL
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BHALANI

Thank You