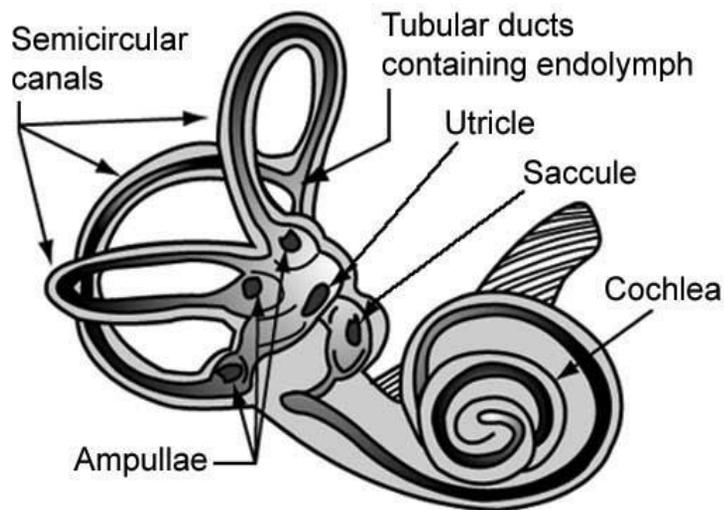


# VESTIBULAR EVOKED MYOGENIC POTENTIAL (VEMP)

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## THE INNER EAR



## VIDEO 1

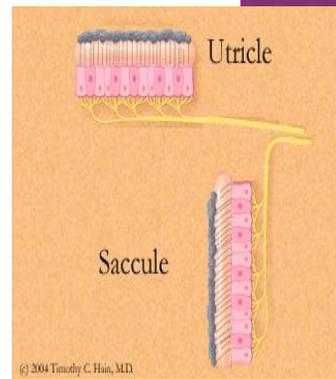
- <https://www.youtube.com/watch?v=lztjklqjw08>

## BALANCE SYSTEM

- Dynamic balance system
  - semicircular canals
  - respond to angular acceleration
- Static balance system
  - Utricle: responds to horizontal linear acceleration
  - Sacculle: responds to vertical linear acceleration
- Both produce compensatory eye movements and postural corrections

## ORIENTATION OF SACCULAR MACULA

The saccule is roughly vertically orientated so that it responds to vertical (ex: the lift) movement  
Hair cells embedded in the macula bend in response to its movement and stimulate vestibular nerve.



## VESTIBULO-SPINAL REFLEXES

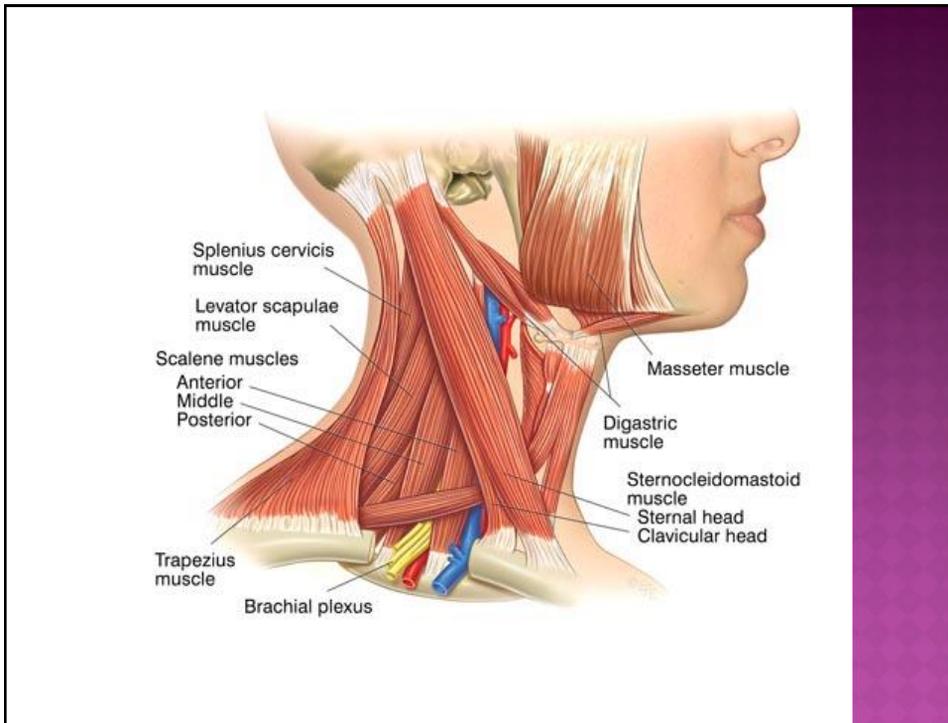
- Activity of labyrinth involved in posture control via vestibulo-spinal reflexes
- Out put of vestibular receptors influence main trunk and extremity skeletal muscles
- Provide compensation for effects of head tilt, turning, falling etc.
- Motor activity is generated in muscle groups appropriate to the vestibular information.

## VESTIBULO-SPINAL REFLEXES

- The VSR has to adjust the limb motion appropriately for the position of the head on the body.
- It uses **otolith input** to a greater extent than does the VOR.

## WHAT IS VEMP?

- VEMP is an inhibitory myogenic response that can be measured at the tonically contracted sternocleidomastoid muscle (SCM) in response to acoustic stimuli or mechanical vibratory stimuli.
- Short, loud acoustic stimuli produce a large inhibitory response in the tonically active ipsilateral sterno-mastoid muscle in the neck



## ORIGIN OF VEMPS

- ◉ Believed to be due to stimulation of saccule
- ◉ Saccule has been shown in animal studies to respond to sound as is close to oval window.
- ◉ Saccule is hearing organ in lower animals

## VEMPS

- Biphasic response has at 13 ms (p13) and 23 ms (n23).
- VEMP is a non-invasive and relatively quick test providing information about the function and integrity of the **ipsilateral saccule** and **ipsilateral inferior vestibular nerve**.

- ◉ Is present with profound sensorineural hearing loss and is abolished by vestibular neurectomy (i.e. is vestibular, not auditory response).
- ◉ Even if the person cannot hear the click, the response may be present.

## ABSENT VEMP RESPONSES

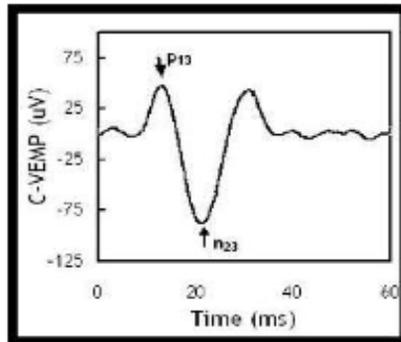
- ◉ Conductive losses (attenuation of the intensity of the signal).
- ◉ Problem in the saccule
- ◉ Evidence for end-organ or vestibular nerve pathology.
- ◉ Inadequate contraction of the sternomastoid muscle.

## EVOKED POTENTIALS

- ◉ Unlike conventional evoked potentials like (ABR) which are produced by synchronous discharge in the **nerve cells**, the VEMP, while still an evoked potential, is generated by synchronous discharges in groups of **muscle cells**.
- ◉ Because the potential is myogenic, the VEMP can be 500 to 1000 times larger than a brainstem potential.

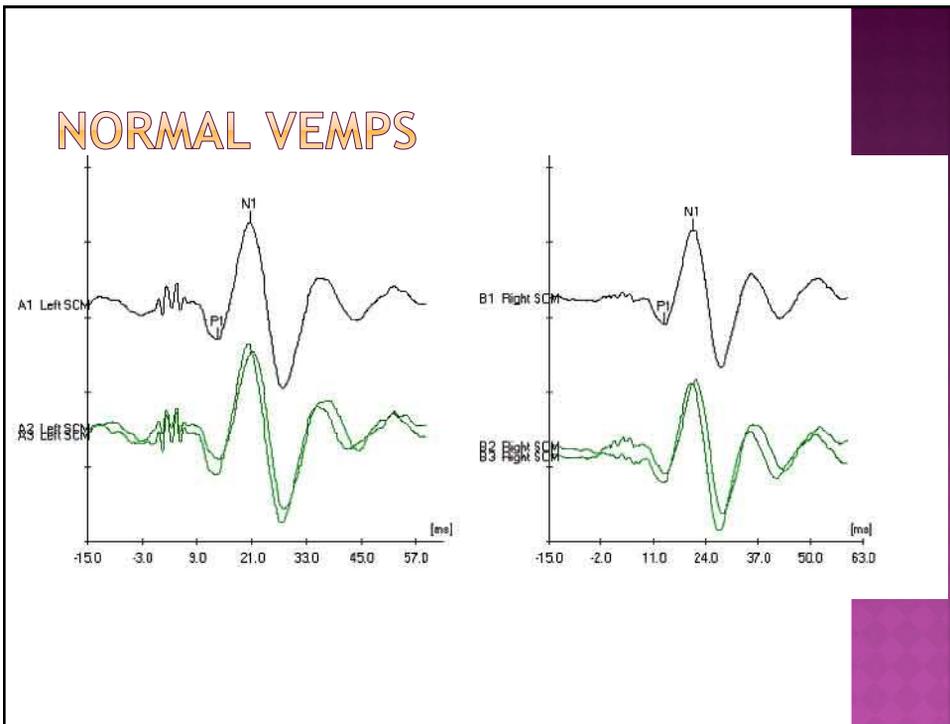
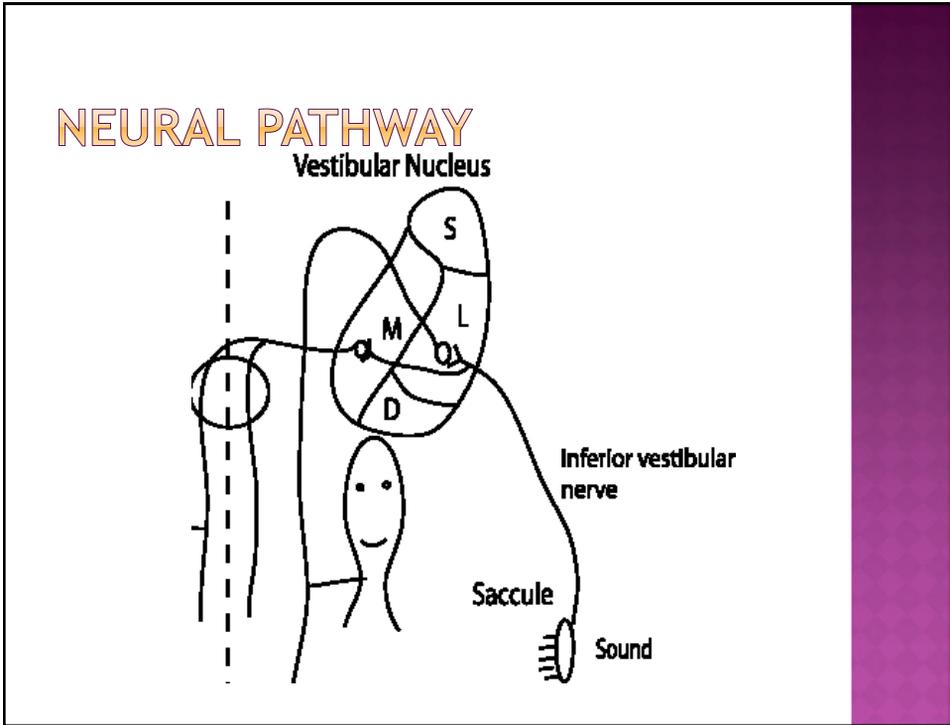
## VEMPS

It is biphasic, with a positive component at 13 ms (p13), followed by a negative component at 23 ms (n23), with more variable later waves.

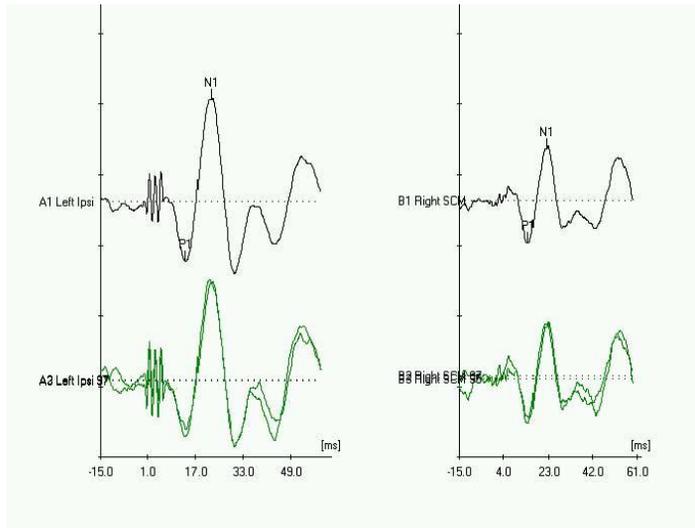


## PATHWAY

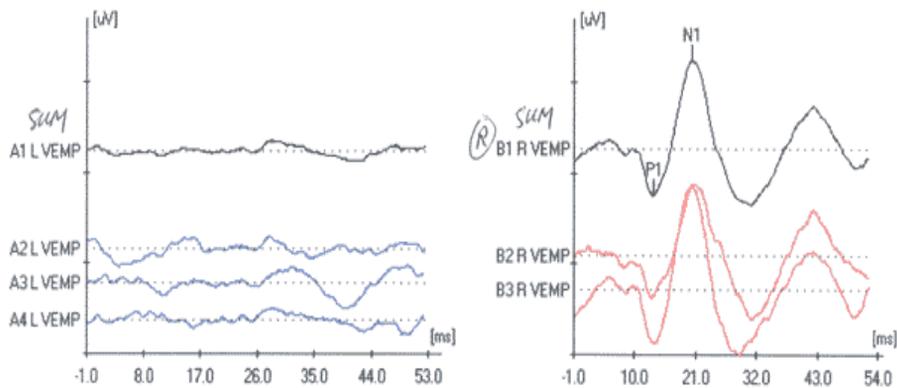
- Sound stimulates the saccule, travels the vestibular nerve to reach the vestibular nucleus in the brainstem. From there, impulses are sent to the neck muscles via 11<sup>th</sup> nerve.
- Final response is from inhibitory potential in muscle motor units (not neuronal)
- Threshold normally around 90-95dBnHL



## VEMPS WITH A RIGHT COCHLEAR HEARING LOSS



## VEMPs FOR A LEFT SIDED CONDUCTIVE HEARING LOSS



## CONTRAINDICATIONS/LIMITATIONS TO TESTING

- Subjects with **cervical spine problems** should be carefully assessed to ensure that they are able to maintain adequate SCM contraction without causing any pain or discomfort. If there is any doubt, then a medical opinion should be sought prior to testing.
- The response amplitude is known to be sensitive to the stimulus level reaching the inner ear. The response is often abolished by a modest conductive hearing loss caused by middle ear problems such as middle ear effusion, perforations or otosclerosis, since the loss **attenuates the stimulus** reaching the inner ear.

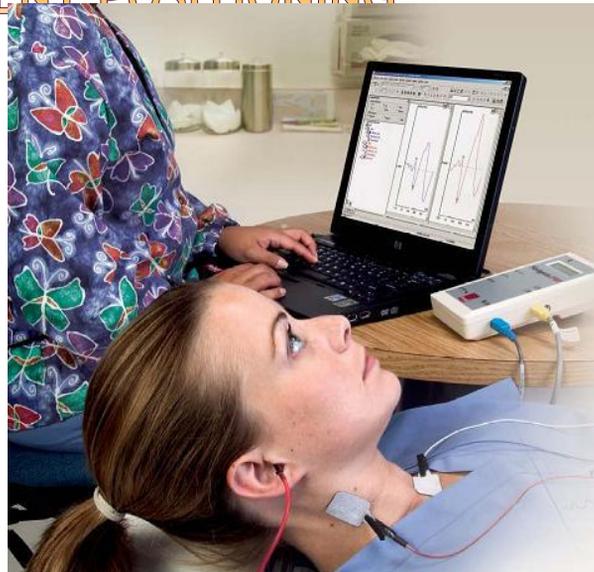
## PATIENT POSITIONING

- VEMP is inhibitory response so requires ongoing muscle contraction
- VEMP magnitude strongly dependant on muscle contraction, so must be consistent between tests and between sides
- Body supine with head slightly raised or sitting with head turned
- NB: Contraindicated in **tinnitus** patients due to intensity of acoustic stimulus.

## PATIENT POSITIONING

Method of SCM contraction	Comments
Neck torsion with head turned away from side being stimulated at $\geq 45^\circ$ whilst sitting with slight head flexion at $\sim 30^\circ$	Easy for most to do, but may be uncomfortable for patients with neck problems. Patients with thoracic/lumbar spine problems find this position preferable to head raise from caloric test position
Head raised from the caloric test position ( $30^\circ$ from horizontal)	Achieves equal bilateral contraction. May be easier for those with difficulty performing the requisite neck torsion such as those with immobile necks. However some (especially the elderly) find it difficult to perform and can cause significant and unnecessary fatigue. Head raised from supine is not recommended as this causes excessive fatigue
Head raised with neck torsion from the caloric test position	Consistent, strong contraction achieved and easy to maintain for short periods. It is easy to adjust the degree of contraction by asking the patient to turn their head by a greater or lesser amount.

## PATIENT POSITIONING



## PATIENT POSITIONING

