

# ELECTRODIAGNOSTIC TESTS FOR VERTIGO

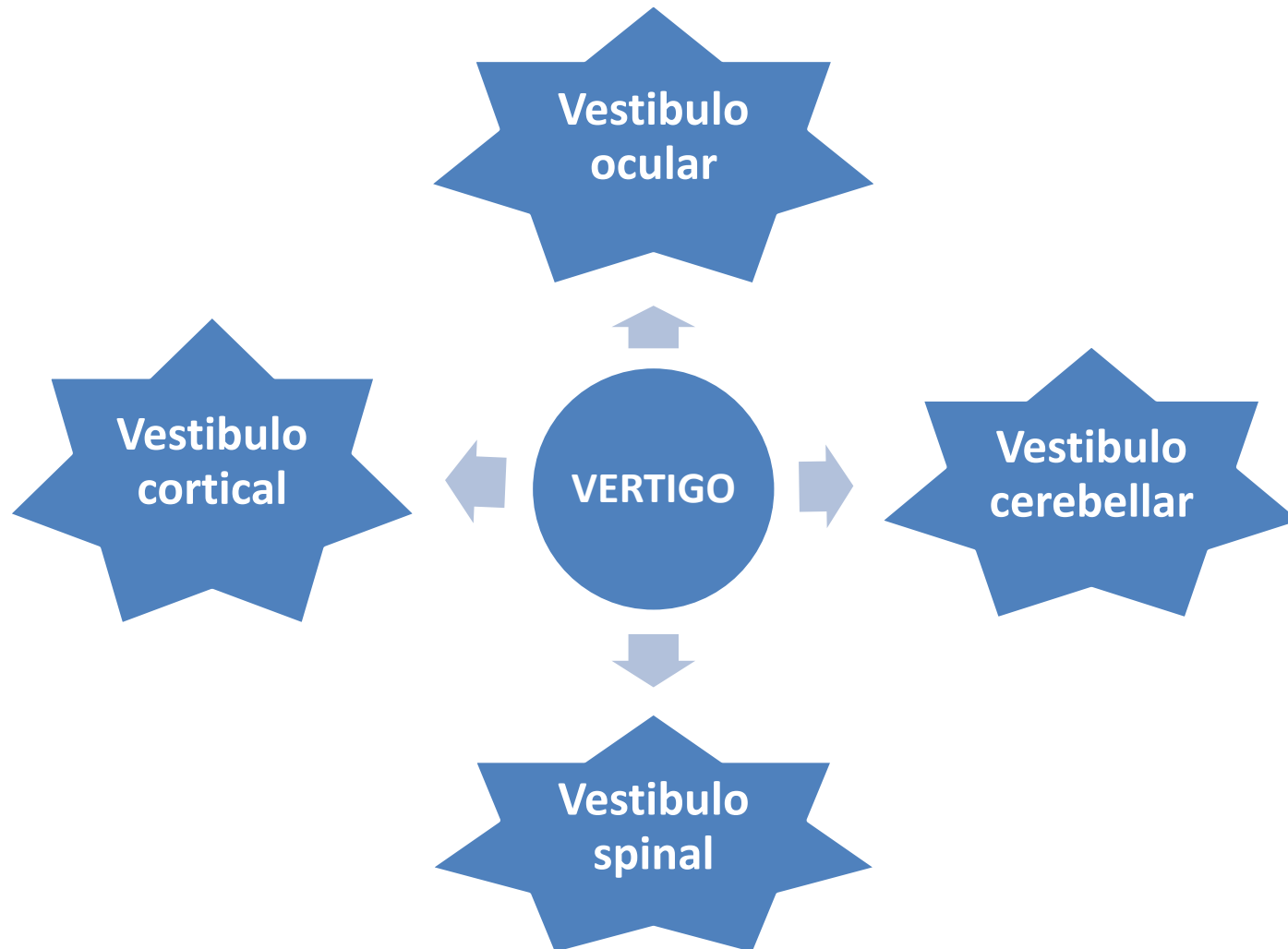
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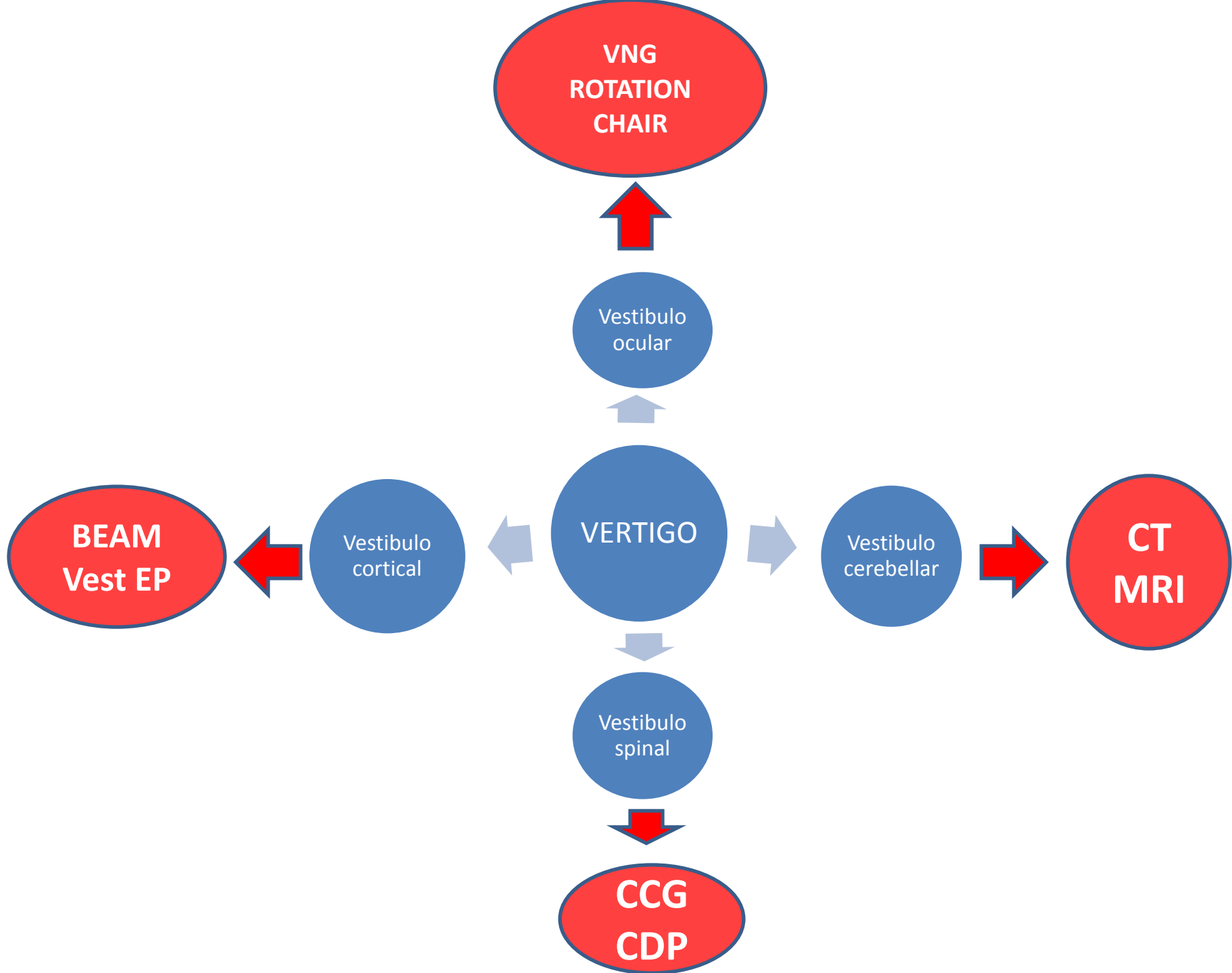


**Prof. G. Selvarajan**  
**Madras Medical College**  
**Chennai**

# INTRODUCTION

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# VESTIBULO OCULAR



# Rotational Chair Test

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# PROCEDURE

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- Hungarian physiologist [Bárány Róbert](#)
- Pt seated on the chair, blindfolded, ENG electrodes applied & Head Tilted Forward.
- Slow Sinusoidal harmonic acceleration used
- Vestibular stimuli: Head & body rotation is given
  - at frequencies of 0.01, 0.02, 0.04 upto 0.64 Hz with peak angular velocities 50 degrees/sec at each frequency
- Computer compares Head velocity and Slow phase Eye Velocity.
- Gain, Phase, Symmetry can be studied



- **GAIN**- slow eye velocity divided by head velocity  
↓ b/l vestibular disease
- **PHASE ANGLE**- measures temporal relation between eye and head velocities-in degrees  
↑ peripheral vestibular dysfunction.  
↓ cerebellar dysfn.
- **SYMMETRY**- ratio of rightward to leftward slow wave eye velocity.

Asymmetry means peripheral vestibular weakness on the same side or excitatory weakness on opposite side.

# Application

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- Research Protocols
- Analyzing horizontal canal vestibuloocular reflex (VOR)
- To diagnose patients with peripheral vestibular lesions
- To monitor patients undergoing pharmacologic vestibular ablation for Ménière syndrome.
- To objectively evaluate efficacy of trt.



# VESTIBULO SPINAL



# Craniocorpography

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- Photographic Record of patients head and body movements
- Performs ROMBERGS and UNTERBERGERS tests
- Crudely classify patients as having central or peripheral vertigo

# PROCEDURE

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- Dark room
- Convex mirror
- Adjustable Camera
- Helmet with 3 lights
- Recording:



- Untenbergers test for 90steps in 1min
- Rombergs test for 1 min

# INTERPRETATION

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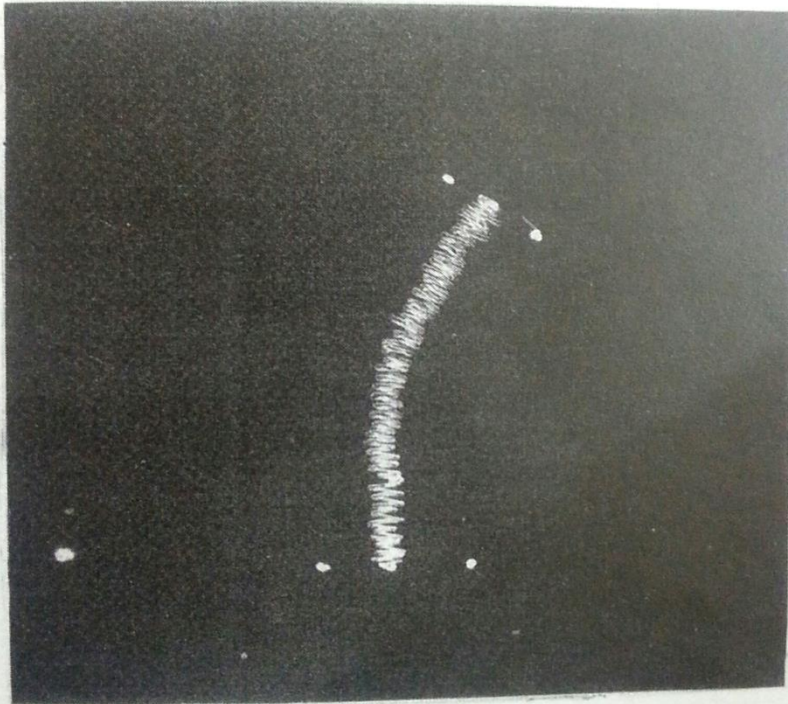
- Only Input to CNS is vestibular. Visual and proprioceptor inputs is eliminated
- Peripheral Vestibular Lesions- **Sway towards side of hypoactive labyrinth**
- In central lesion- **side to side sway**
- Breadth of sway - severity of lesion - >10cm sway suggests central lesion

# Normal



ANTERIOR

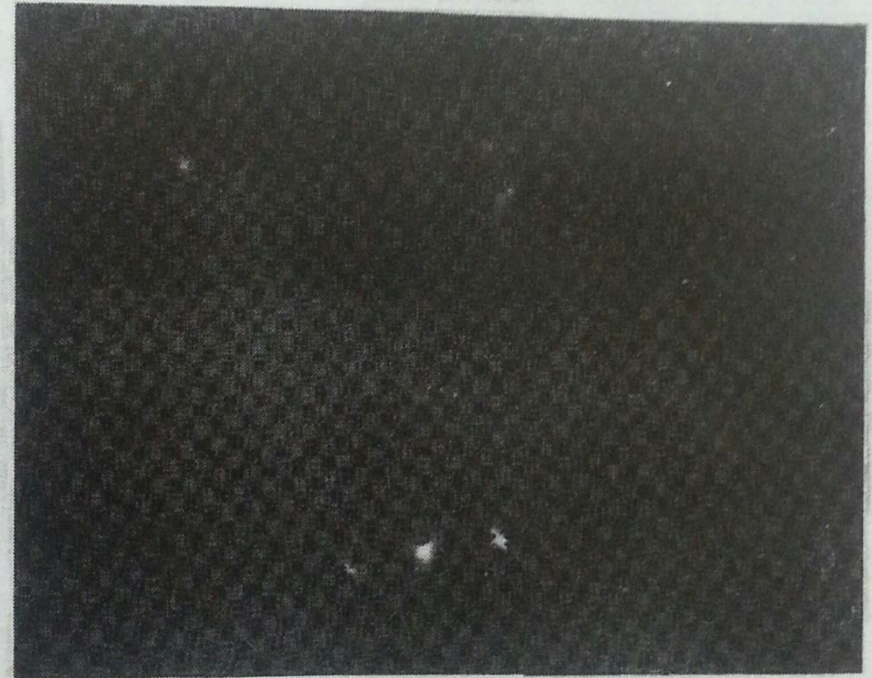
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POSTERIOR

ANTERIOR

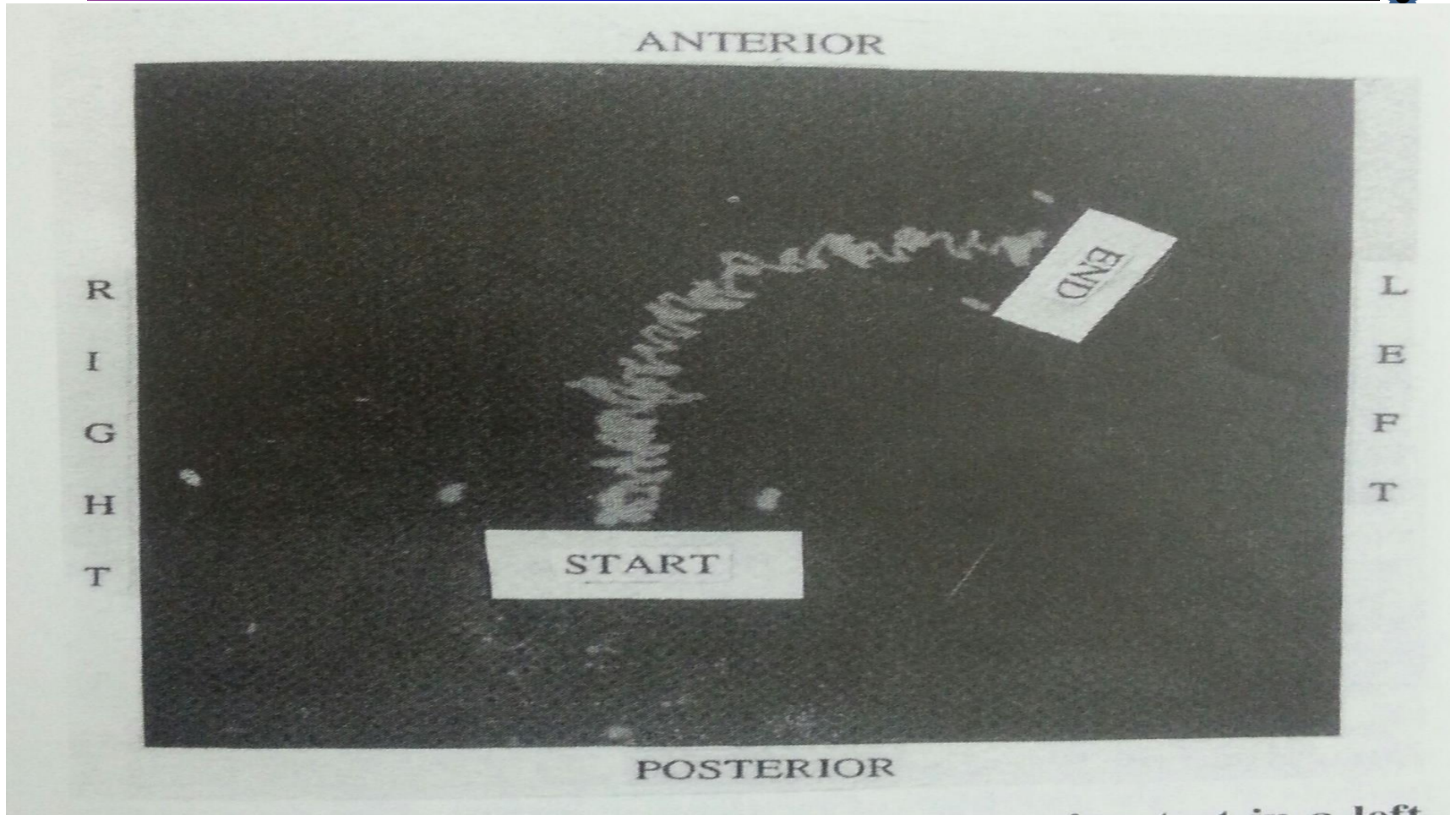
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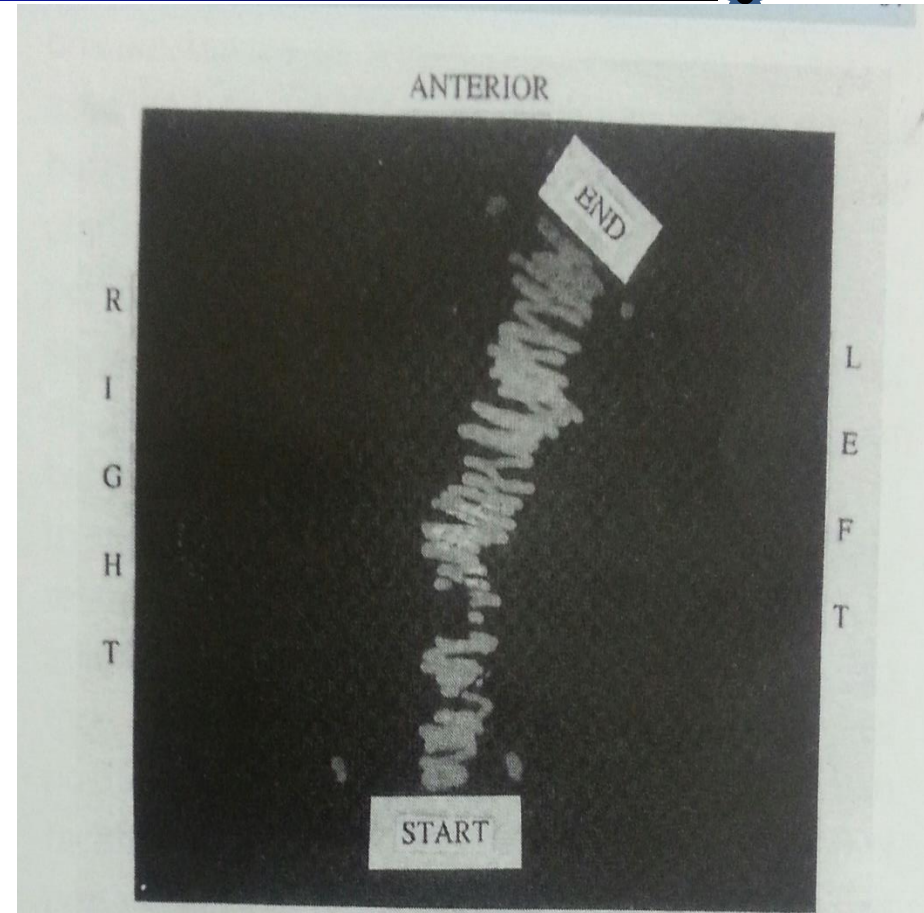
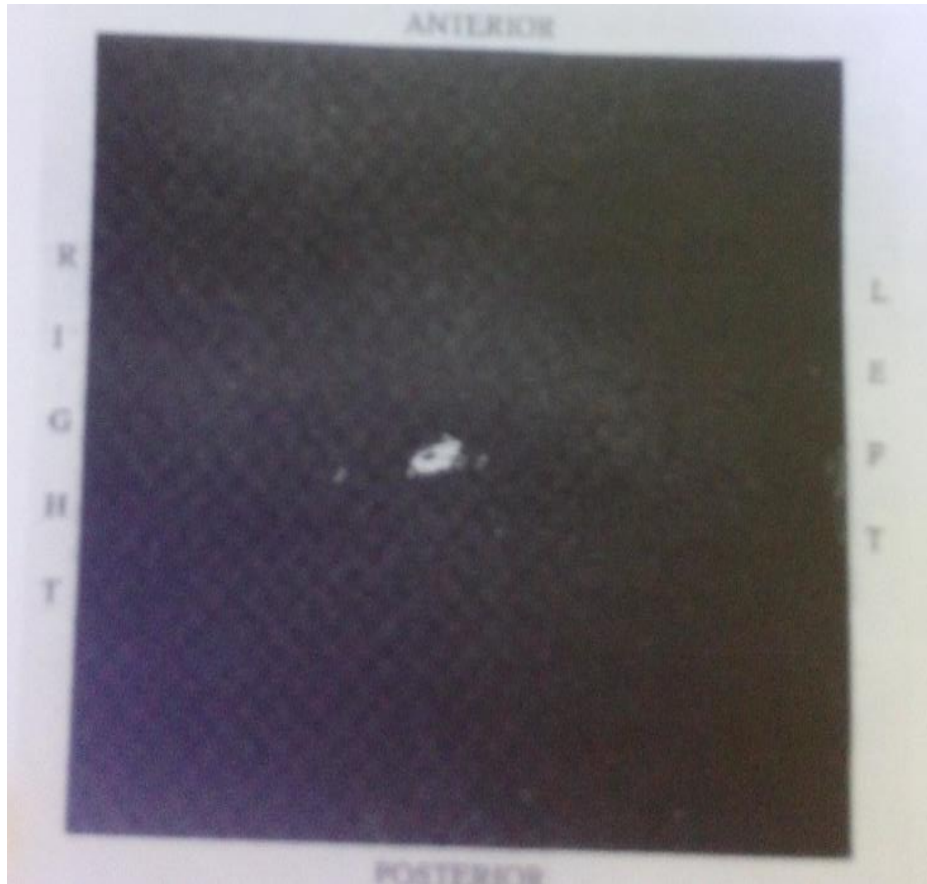
POSTERIOR

# Peripheral Vestibular lesion Left





# Cerebellar Ataxia



# Advantages

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- Non- invasive, quick
- Objective test for vestibular function
- Can be done on children and patients with perforated Ear drums

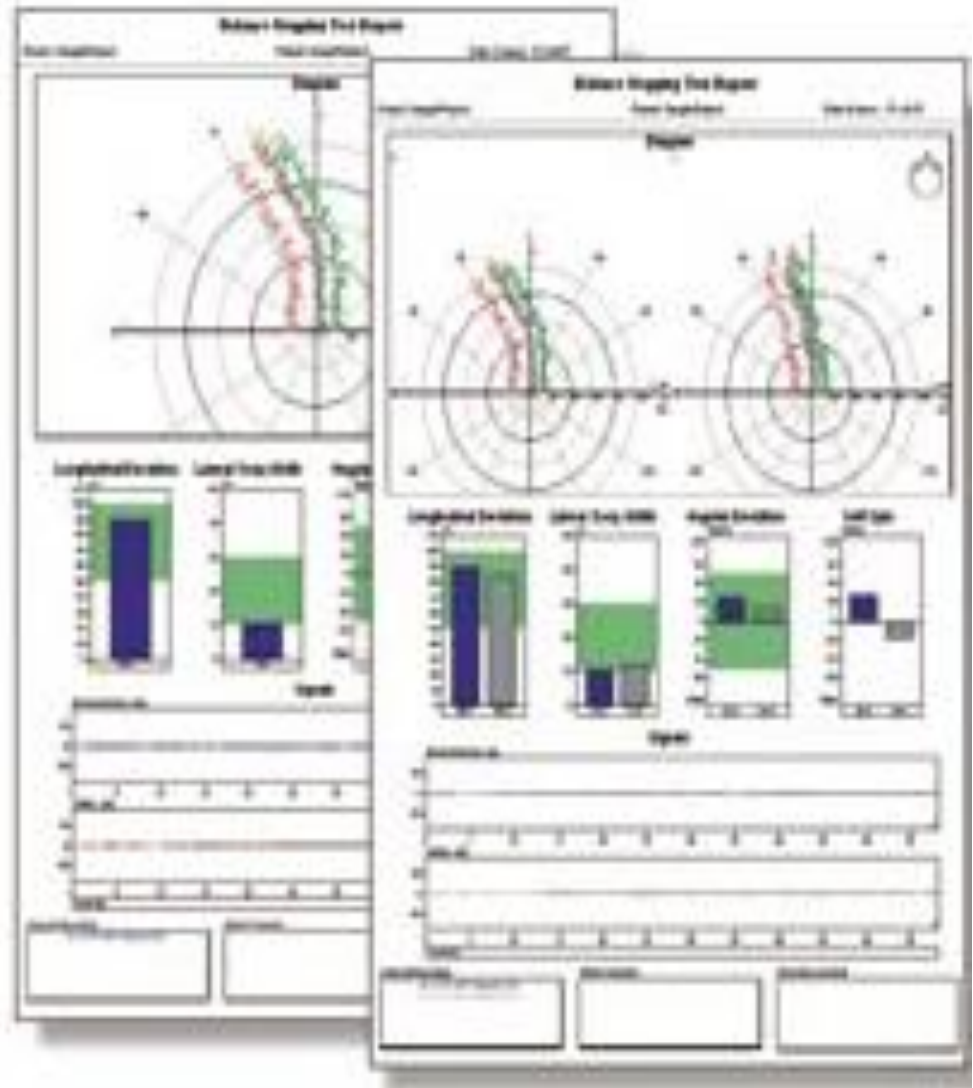
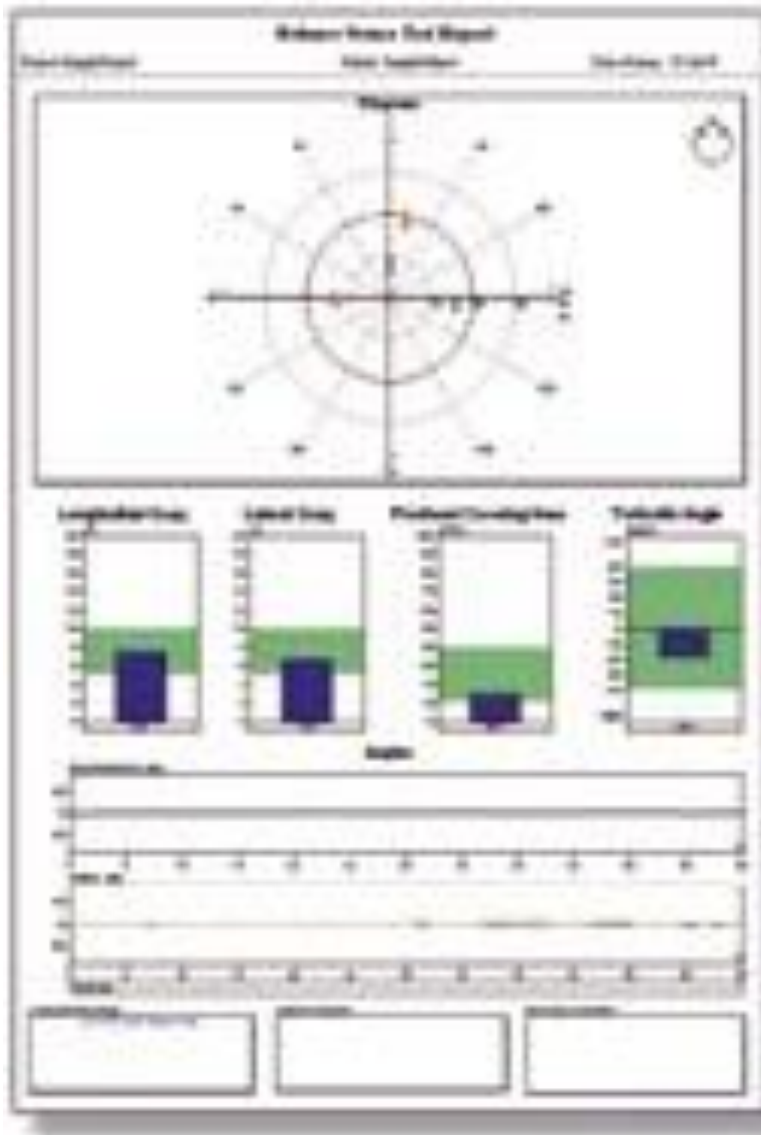


# Ultrasonic Guided Computerised CCG

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# Ultrasonic Guided Computerised CCG



# Computerized Dynamic Posturography

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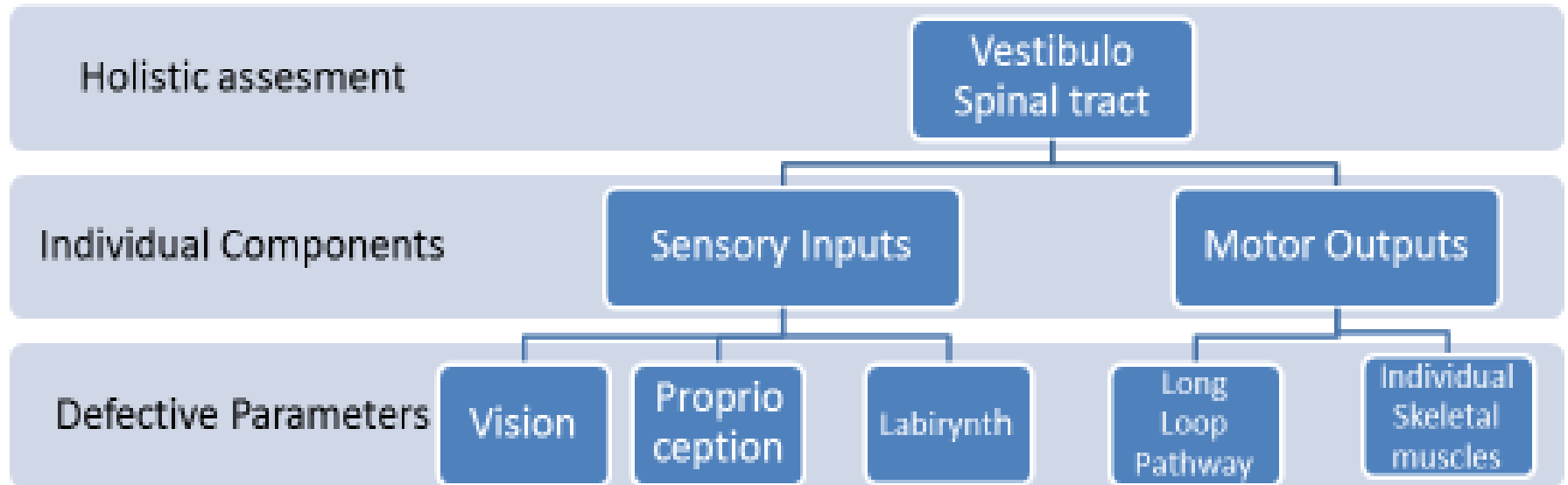


- To assess equilibrium as a whole
- Evaluates patient's functional postural ability
- The only method that integrates contributions from vestibular, visual, SOM
- Does not help to locate the site or cause of lesion
- Does not replace other tests but supplement them



- Position of centre of gravity- SOT
- To execute automatic movements in body muscles such that centre of gravity is brought back-MCT

# Computerised Dynamic Posturography



# Apparatus



# Procedure

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- Series of tests used to assess overall function of balance as a whole.
- Two test components:
  - Sensory Organization Test
  - Motor Coordination Test:
    - Motor control test
    - Adaptation test

# Sensory Organisation Test



1.



2.



3.



1. Eyes open, fixed surface/  
platform, fixed visual  
surround.
2. Eyes closed, fixed platform.
3. Eyes open, fixed platform,  
sway referenced/ moving  
visual surround.
4. Eyes open, sway  
referenced/ moving  
platform, fixed visual  
surround.
5. Eyes closed, sway  
referenced/ moving  
platform.
6. Eyes open, sway referenced  
platform and visual  
surround.

4.







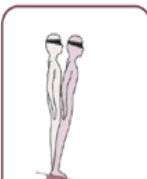

5.



6.





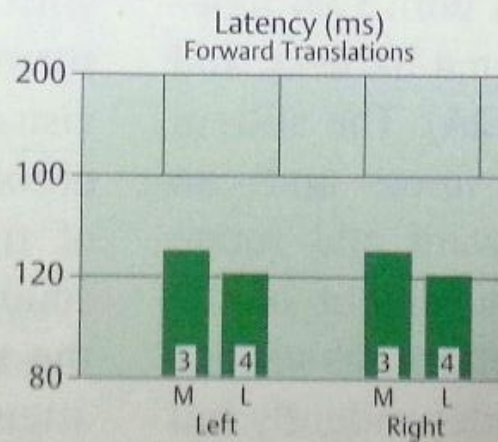
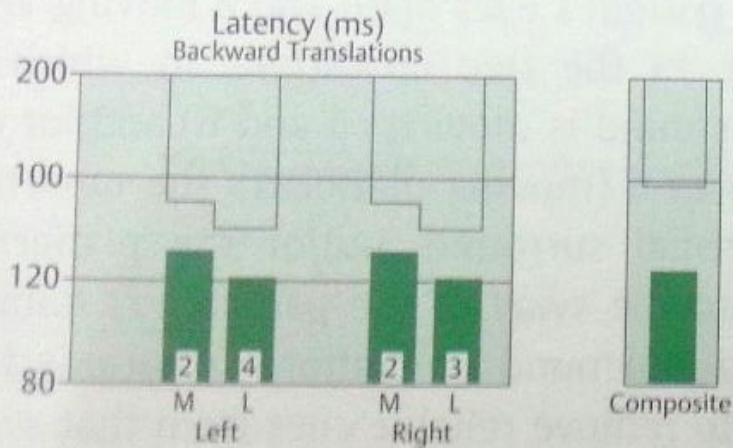
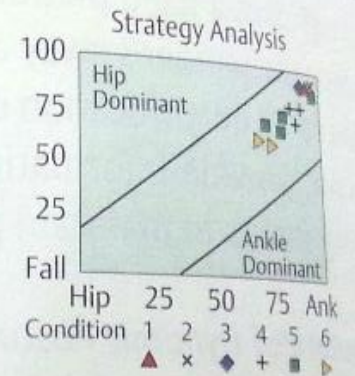
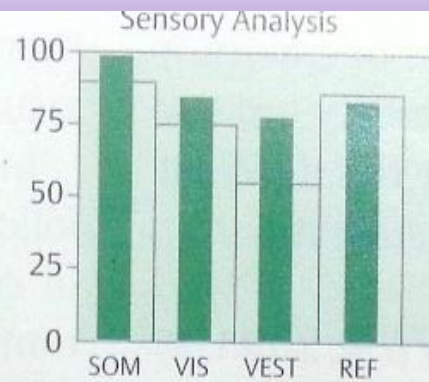
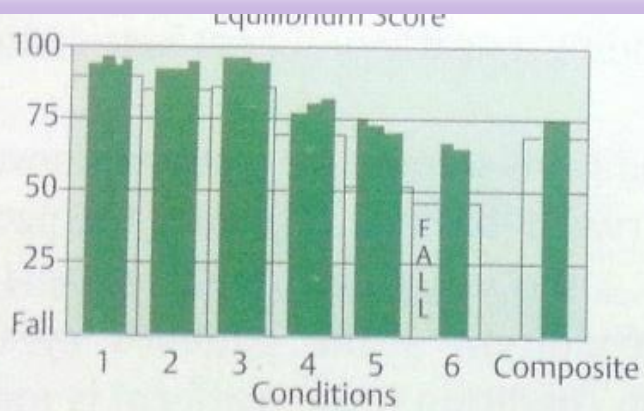
|    |   |  |        |       |       |  |
|----|---|--|--------|-------|-------|--|
|    |   |  |        |       |       |  |
| 1. | 1.   |  | Open   | Fixed | Fixed | Pt has apparently compensated condition. This test is used as Ref value for the Equilibrium scores |
| 2. |   | 2.    | Closed | -     | Fixed | <b>Somatosensory</b> input deficit   |
| 3. | 3.   |  | Open   | Sway  | Fixed |  |
| 4. |   | 4.    | Open   | Fixed | Sway  | <b>Visual Input</b> deficit  |
| 5. | 5.  |  | Closed | -     | Sway  | <b>Vestibular input</b> deficit  |
| 6. |   | 6.  | Open   | Sway  | Sway  | Most difficult test, Tests CNS ability to coordinate information                                   |

# Sensory Analysis ratios

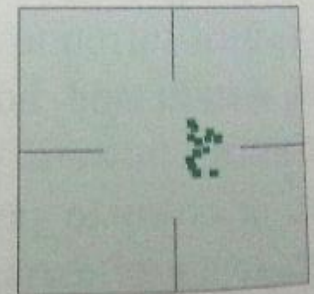
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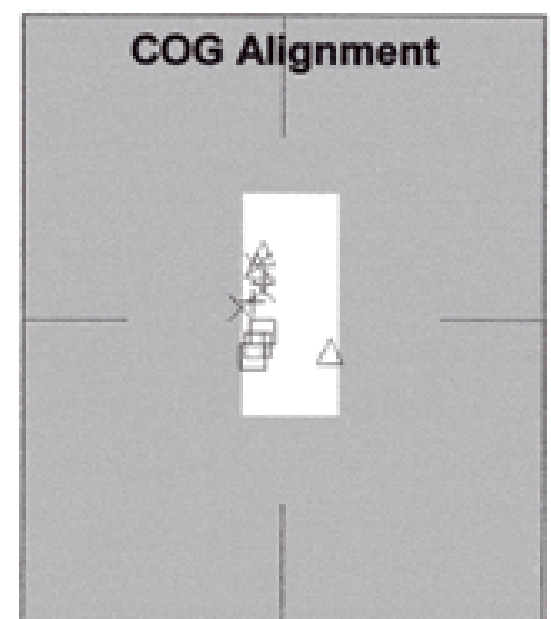
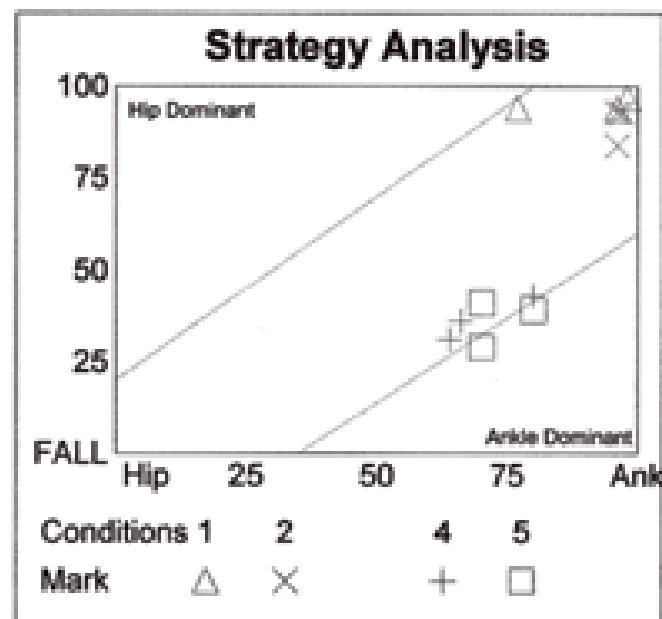
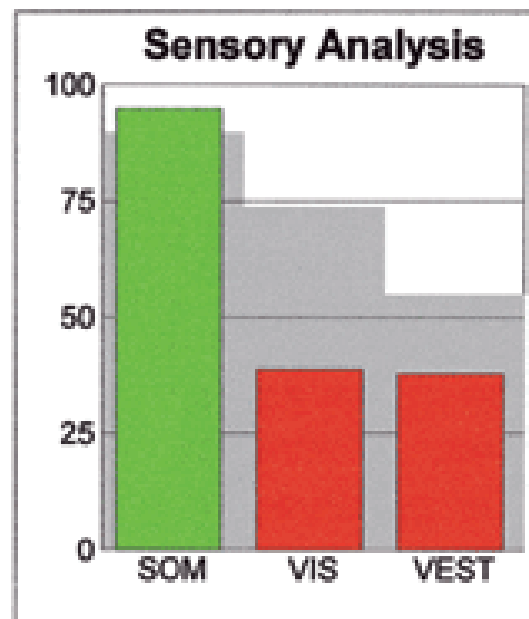
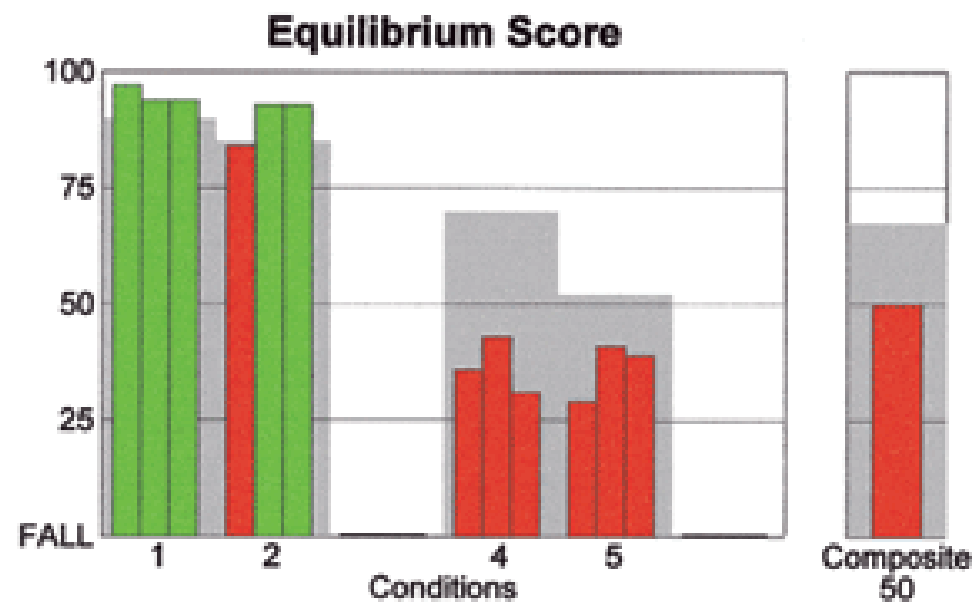
| <u>Ratio</u>               | <u>Comparison</u>                         |   |
|----------------------------|---|---|
| <u>Somatosensory (SOM)</u> | <u>Condition 2</u><br>Condition 1         | Patient's ability to use input from somatosensory system to maintain balance  |
| <u>Visual (VIS)</u>        | <u>Condition 4</u><br>Condition 1         | Patient's ability to use input from visual system to maintain balance   |
| <u>Vestibular (VEST)</u>   | <u>Condition 5</u><br>Condition 1         | Patient's ability to use input from vestibular system to maintain balance   |
| <u>Preference (PREF)</u>   | <u>Condition 3 + 6</u><br>Condition 2 + 5 | Inaccurate visual cues result in increased sway compared to absence of visual cues. Hence patient relies on visual cues even if inaccurate. |



Center of gravity alignment



Example of a normal platform posturography examination.



# Motor Coordination/ Control Test



1.



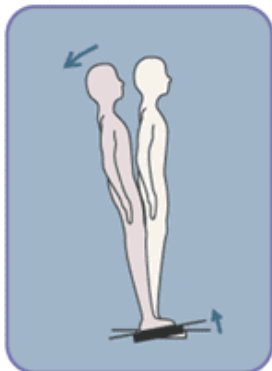
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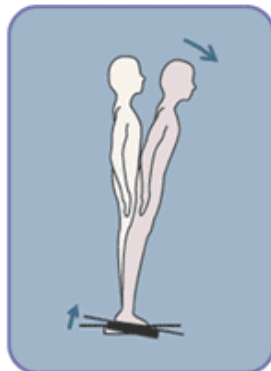
Forward/Backward Translations

- Uses 3 posterior 3 anterior 3 rotations around ankle each of 3 magnitude.
- Output parameter are-
  1. latency
  2. weight distribution onto each leg
  3. Measure of strength depending upon strength of perturbation

1.



2.



Toes Up and Toes Down Rotations

Patients response compared with normal subject of same age.

- Adaptation Test: For each platform rotation, a sway energy score quantifies the magnitude of the force response required to overcome induced postural instability

# Strategy Analysis and COG

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## **Strategy Analysis:**

quantifies the relative amount of movement of ankles (ankle strategy) and hips (hip strategy) that patient used to maintain balance during each trial.

Normal, stable individuals move primarily ankle joints when surface is stable and shift to hip movements as they become less stable.

## **COG Alignment:**

Reflects patient's COG position relative to center of base of support at the start of each trial of SOT. Normal individuals maintain their COG near the center of support base.

# INTERPRETATION

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- **Unilateral:** Prolonged latency – peripheral Nerve Lesion
- **Unidirectional:** Peripheral Nerve or Motor Tract Lesion
- **Bilateral/ Bidirectional:** Systemic CNS disorder (Multiple sclerosis, polyneuropathy)

# ADVANTAGES

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- Highly sensitive for central pathologies:  
Vestibular and non-Vestibular CNS pathology
- Asses integrity of CNS to detect defects when the 3 sensory inputs send in contradictory information
- To determine management protocols e.g. darkness, uneven surfaces.
- To individualize Vestibular rehabilitation exercises



# VESTIBULO CORTICAL



# BEAM



- Brain Electrical Activity Mapping
- this is a topographic representation of the EEG in response to Vestibular stimuli – Vest EP
- Vestibular stimulation- electrical activity in brain central processing. Recorded by surface electrode on the scalp
- Vestibulo cortical aspects of balance.
- A recent tool in the diagnosis of vertigo
- Following the hierarchy of VEMP and ABR,

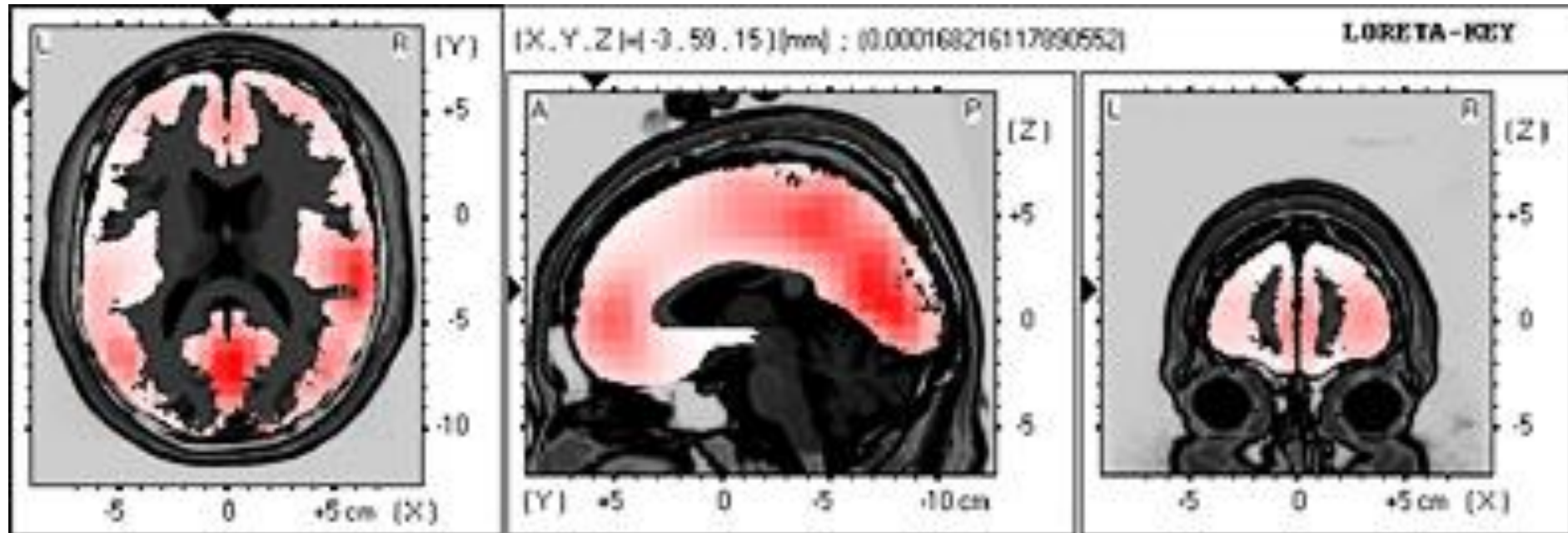
# Procedure

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- Vestibular Stimuli: rotational stimuli – using square wave signals - stimulating natural head movements
- Patient seated in a rotational chair – head fixed, rotated clockwise and counter clockwise with acc/deceleration pulses of short duration
- There is no exact stimuli – different types preferred by different researchers
- Multiple EEG electrodes

# LORETA



**Low Resolution Electromagnetic Tomography  
Talairach Atlas**

# Electrocochleography

- 
- technique of recording stimulus-related responses or electrical potentials of the inner ear.
  - Extension of ABR protocol
  - Electrode is placed close to tympanic membrane or cochlea
  - Auditory Stimulus - click or tone burst presented at a relatively slow rate (11.1/sec).
  - Response collected from 0 to 5 msecs.
  - Used mainly in Ménière's disease.



- The components of ECoChG are:
  - **CM (cochlear microphonic)** - Stimulus-dependent cochlear response, which changes direction with changing polarity.
  - **SP (summating potential)** - direct current response from Organ of Corti hair cells. Leading hump on AP or wave I (sometimes it is a separate hump).
  - **AP (action potential)** - alternating current response generated by cochlear end of 8th nerve (wave I). Represents summed response of thousands of firing auditory nerve fibers.

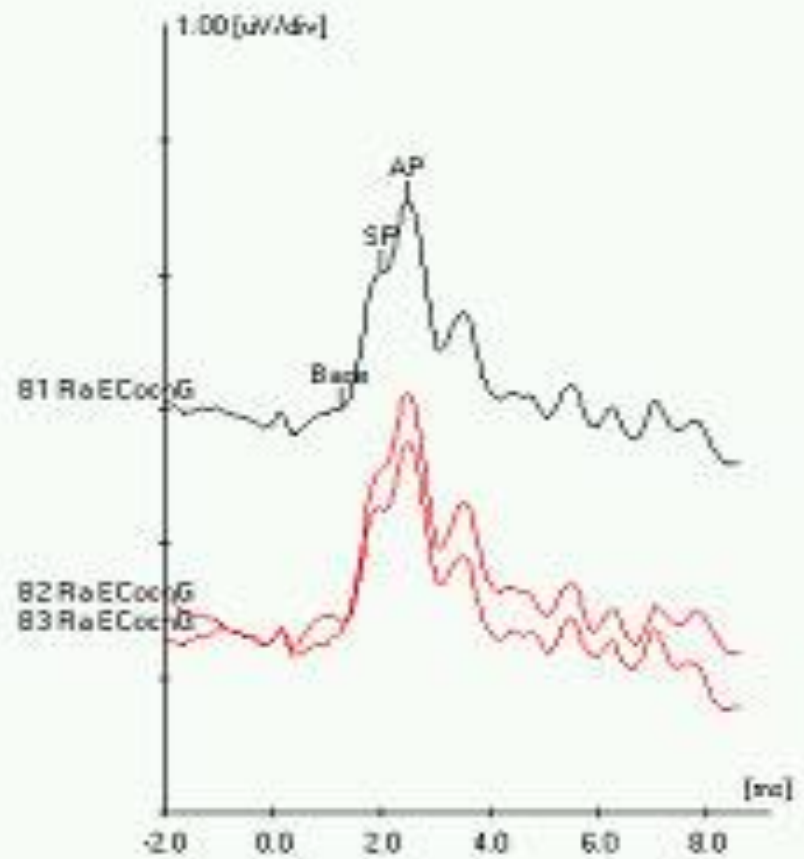
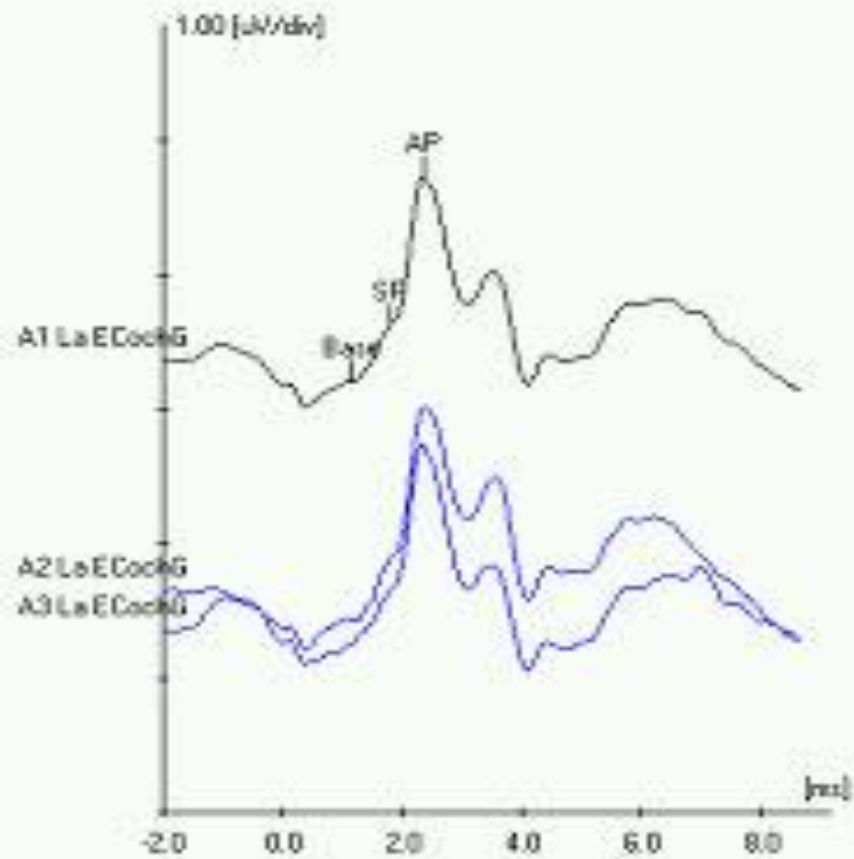
# PROCEDURE

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- **Electrodes placement:**
  - **Ear-canal:** tip-trode (gold foil) - Foil covered foam insert piece in external ear canal – does not touch TM
  - **Extra tympanic:** tymptrode - thin coated wire placed in ear canal - rests gently on TM
  - **Transtympanic:** needle electrode - placed through TM - rests on oval window/ promontory
- Electrode on the forehead is ground
- Stimulus given: 1000 to 2000 clicks to an ear for each test run and records the activity for 5 milliseconds after each click.
- The system records and averages each response

# Tracing





# THANK YOU!!!

