

# Functions of the Balance System (2 of 3): **Postural stabilization**

**Goal: maintenance of erect posture in static & dynamic conditions both in**

- routine daily activities
- complicated activities like cycling / playing badminton / other sports activities / dancing etc.

Spontaneous balance correction response to stabilize body when there is a destabilizing force

Volitional balance stabilizing response in sporting activities, dancing etc

**Evaluated by posturography e.g., CDP, Stabilometry, CCG**



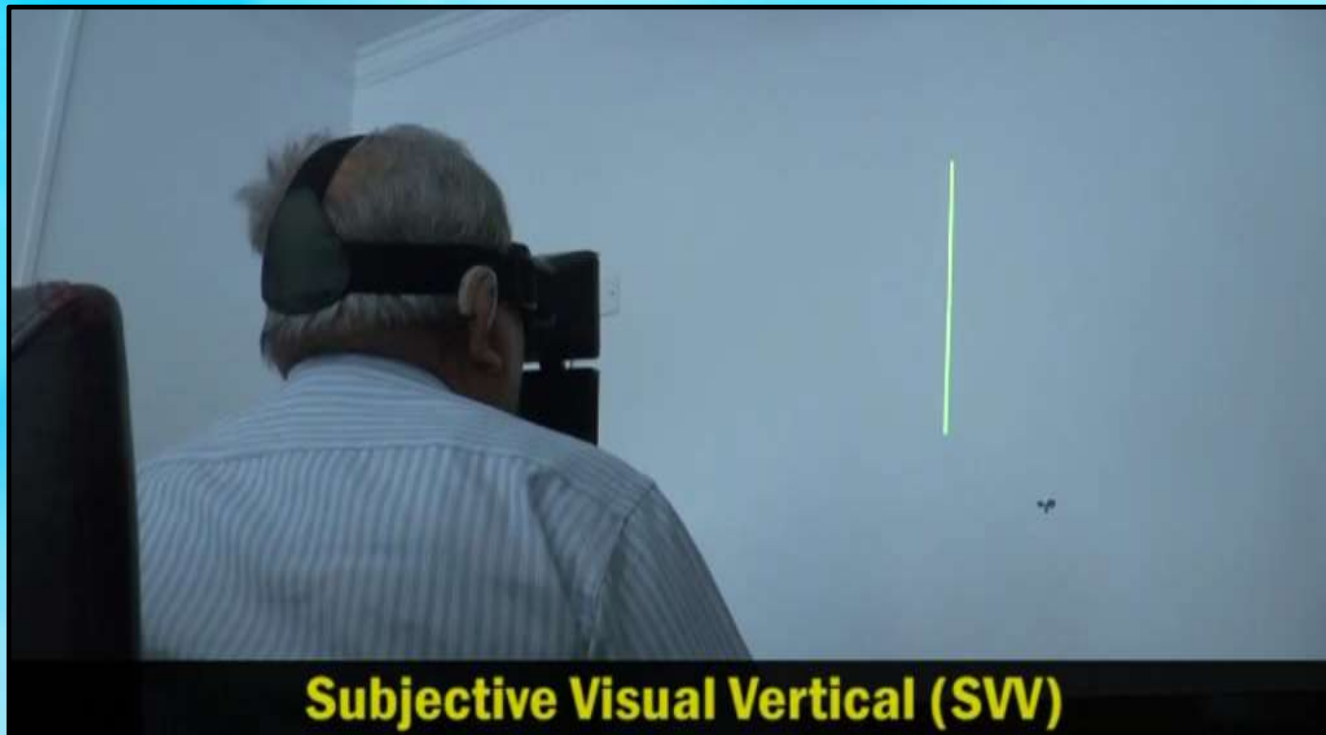
# Functions of the Balance System (2 of 3): **Postural stabilization**



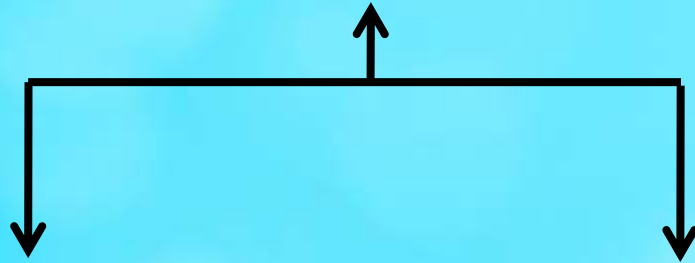
# Functions of the Balance System (3 of 3): **Graviception**

**Goal: Perception of the vertical & horizontal / graviception-**

- orientation relative to gravity
- determining direction /trajectory & speed of movement of a visual target
- an otolithic function



# OTOLITH FUNCTION



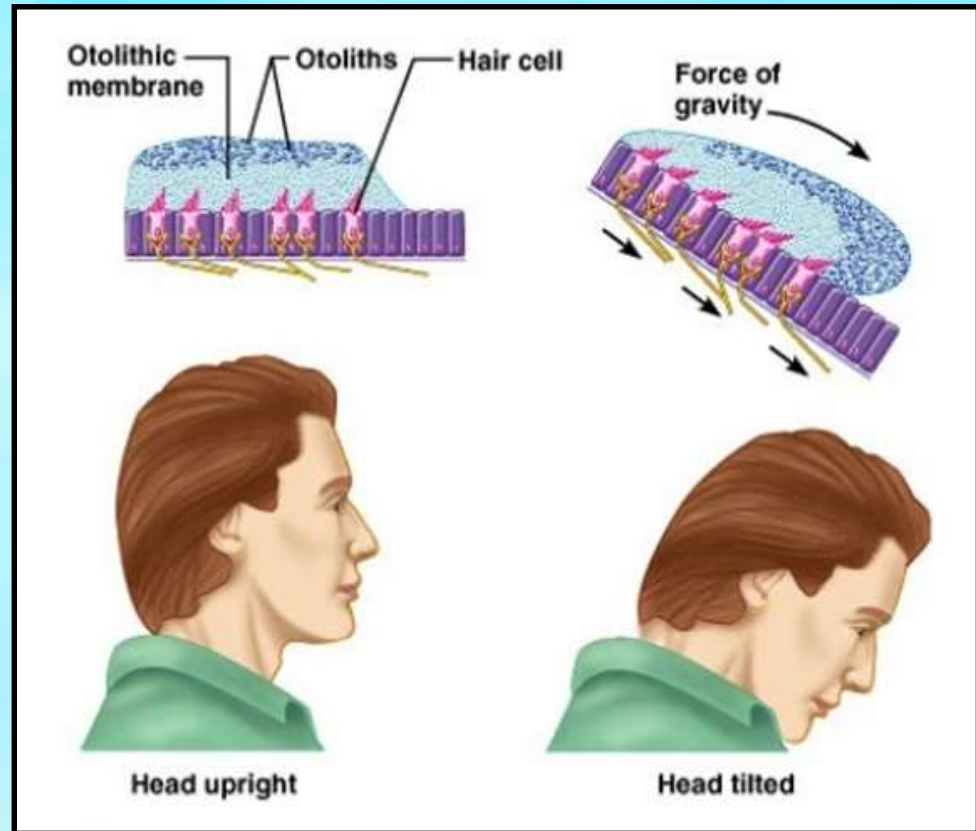
## ***Maculo-spinal reflex***

Maintain postural balance  
e.g. *train suddenly stops but subject does not fall.*

## ***Maculo ocular reflex***

stabilizes gaze during head movement laterally & vertically.

***Maculo-spinal reflex & Maculo-ocular reflex both become defective in otolith dysfunction***



# OTOLITHIC DYSFUNCTION

## *defects in VOR*

- skew deviation
- ipsilat, ocular cyclotorsion

Vertical diplopia in acute stage



## *defects in VSR*

- no physical sign

General imbalance on standing and walking that persists even after the acute stage



# What happens in OTOLITHIC DYSFUNCTION?

Deranged transduction of linear movement in the horizontal & vertical planes.

## **Results :-**

- *Otoliths provide erroneous information for control of posture + gaze stabilisation in horizontal / vertical planes*



*incorrect sensation of upright posture  
self-motion  
incorrect spatial orientation of body*



## **Pts. complains:-**

- *strange feeling of disorientation rather than rotating / spinning*
- *instability*
- *psychological disturbances like panic / anxiety*

# Symptoms of OTOLITH dysfunction

**VISUAL** *due to inability to maintain stable images in the retina*

- Poor vision while pt. in moving
- altered sense of verticality / horizontality
- oscillopsia
- vertical / oblique diplopia
- altered depth perception

**POSTURAL** *due to decrease of resting activity of Graviceptive pathways → decreased muscle tone in graviceptive muscles → imbalance of muscle tone*

- Head tilt on ipsilateral side
- Imbalance
- Ocular torsion
- Skew deviation

**PERCEPTUAL** *due to improper information reaching the vestibular cortex*

- Erroneous perception of relation between self & environment
- Illusion of moving up & down e.g., *standing on the deck of a moving ship*
- Walking on soft ground or on a tilted surface
- Sensation of falling & lateropulsions / feeling of being pushed
- Marked disorientation, dissociation from surroundings, hallucinations

# Symptoms of OTOLITH dysfunction

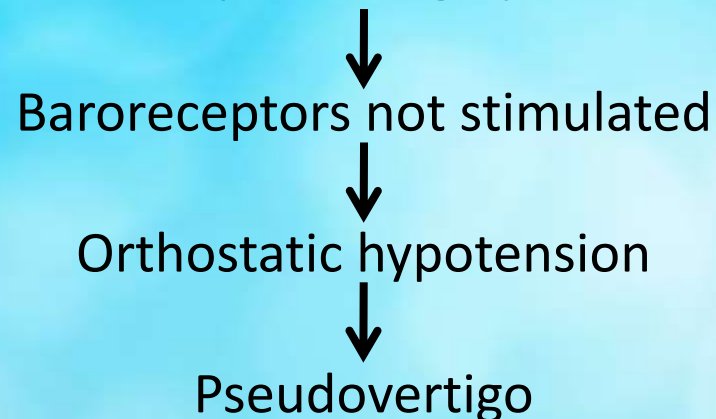
## Neuro-vegetative & Autonomic Symptoms

### Otolith organs partly control

- blood pressure
- some cardiorespiratory parameters

### Symptoms- orthostatic hypotension

Pts. suddenly standing up not sensed



*Mal-de-debarquement (post-sea sickness) with nausea / vomiting / bradycardia / hypotension is believed to be due to excessive stimulation of otolith organs due to rocking of the ship  
Motion sickness also has same etiology*



# **HINTS** - *a clinical test based on derangement of otolithic pathways*

- **Used to differentiate Cerebellar Stroke Vs Vestibular Neuritis in patients presenting with acute vestibular symptoms**
- **HINTS examination is more sensitive than MRI in detecting cerebellar stroke in first 48hrs in patients** (*Newman-Toker 2013*)

# HINTS Test



HI

- Horizontal Head Impulse
- Impulse Normal



N

- Nystagmus
- Fast-phase Alternating

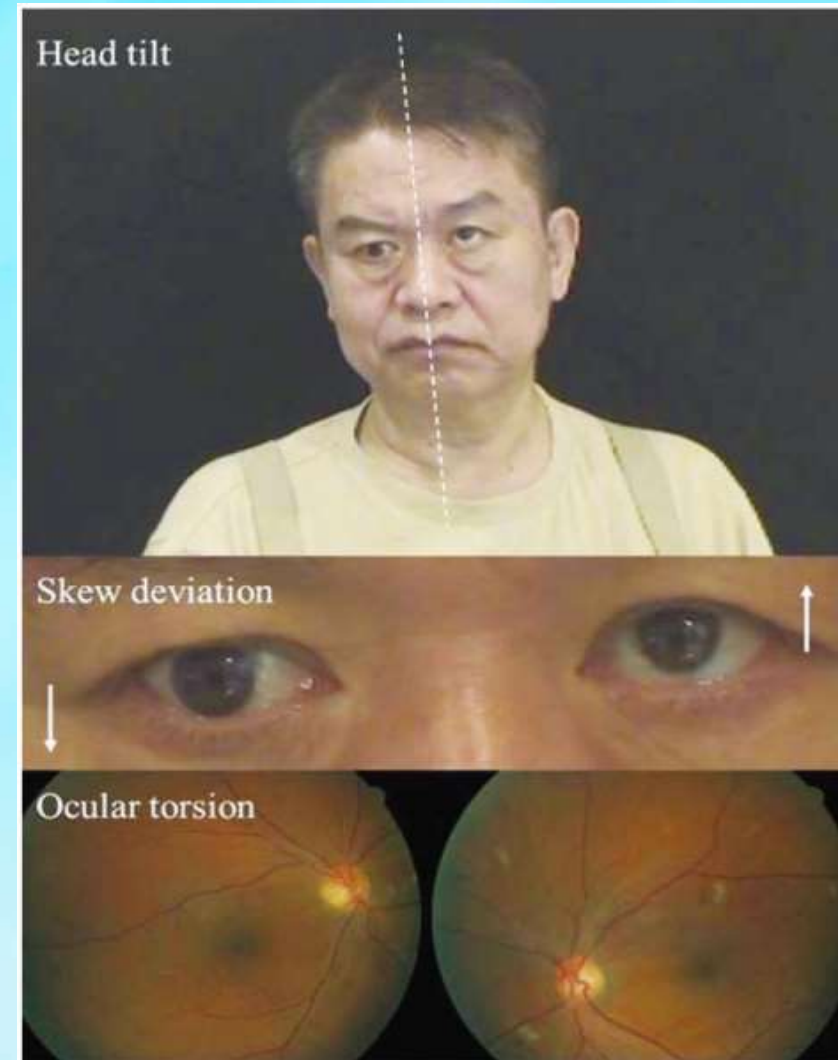


TS

- Test of Skew
- Refixation in (alternate) Cover Test

# Ocular Tilt Reaction

- The ocular tilt reaction (OTR) is a compensatory postural reflex, which arises from unequal stimulation of the otoliths
- OTR is a postural synkinesis consisting of:
  - skew deviation
  - binocular eye torsion.
  - head tilt.
  - deviation of the perception of the visual vertical to the same side.



# Causes of OTR

## Pathological Causes

- **Peripheral Vestibular causes**  
*-Otolithic dysfunction*
- **Neurological (CNS) Causes**
  - *Cerebellar Infarction/stroke*
  - *Multiple Sclerosis*
  - *Wallenberg's syndrome*
  - *Post Vestibular Schwannoma Surgery*

## Etiology

- Damage to the vestibular pathways that mediate head-eye posture in the roll plane
- Localization: utricle/labyrinth, vestibular nerve, brainstem, or cerebellum
- Causative lesion: variable, but commonly stroke, demyelination, trauma, iatrogenic/post-surgical, hemorrhage, or tumor

# VESTIBULO-SPINAL REFLEX (VSR)

- Function of VSR- to stabilize the head on the shoulders and also the body on the ground
- Tested by:
  - Posturography
  - Craniocorpography
  - Stabilometry
  - Vestibular Evoked Myogenic Potentials (cVEMP)



Vertigo has a strong psychic component... **pleasurable** for some, **dreadful** for others



*Thanks for enduring this presentation on the complexity of the physiology of balance*



**What is your state???**  
**confused? relieved ? bored? dizzy ?**