

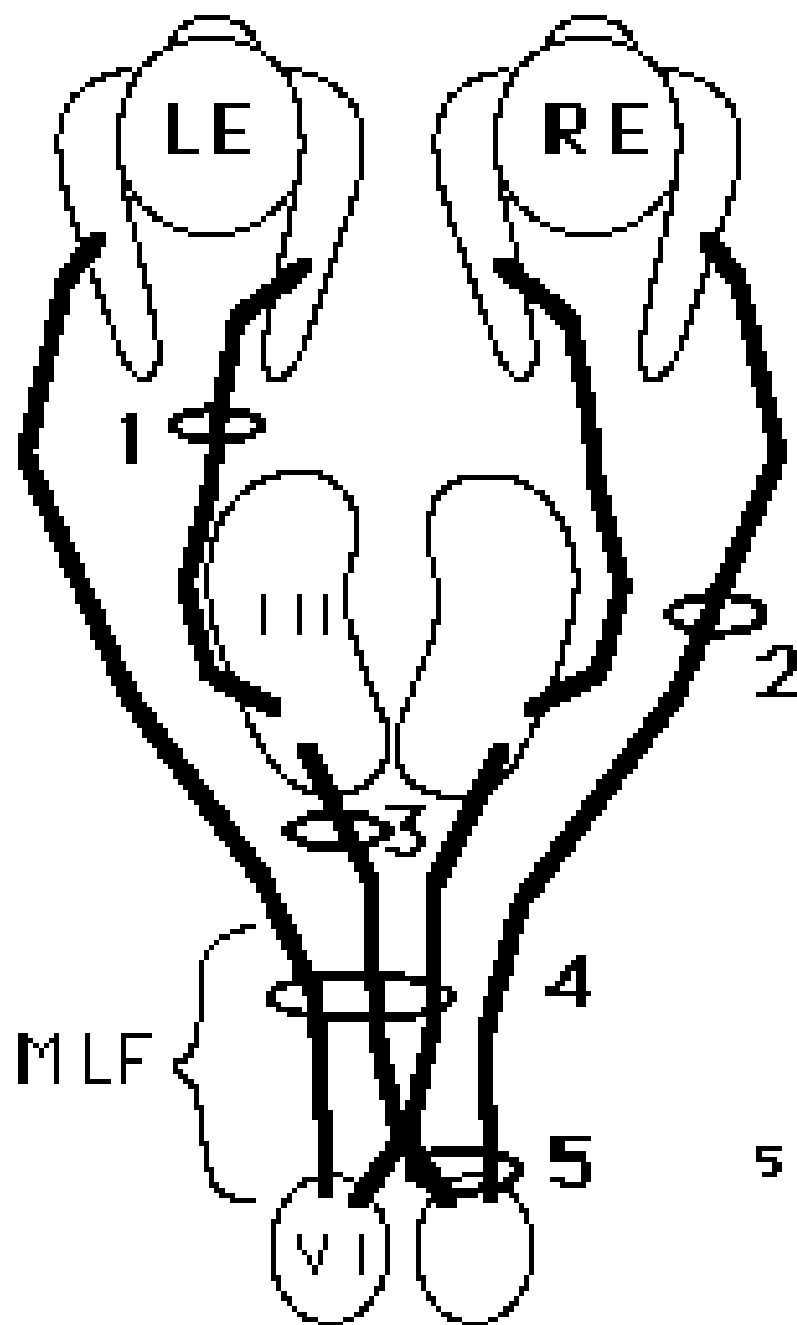
Quiz 2, Thursday, February 28

Chapter 5: orbital geometry (all the Laws for ocular motility, muscle planes)

Chapter 6: muscle force mechanics- Hooke's law

Chapter 7: final common pathway- III, IV, VI

Chapter 9: Pre-motor sites and interconnections.
riMLF (vertical), PPRF (horizontal saccades)
VI(horizonal binocular yoking)
MLF & MLF lesions and disorders



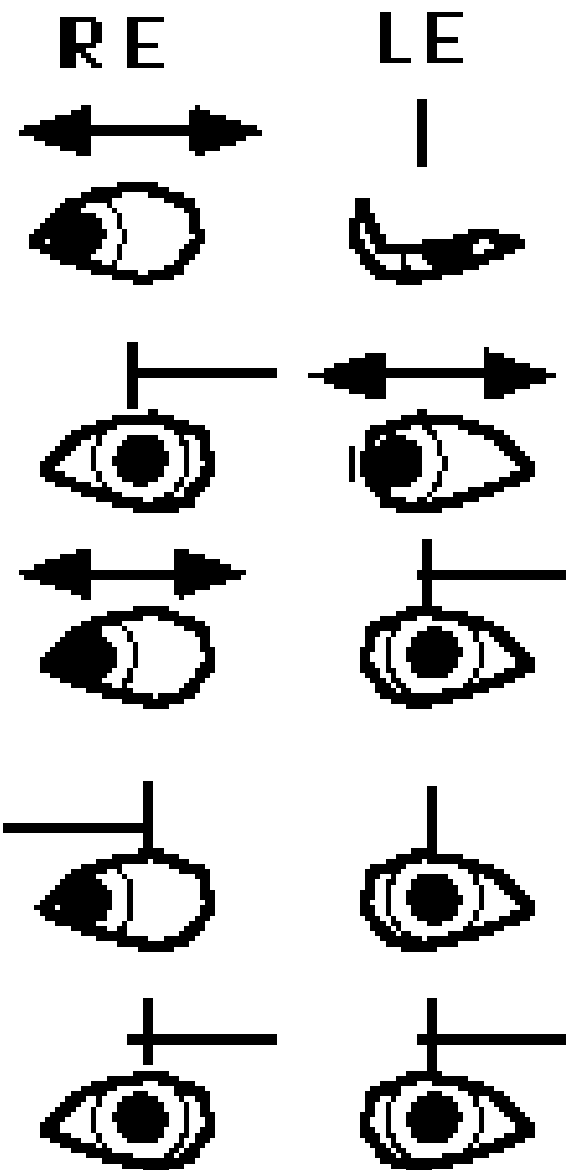
1 Oculomotor
Ophthalmoplegia

2 Abducens palsy

3 Unilateral INO
(Internuclear
Ophthalmoplegia)

4 One and a Half
Syndrome

5 Foville's Syndrome
(Posterior INO)



Vestibular system- the sixth sense

Static senses head orientation- Otoliths

Dynamic senses head rotation- Canals

Evolution of the vestibular system (the sixth sense)
from the lateral line of fish.

Cochlea (high frequency)

Otoliths (low frequency)

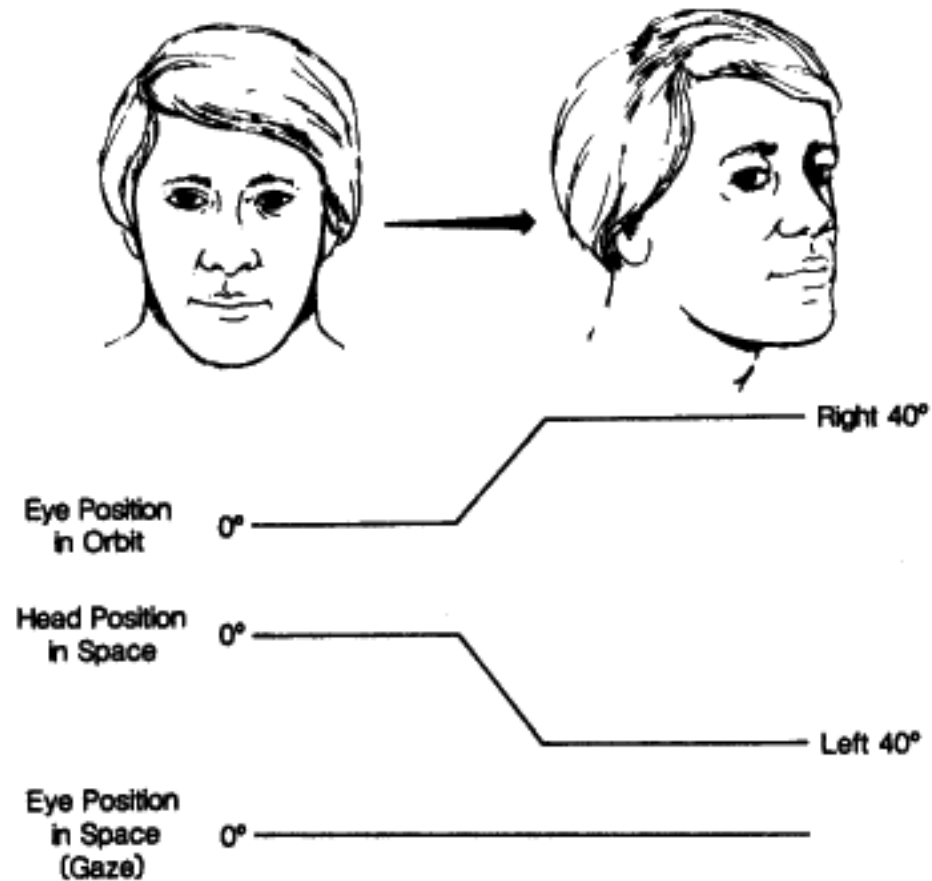
Canals (mid frequency)

Common disorders:

Benign Positional Vertigo: Meniere's syndrome

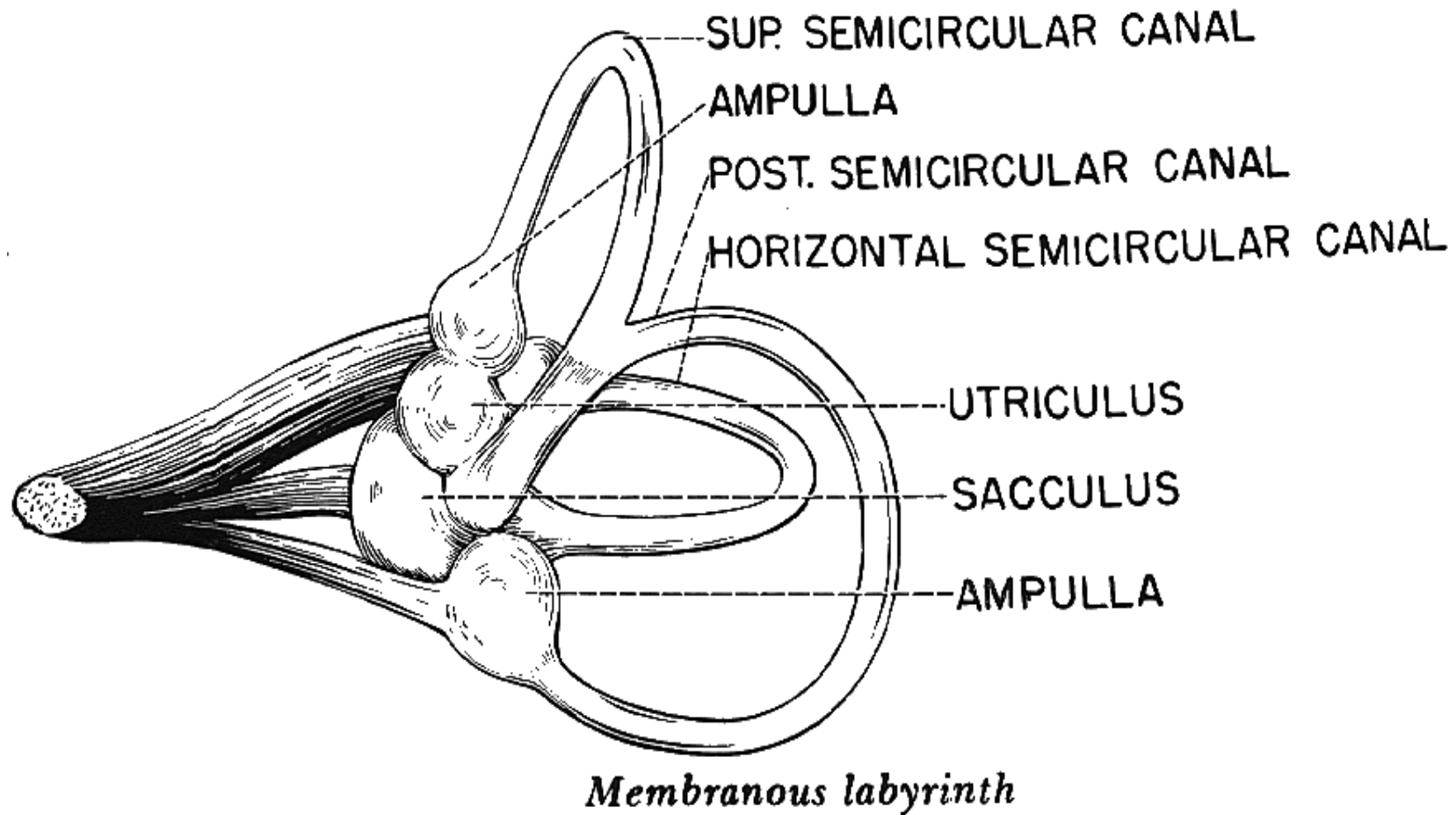
Story about Jack Crawford

VOR holds gaze steady

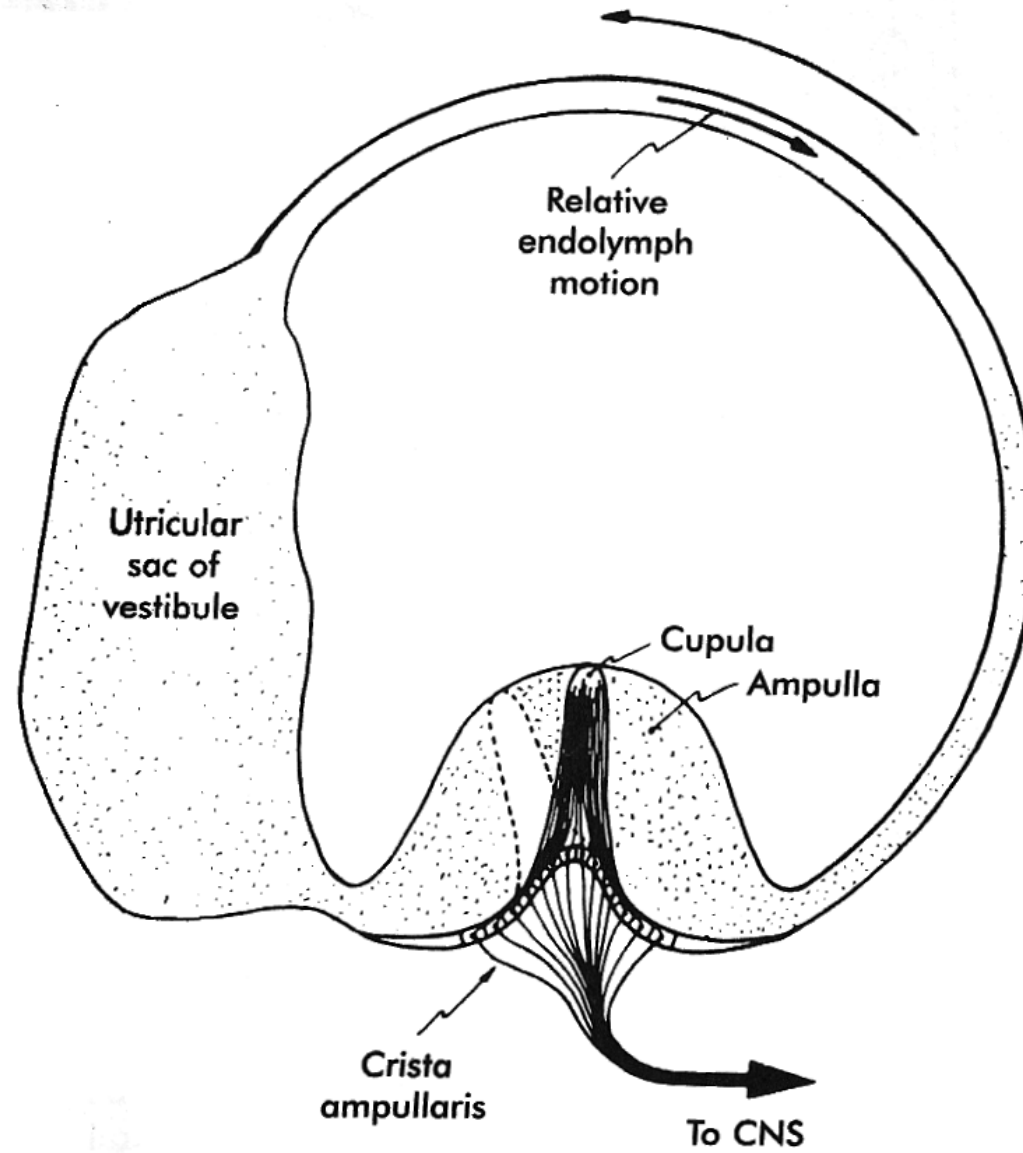


$$\text{EYE}_{\text{space}} = \text{EYE}_{\text{orbit}} + \text{HEAD}_{\text{space}}$$

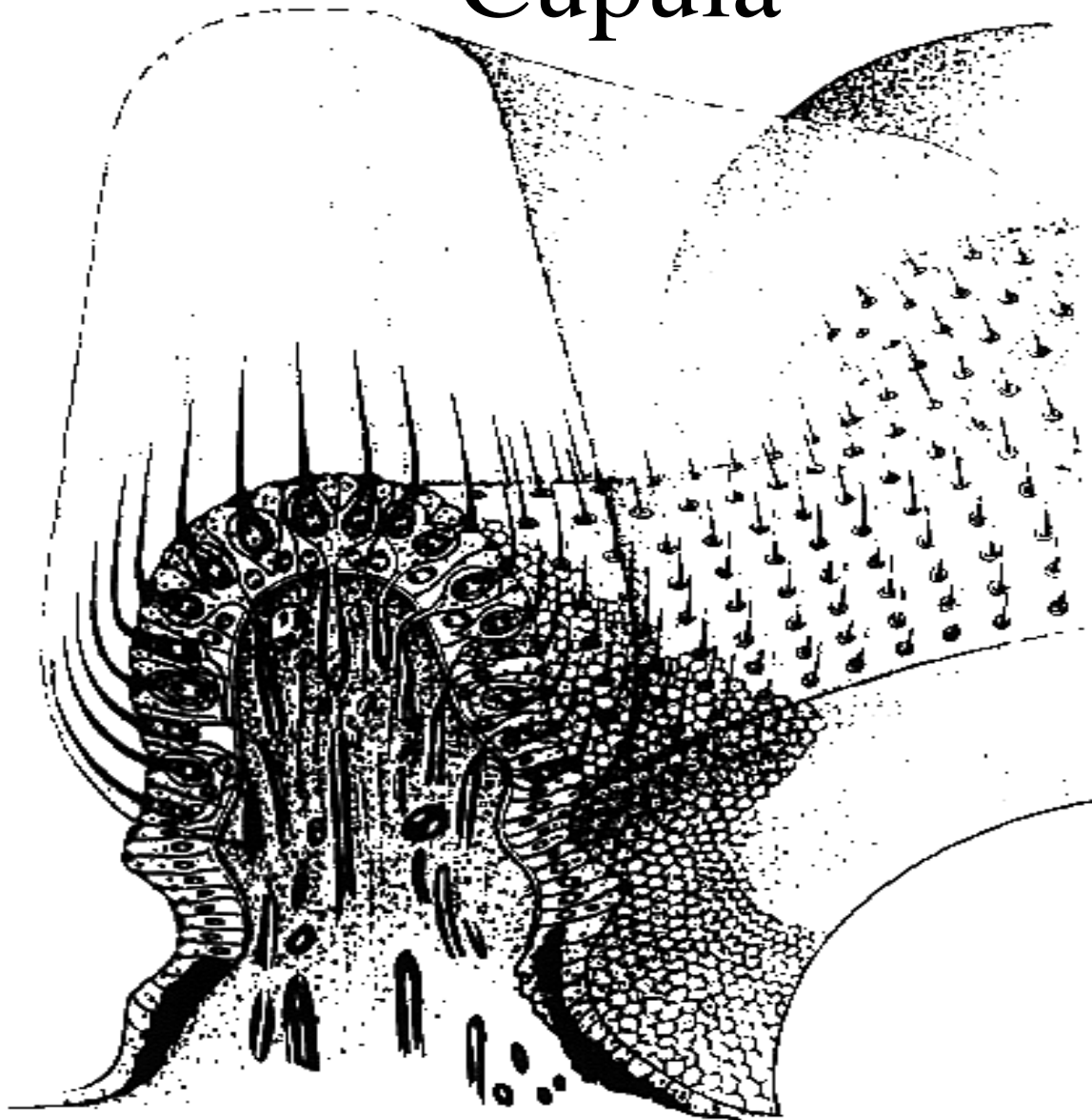
Vestibular System components



Semicircular Canal detail



Cupula



VOR- 3 synapses

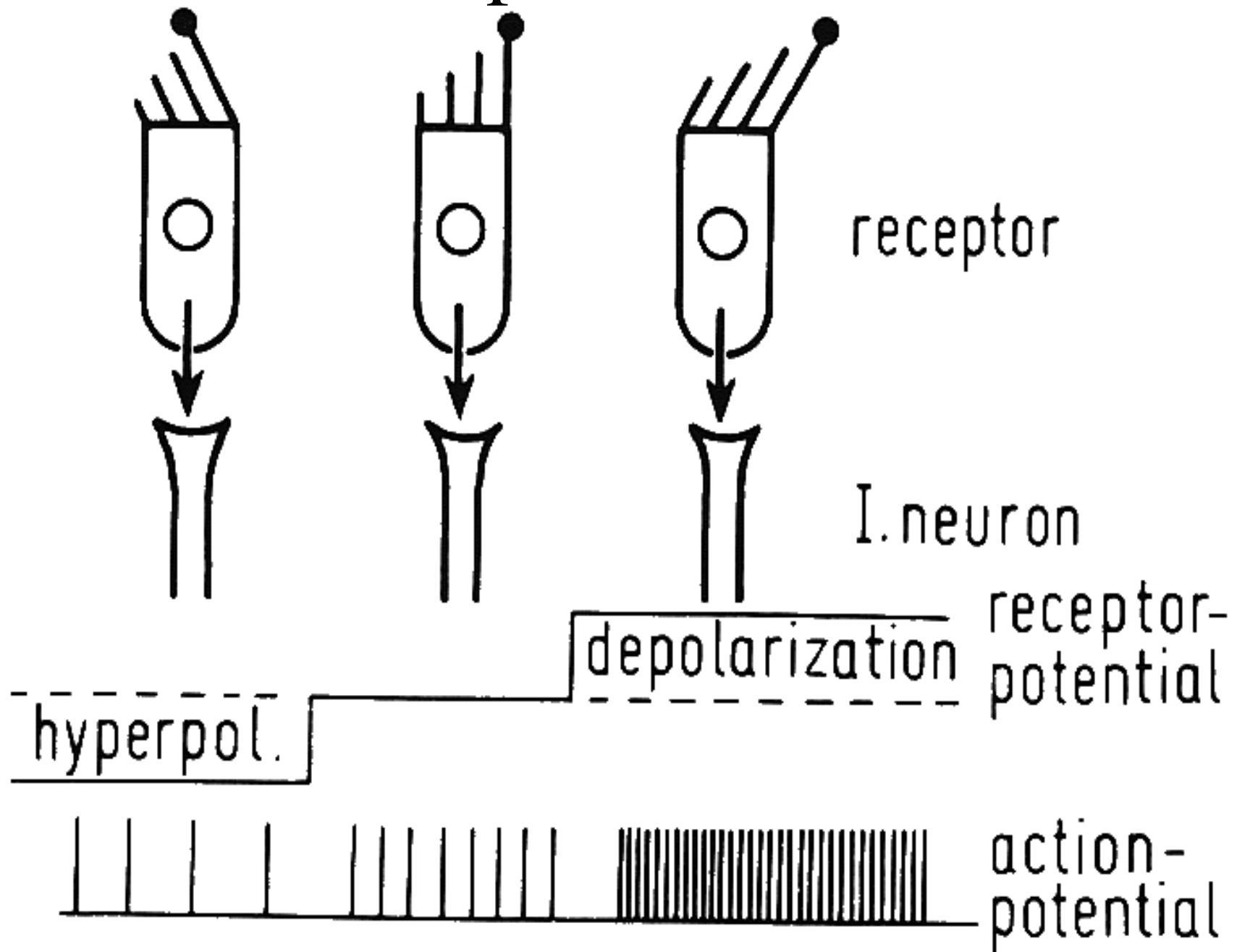
bipolar cells

Vestibular nuclei

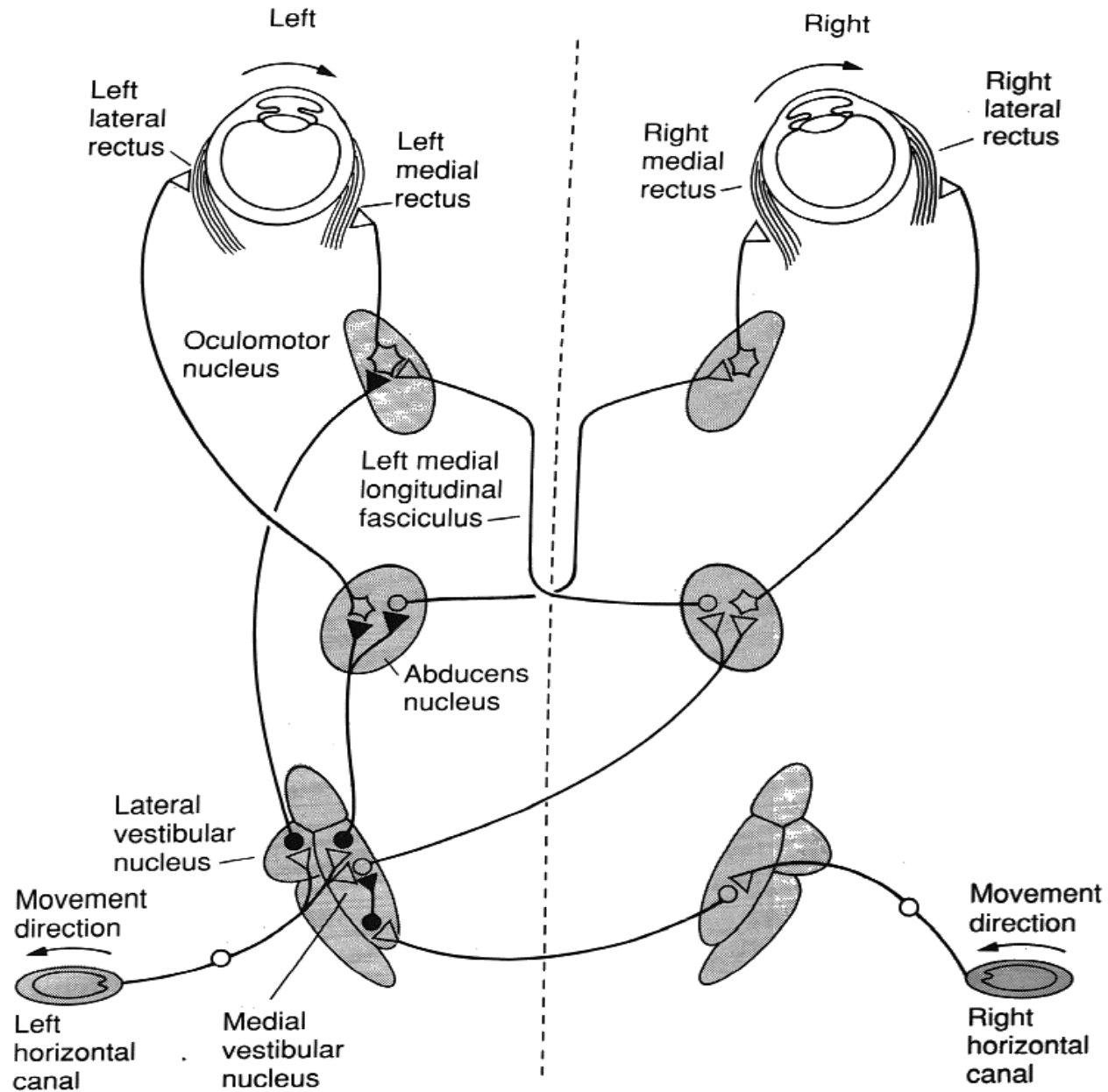
Motor neurons III and IV

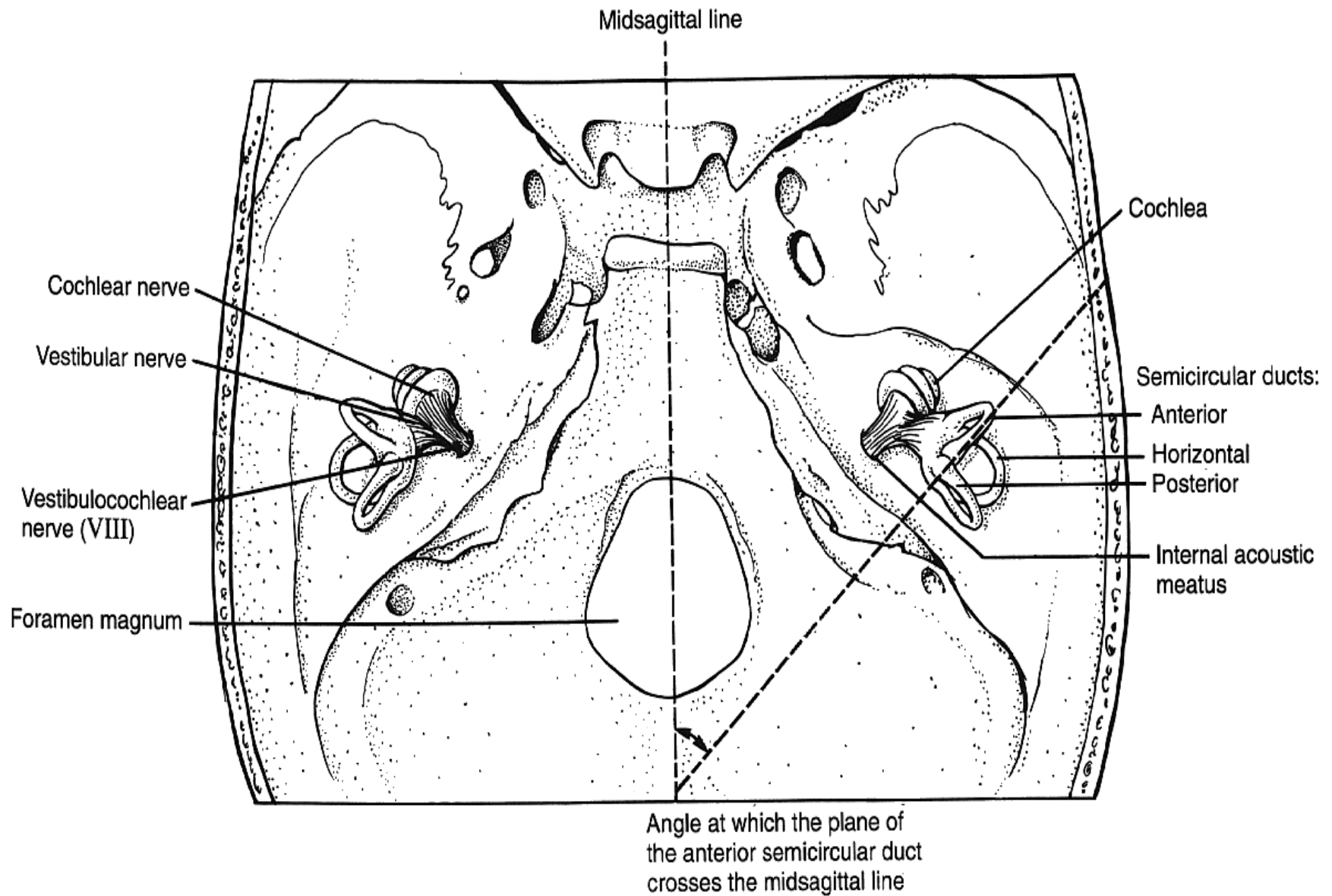
Short latency- 16 msec

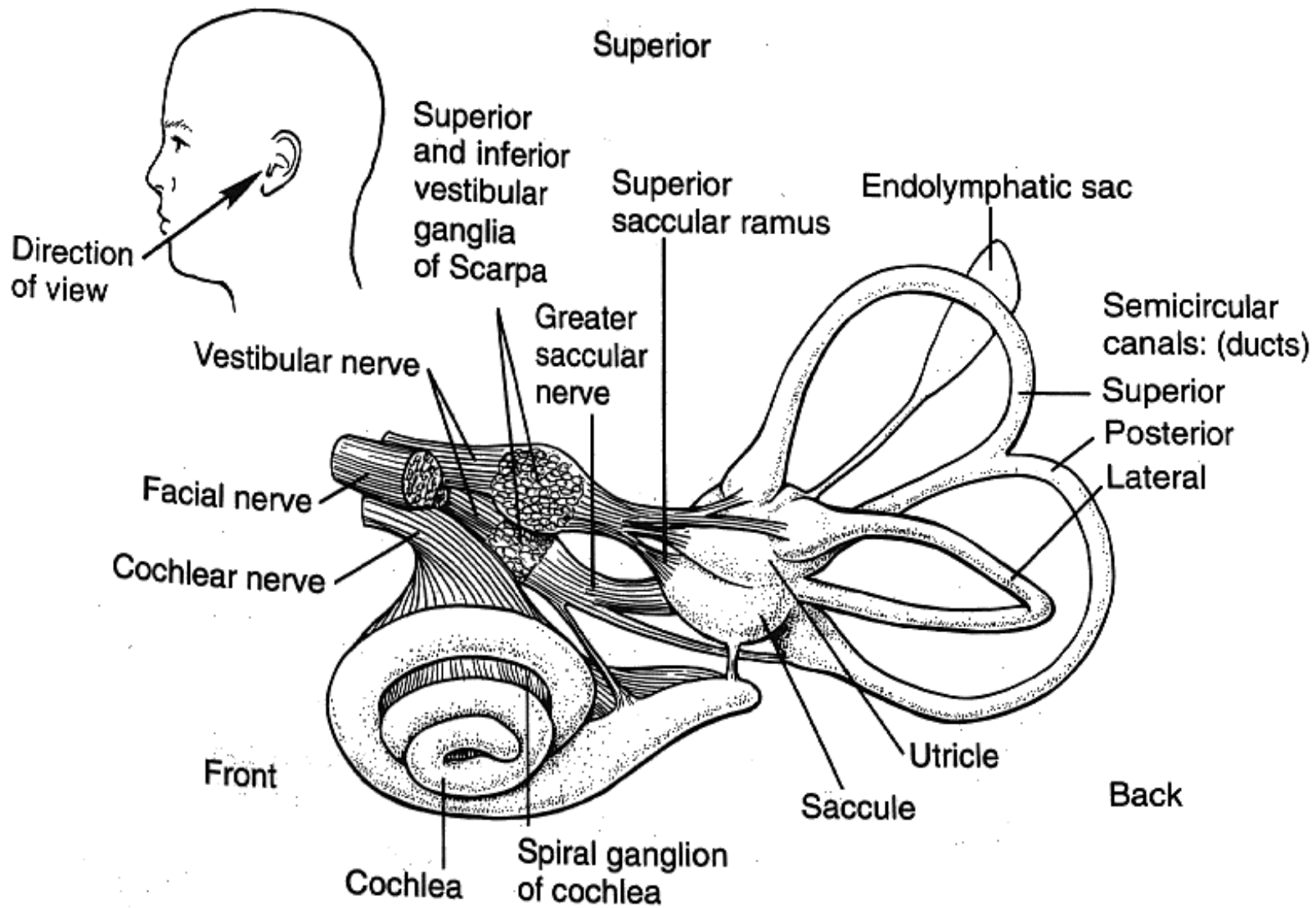
Bipolar Cells

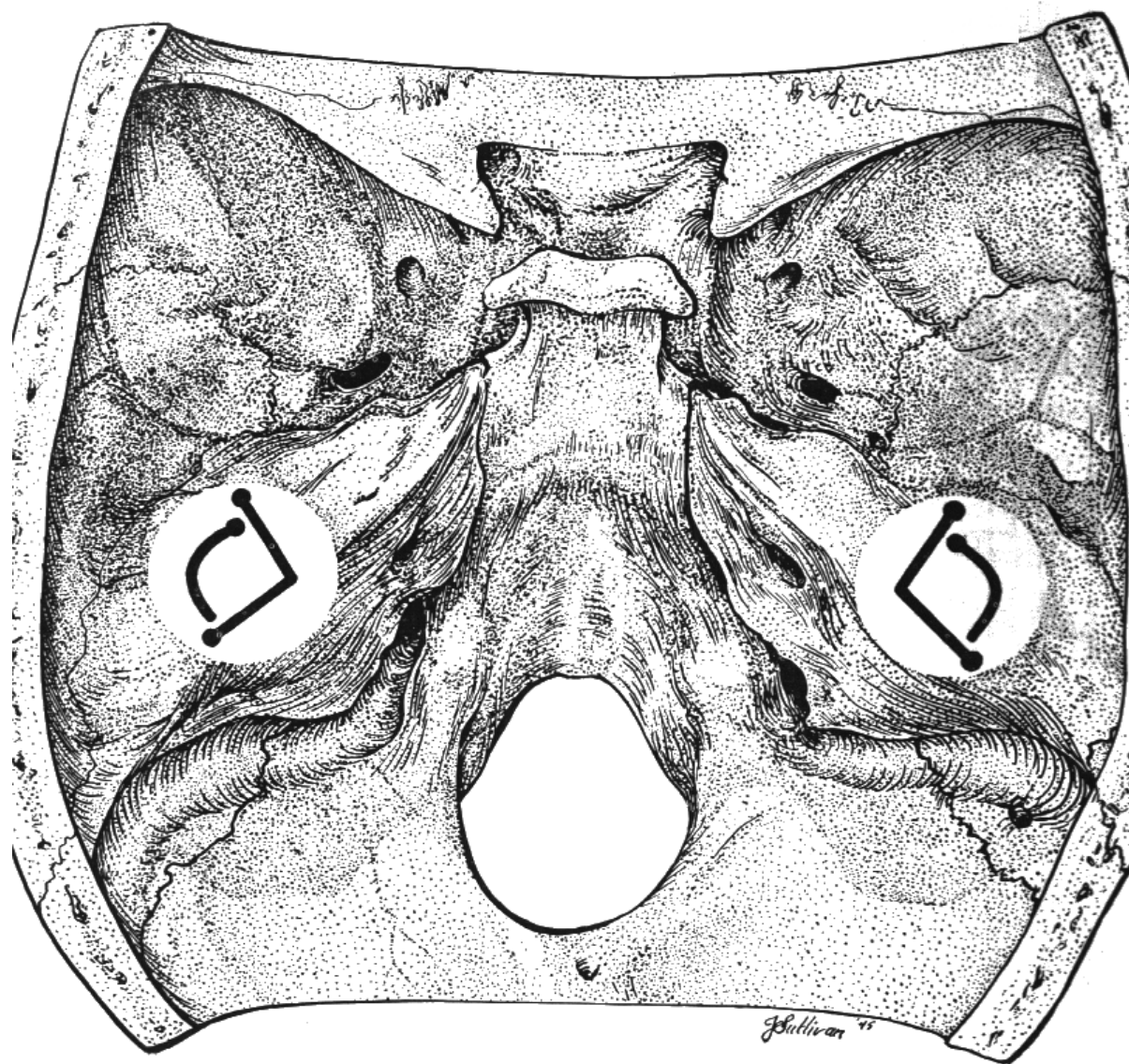


Horizontal VOR

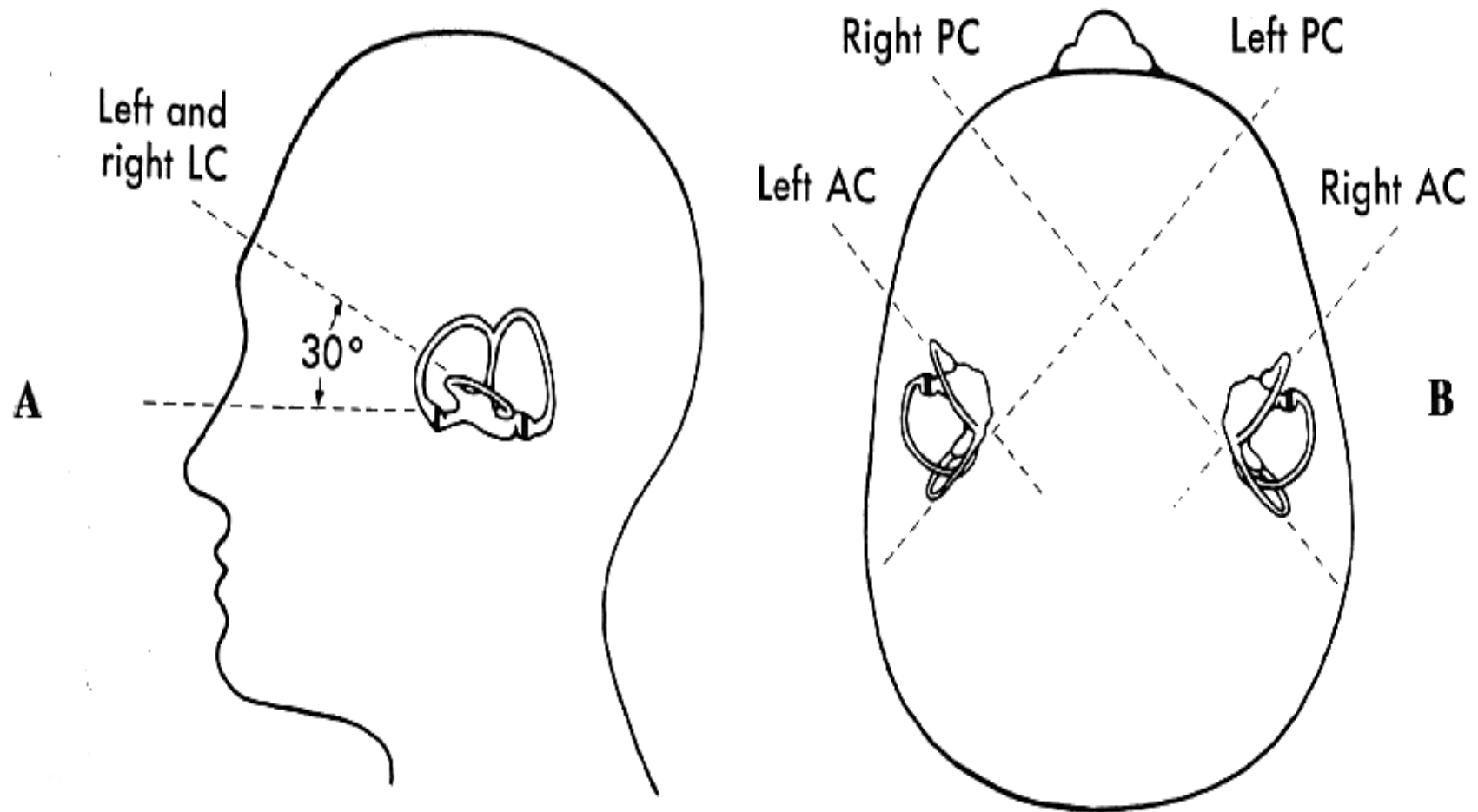




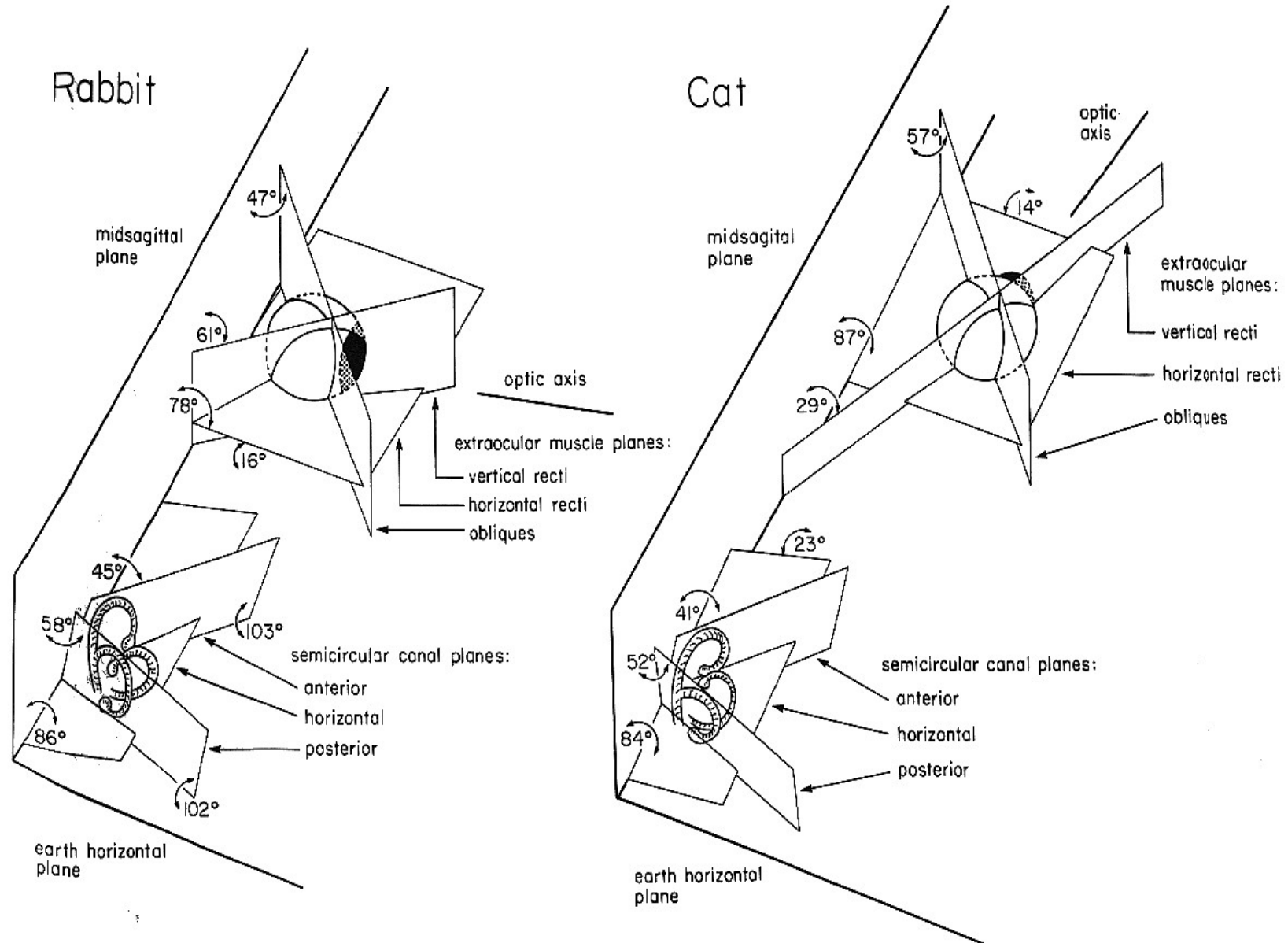




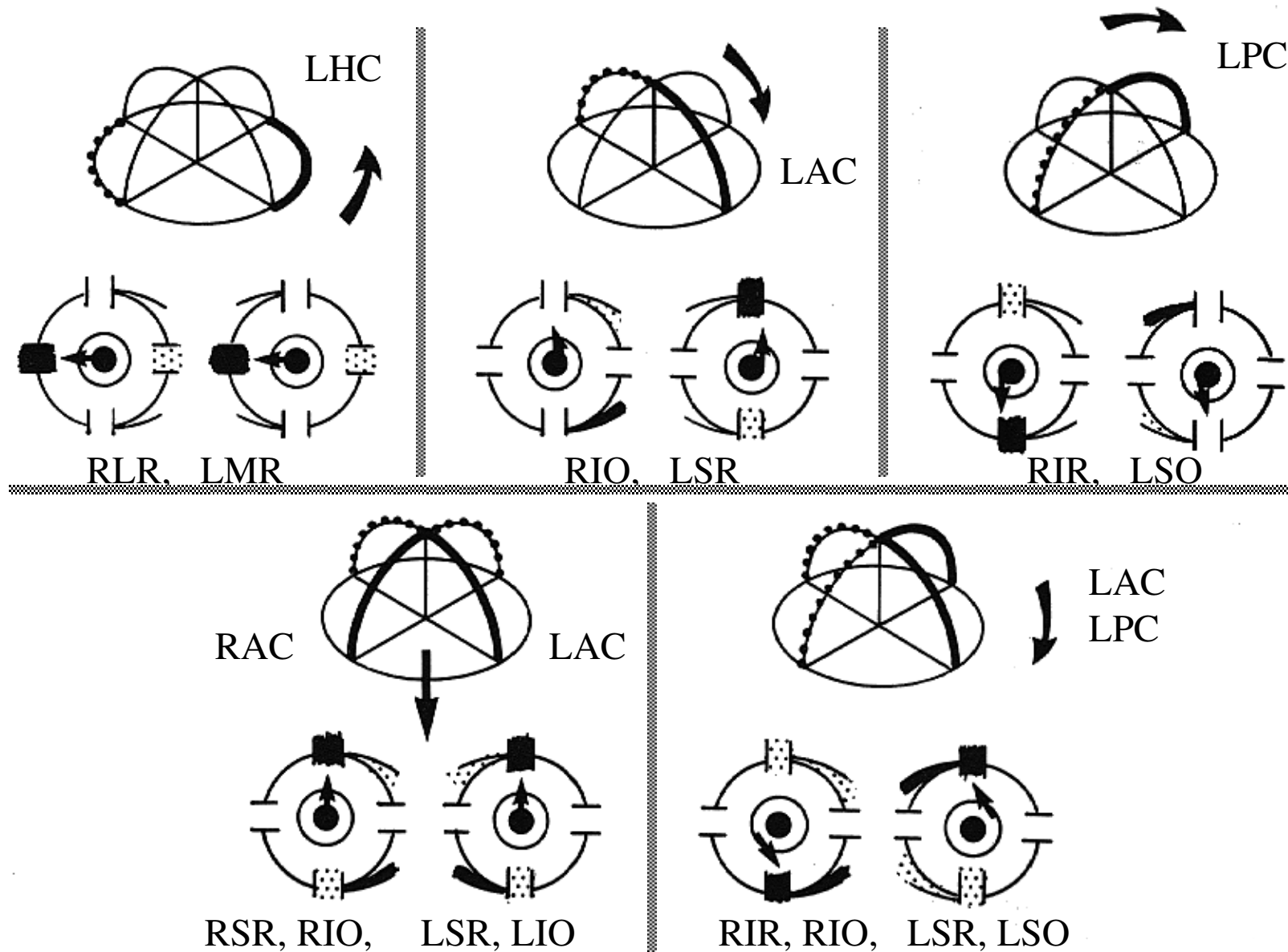
Canal planes



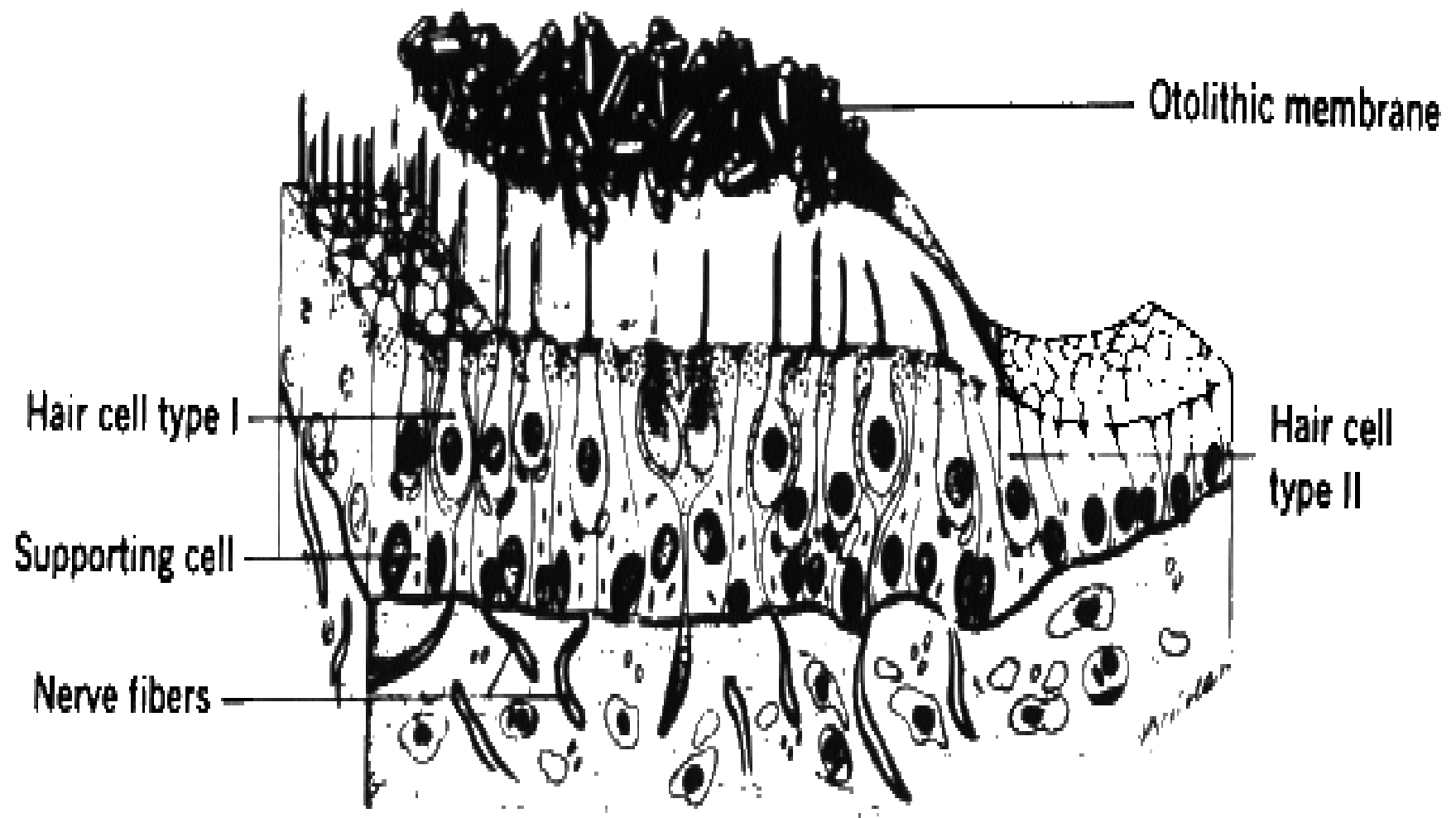
Canals & Muscle Planes



Canal-muscle pairings during head rotation

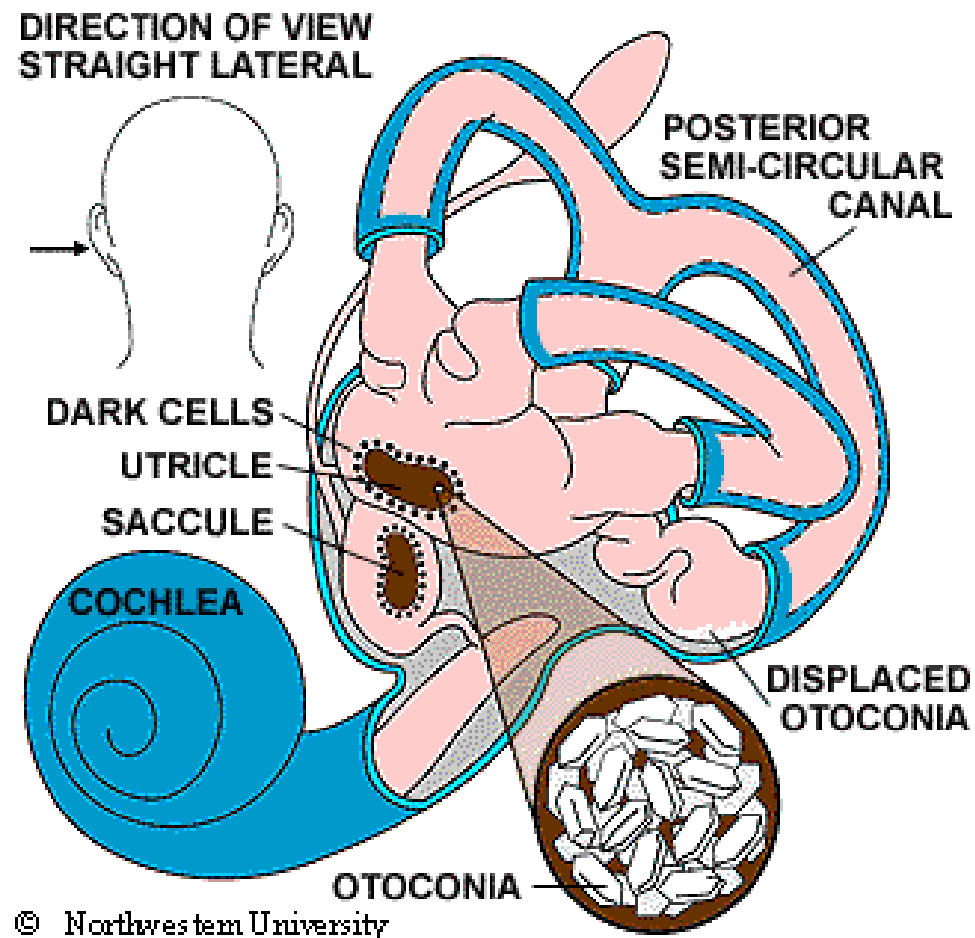


Calcium Carbonate Crystals



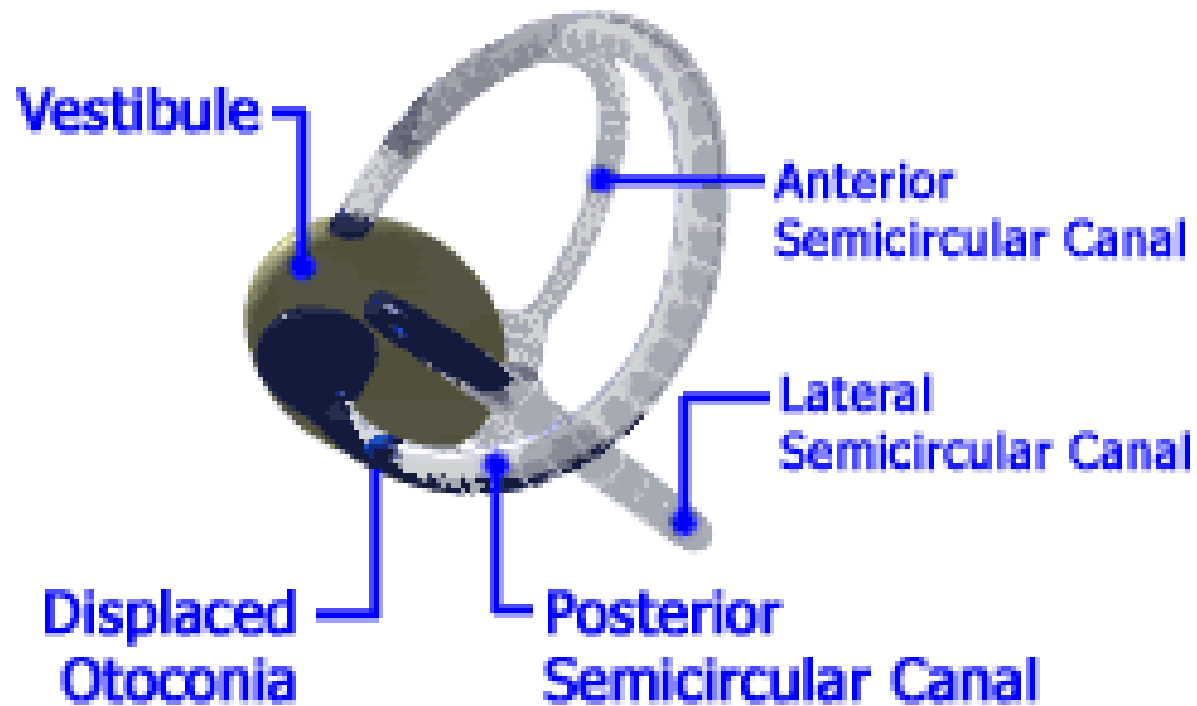
Otoliths

Benign Positional Vertigo



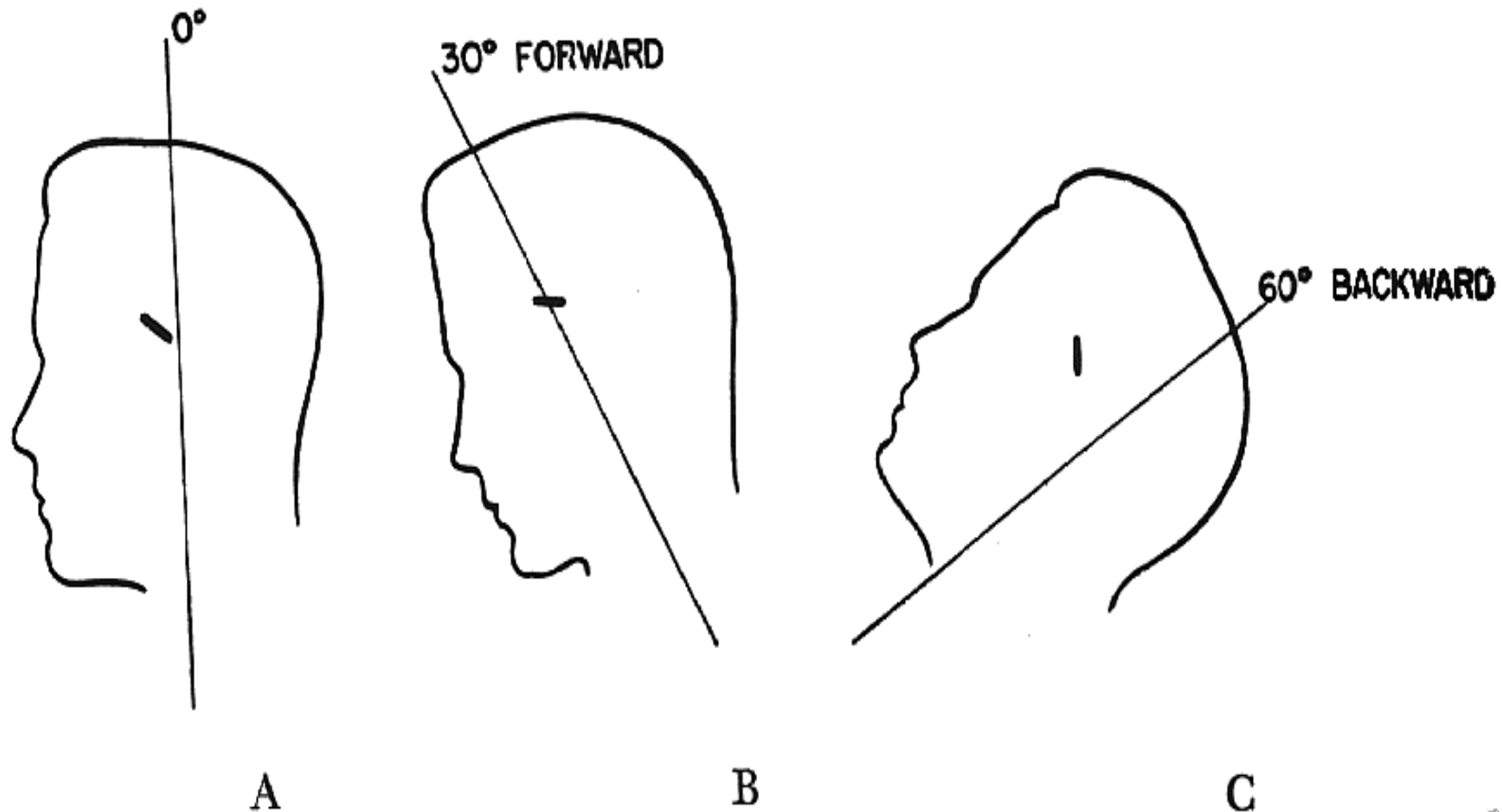
Show Epley Maneuver film

Benign Positional Vertigo

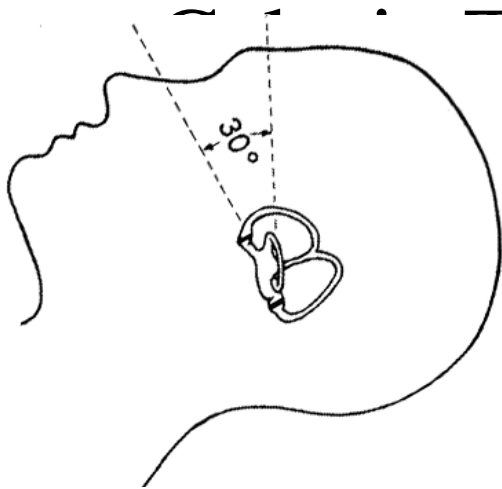


Show Epley Maneuver film

Head Posture for Caloric Nystagmus



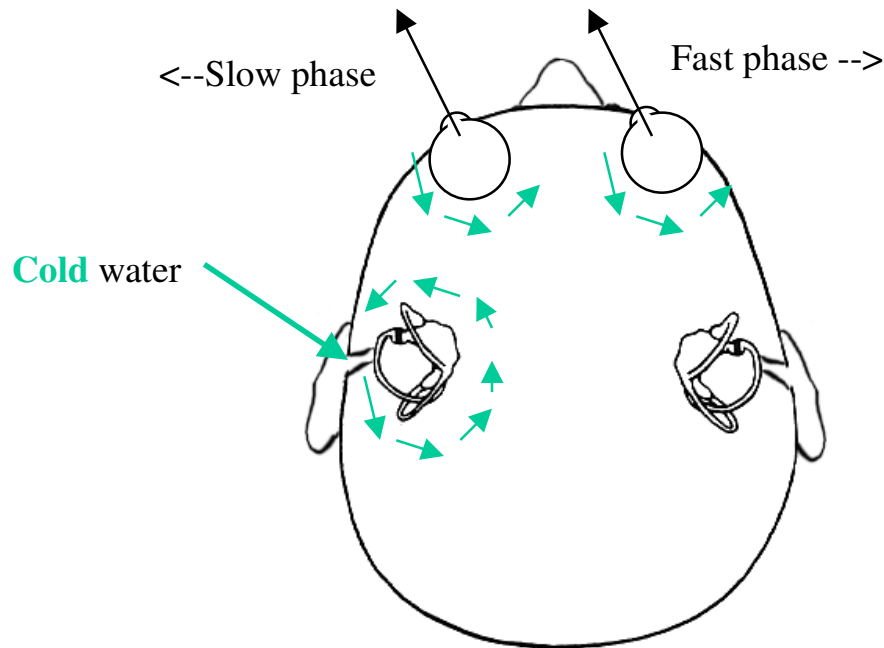
Bedside clinical evaluation of VOR



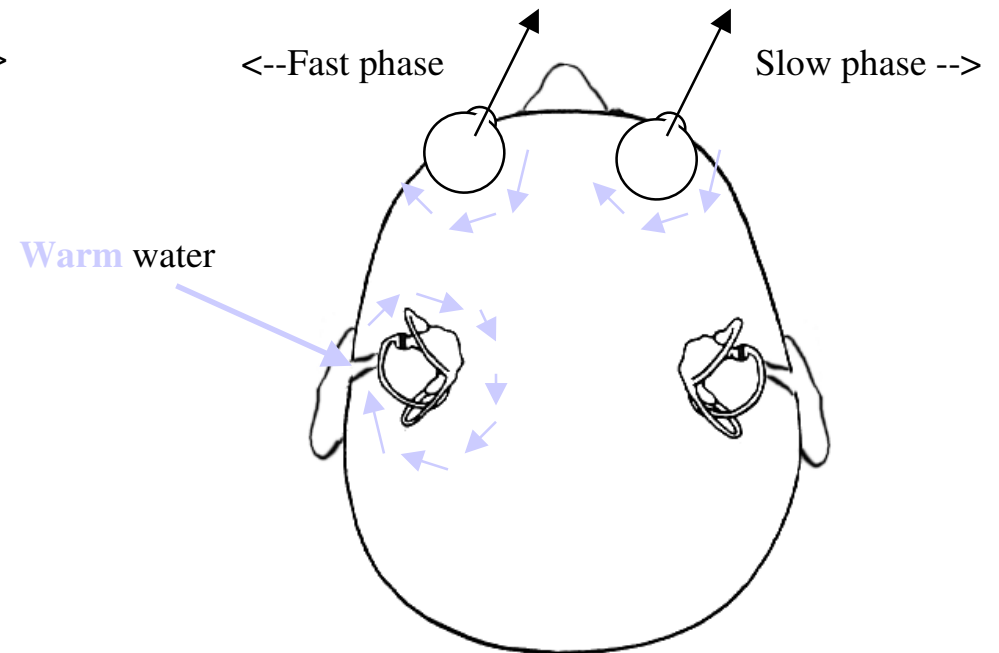
Test for Vestibular Function

Patient's head is tilted back 60 degrees so that Horizontal Canal is roughly vertical.

Endolymph circulation produces VOR. Fast phase for Cold caloric is toward Opposite ear, for Warm caloric it is toward Same ear. COWS



Cold water in the left ear canal makes endolymph sink and circulate CCW.



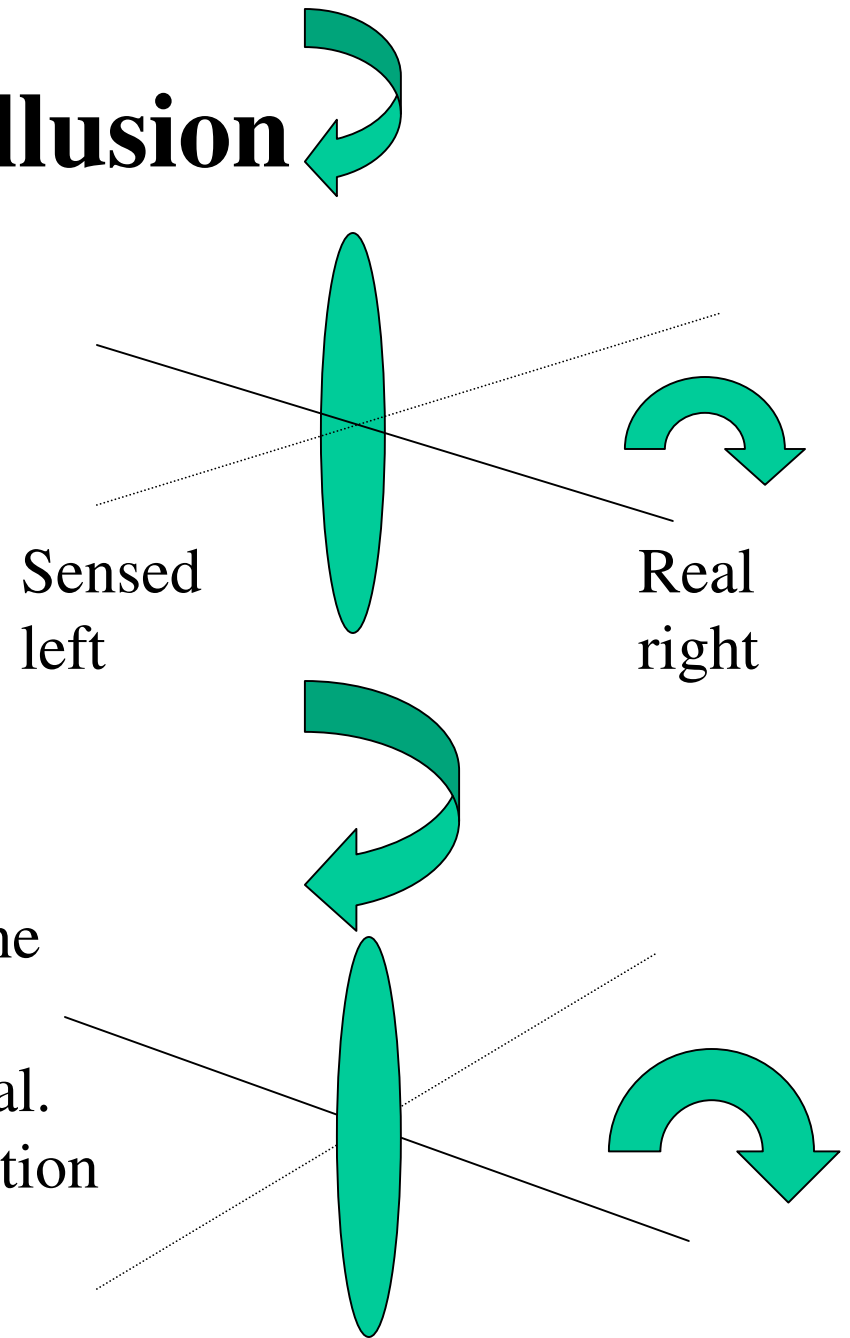
Warm water in the left ear canal makes endolymph rise and circulate CW.

Aviation Otolith illusions

The Death spiral- roll illusion

While banking to the right the pilot senses a left roll because centripetal force stimulates the left utricle

Compensate by banking plane more to the right to correct attitude.
This causes a clockwise descending spiral.
The centrifugal force increases the sensation of a left roll and it ends in a big splash.

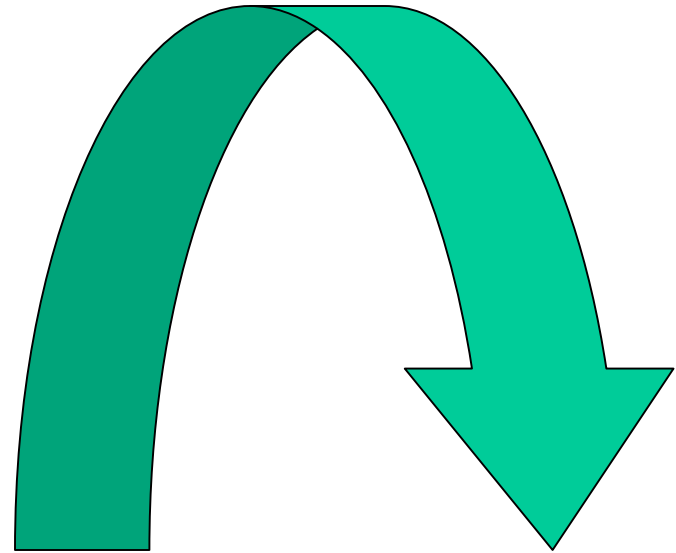


Ocular Corellas upward pitch illusion

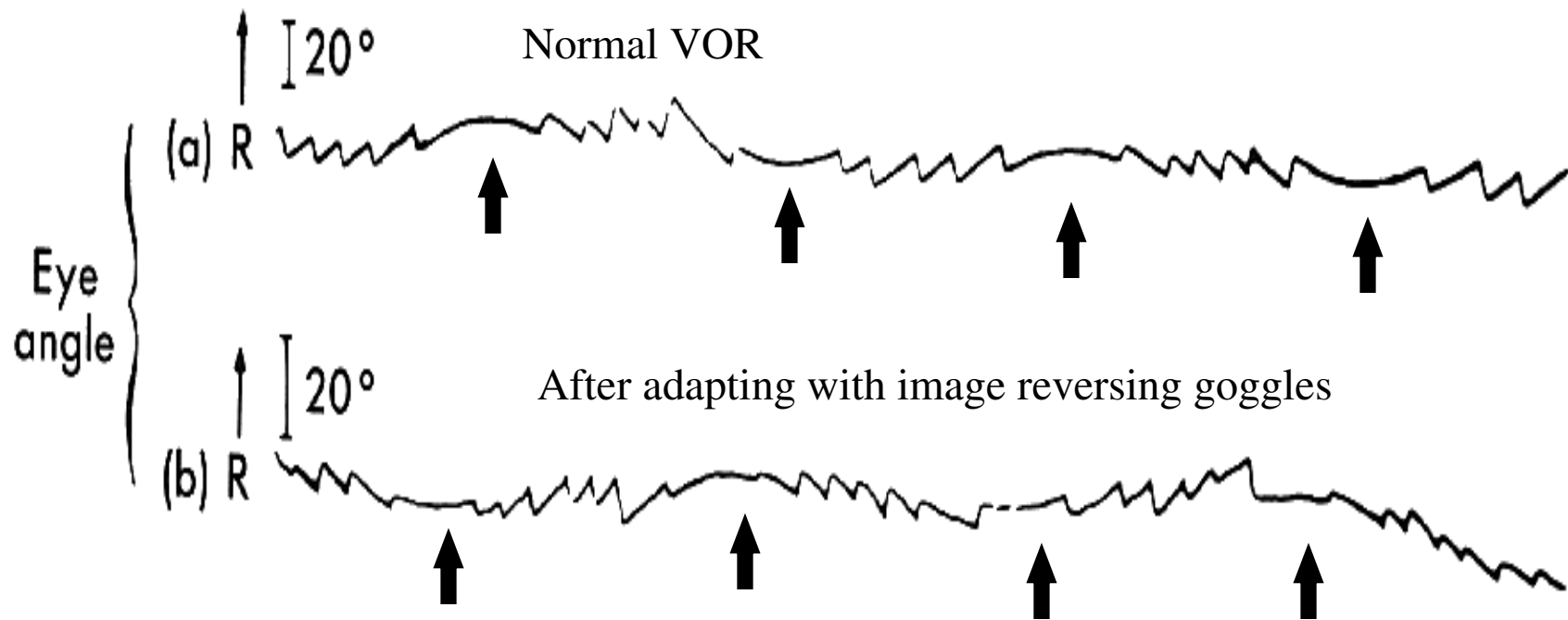
During takeoff from the deck of an aircraft carrier, the forward thrust acceleration stimulates Sacculus to sense upward pitch

Pilot compensates by pitching the nose down and flies into the ocean in a parabolic flight.

Try this out during takeoff on a passenger jet. Notice if you think the nose is up along the isle and compare to the visible horizon seen outside the window.

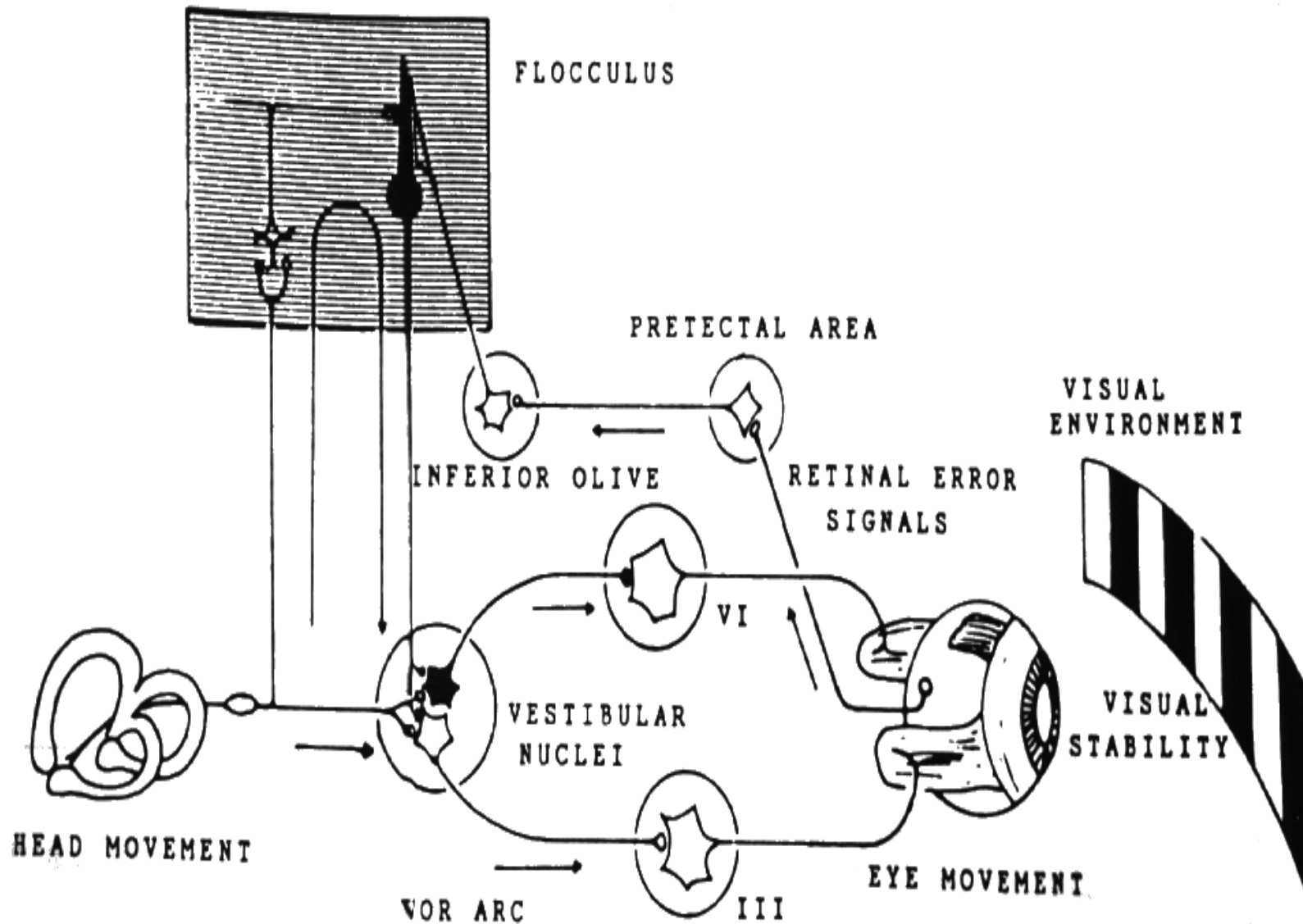


VOR can be reversed by adaptation



In the dark, subject was rotated about 360 degrees first one way, then the other. Arrows show where head rotation changed direction. Stimulus was the same for both traces, but movement was reversed after adaptation. Note the fast phases mixed in with slow phases.

VOR Adaptation

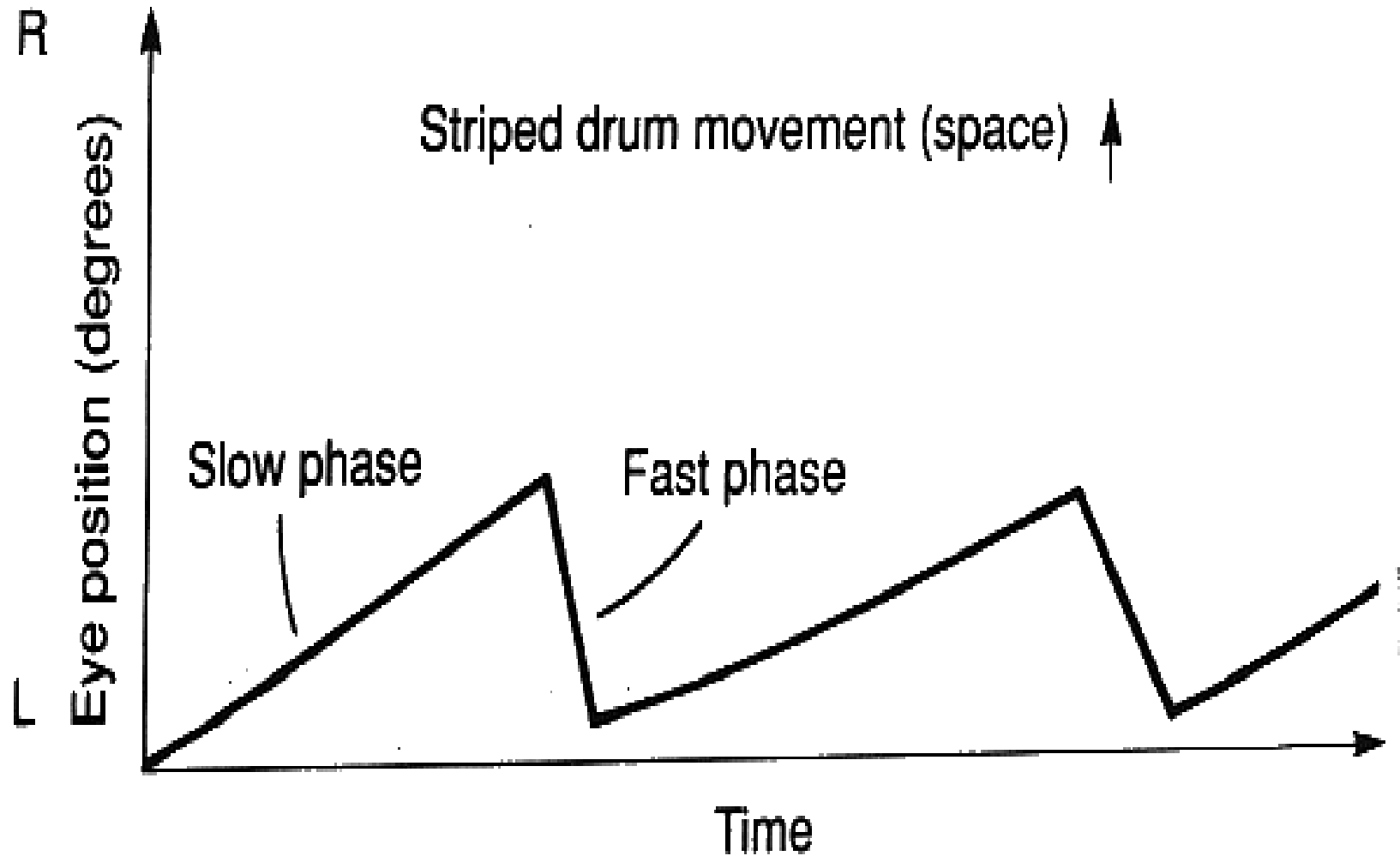


OKN supplements the VOR at low velocities and constant velocities

Body sway

Constant rotation velocity

OKN Jerk Nystagmus



Observed by Purkinje in early 19th century

Examples of Visual Vestibular interactions

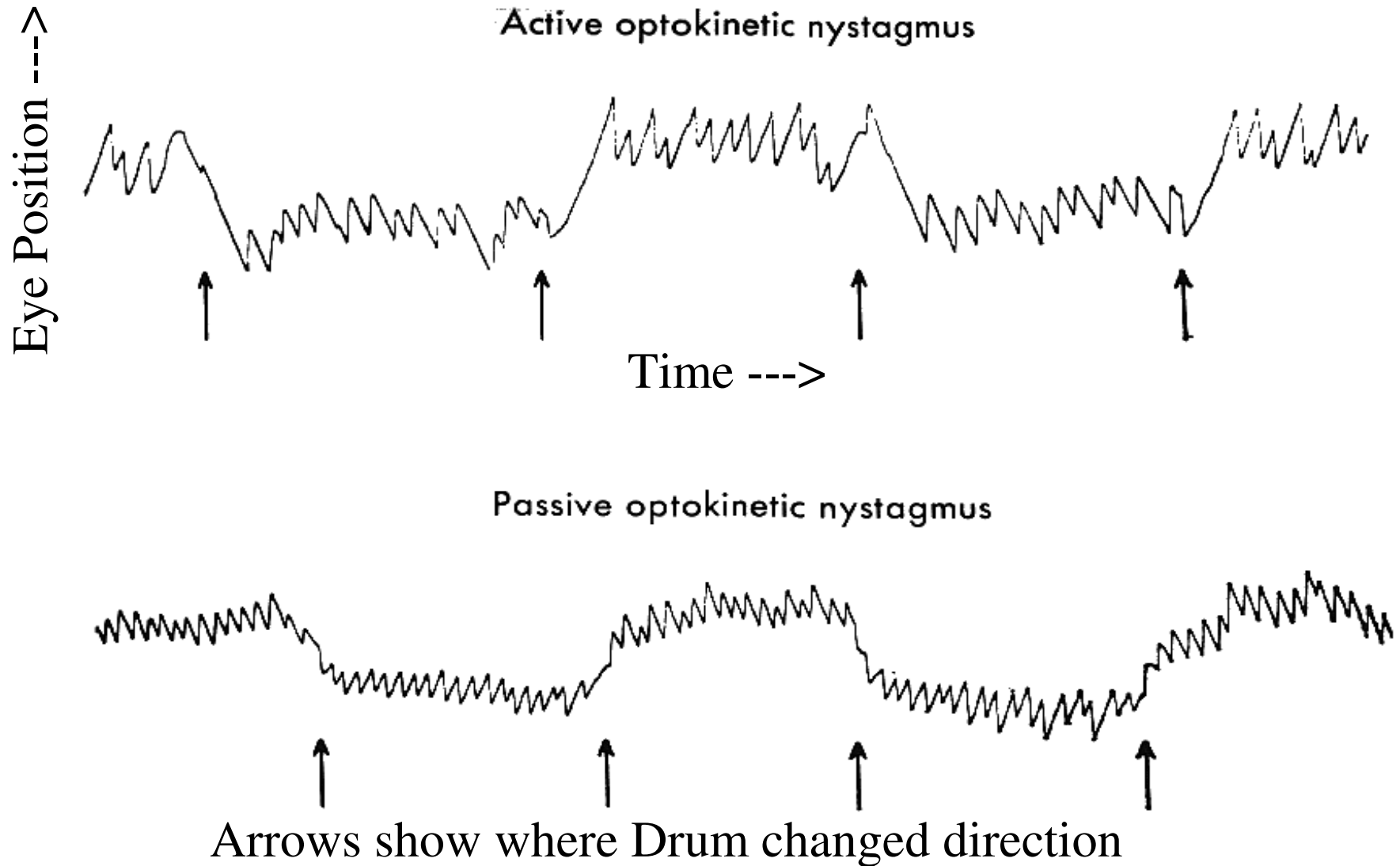
Mystery spot- Santa Cruz

Otolith-visual conflict- otolith dominates

Linear Vection- cinerama, boat docks, stop lights

Canal-visual conflict- vision dominates

Active and Passive OKN

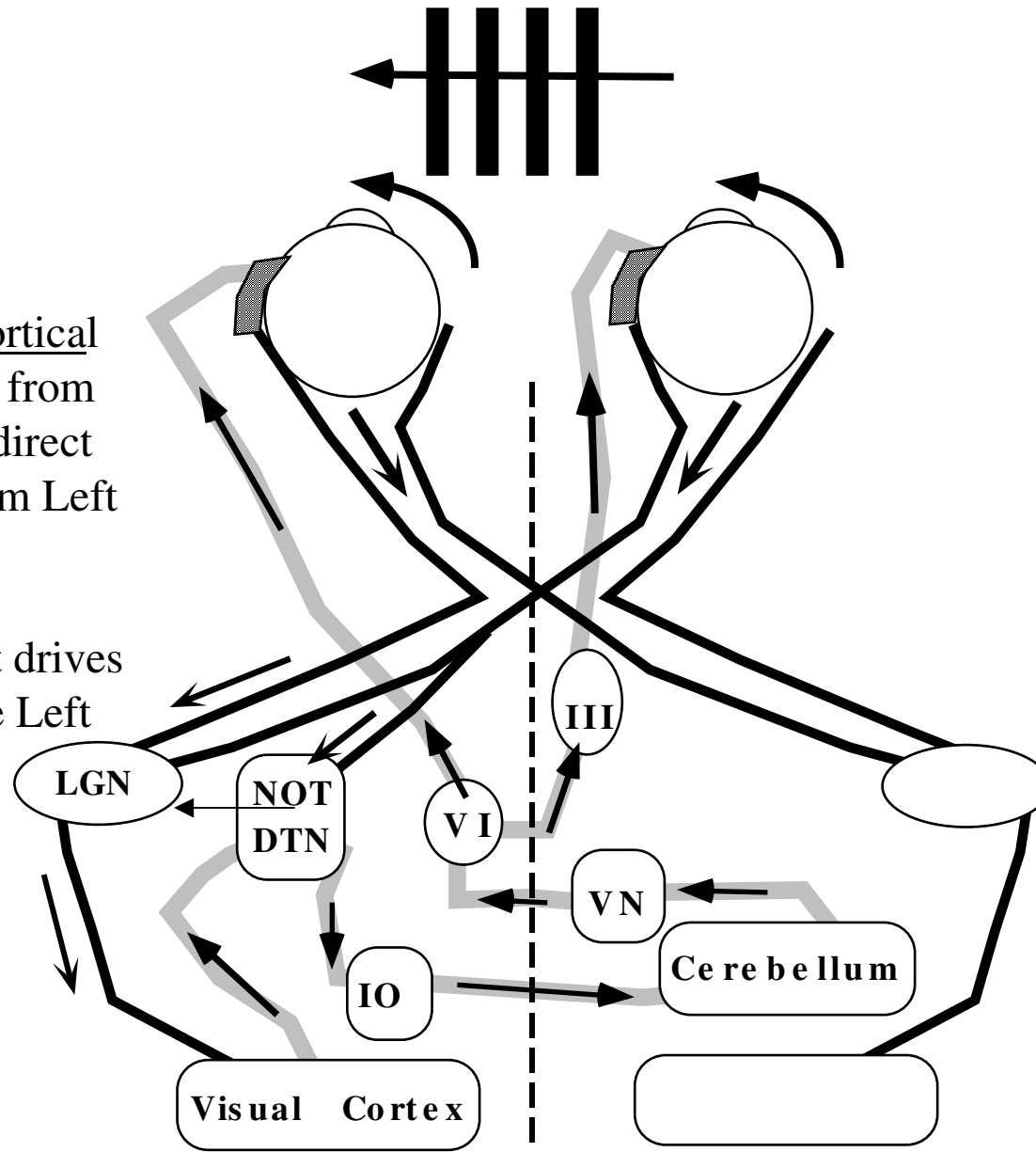


Cortical and Subcortical OKN Pathways

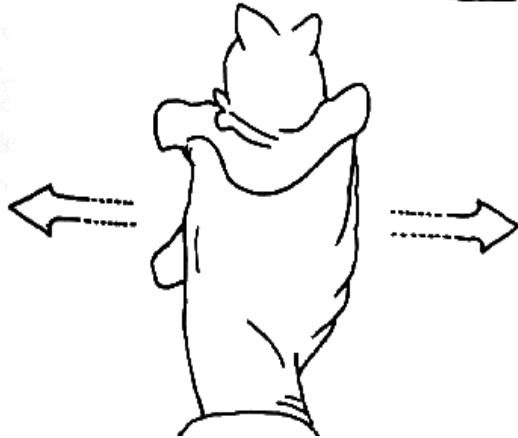
Left side NOT

Gets direct subcortical visual input only from Right eye and indirect cortical input from Left eye.

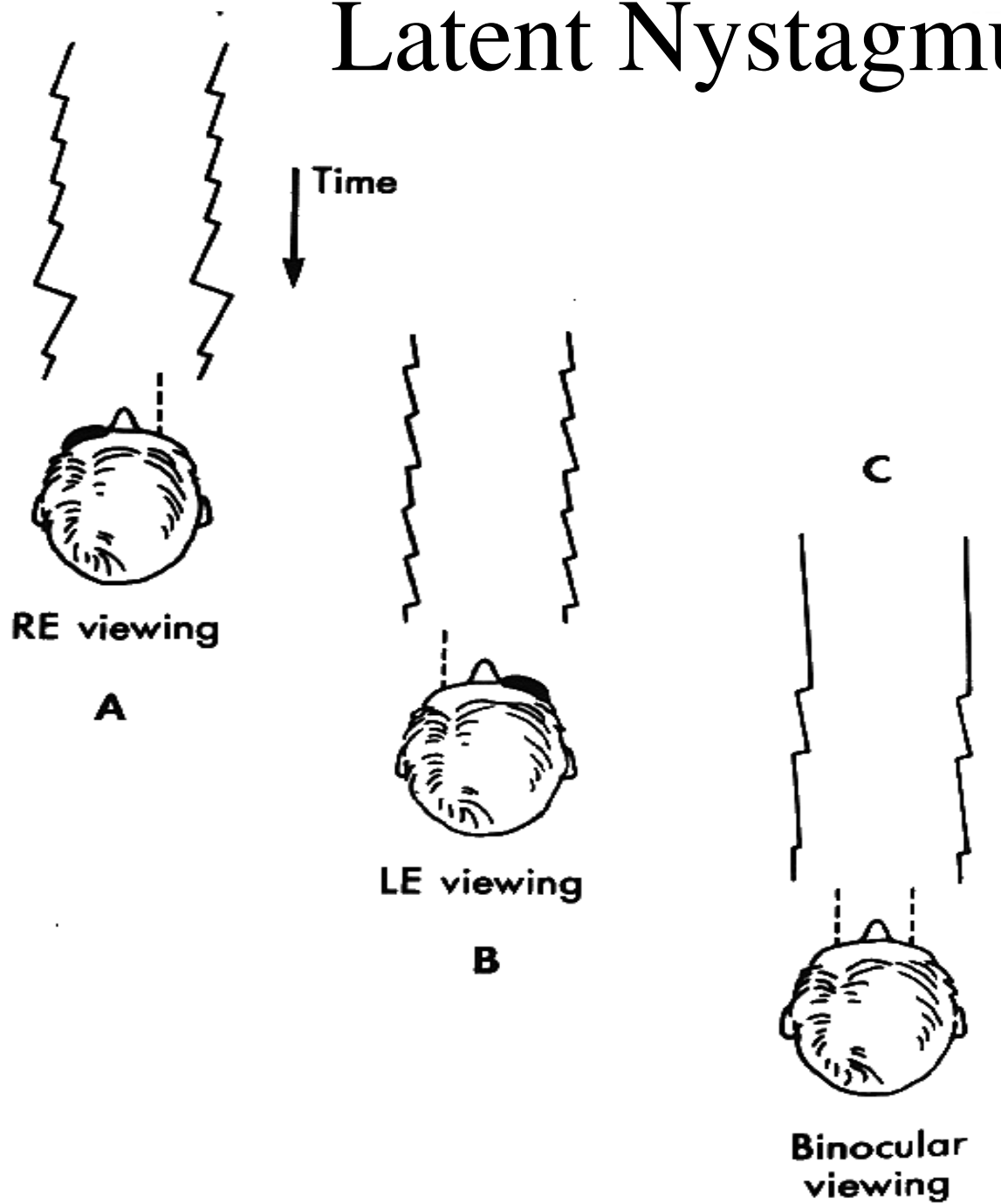
Subcortical input drives slow phase to the Left in both eyes



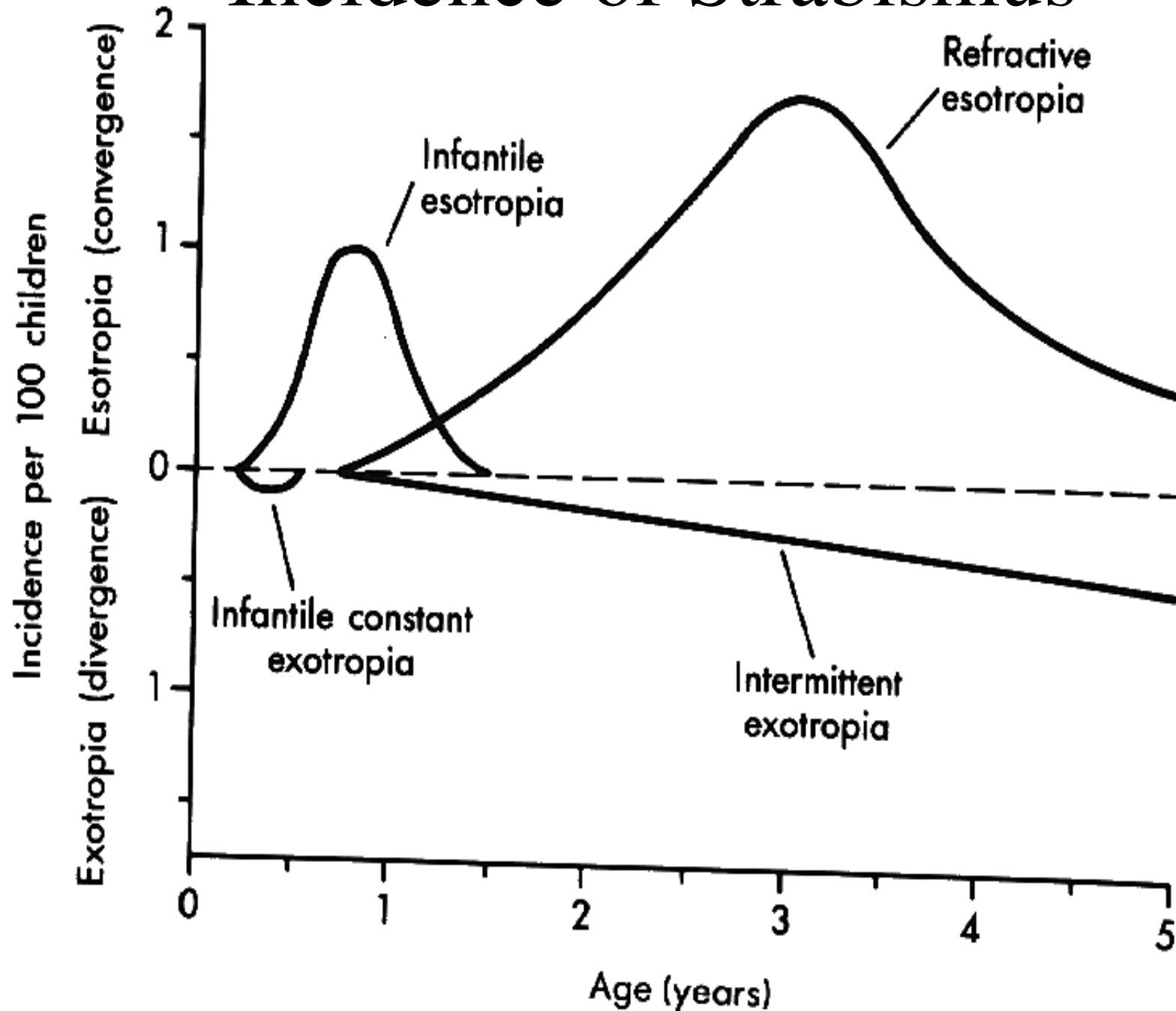
Asymmetric OKN in normal infants and strabismus



Latent Nystagmus



Incidence of Strabismus



Latent Nystagmus



Hair Cell Sensory Endings in the Cristae



Primary Vestibular Nerve



Vestibular Nuclei



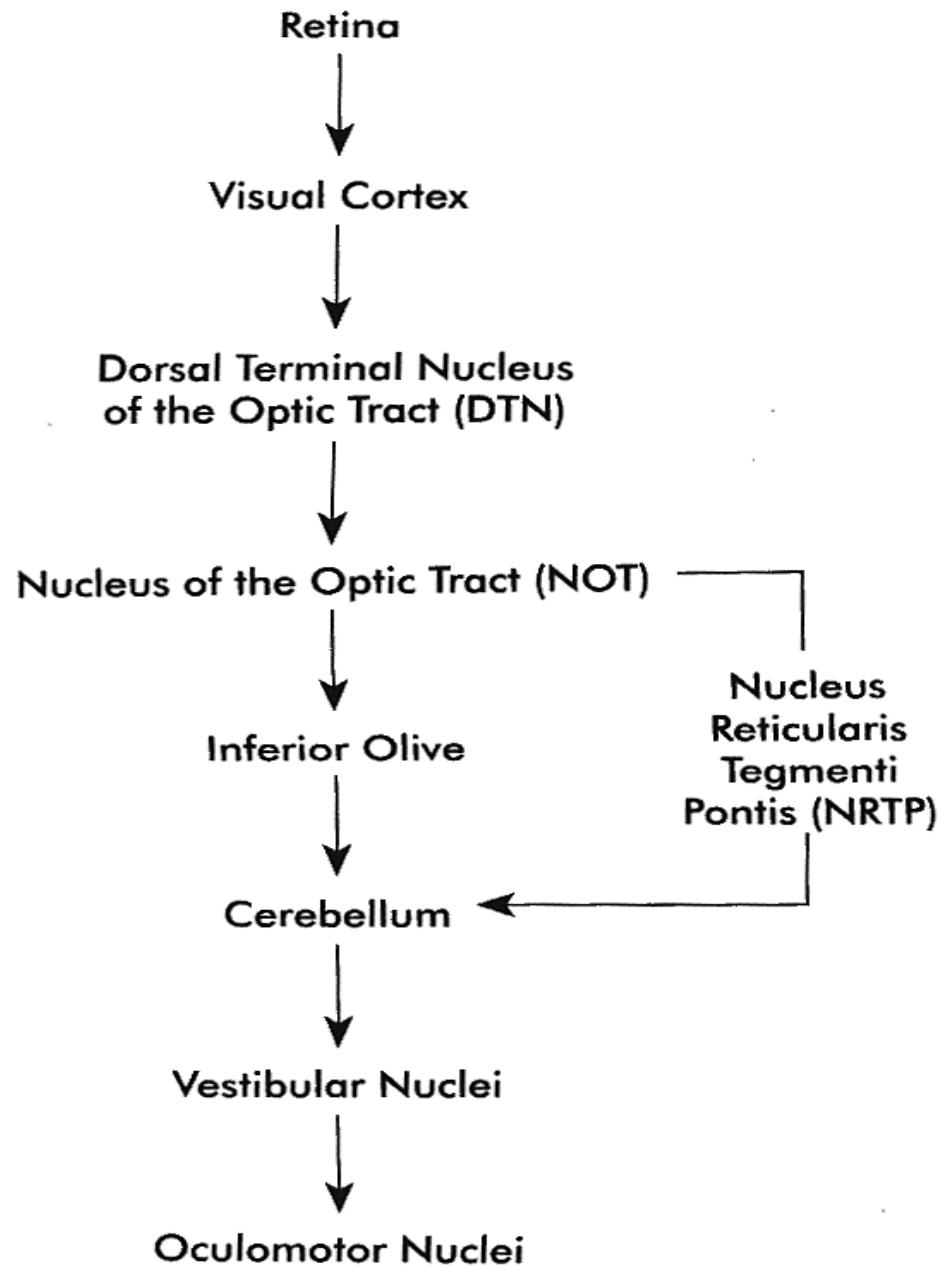
**Secondary Vestibular Neurons
via Medial Longitudinal Fasciculus**



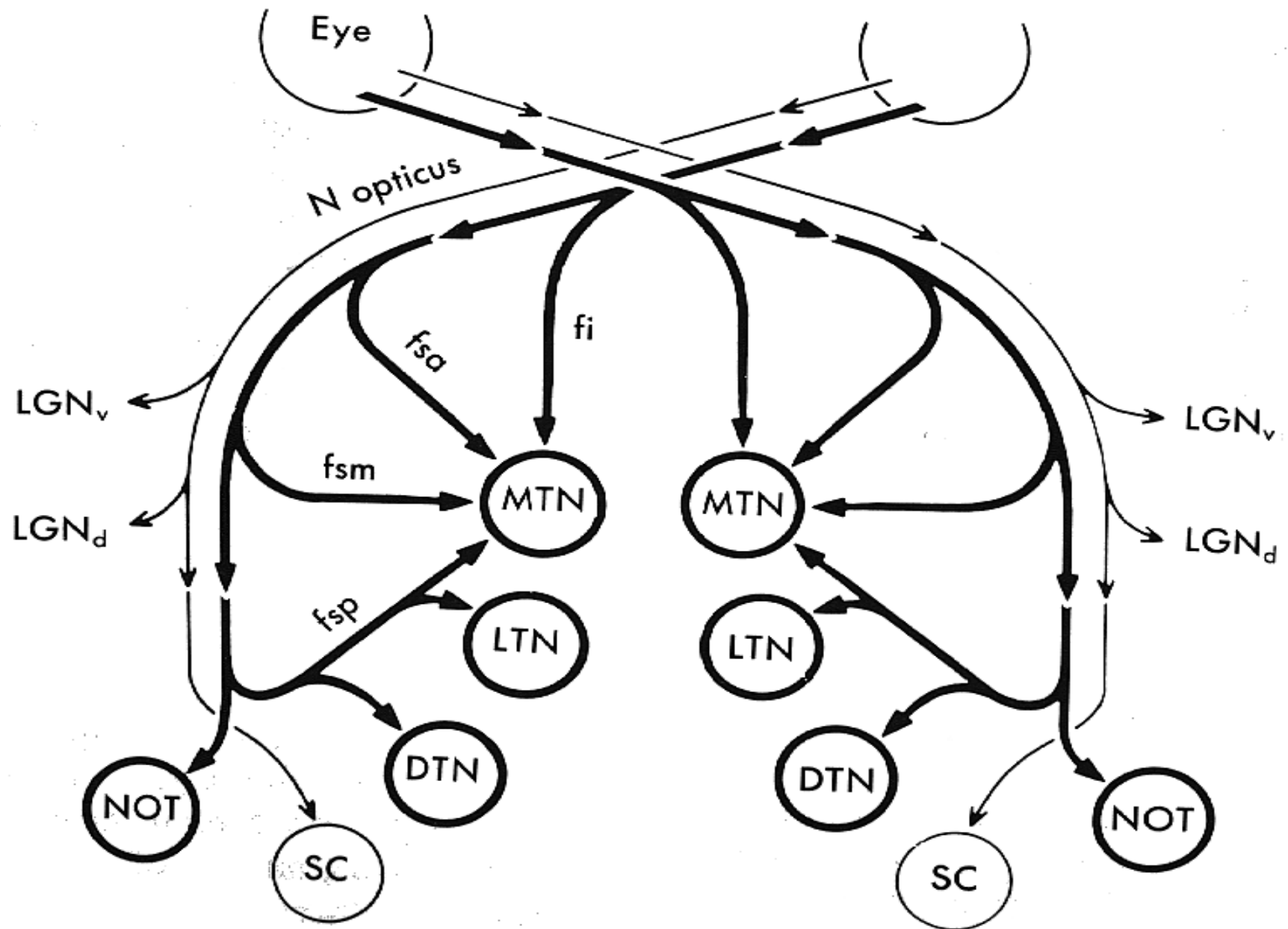
Oculomotor Neurons



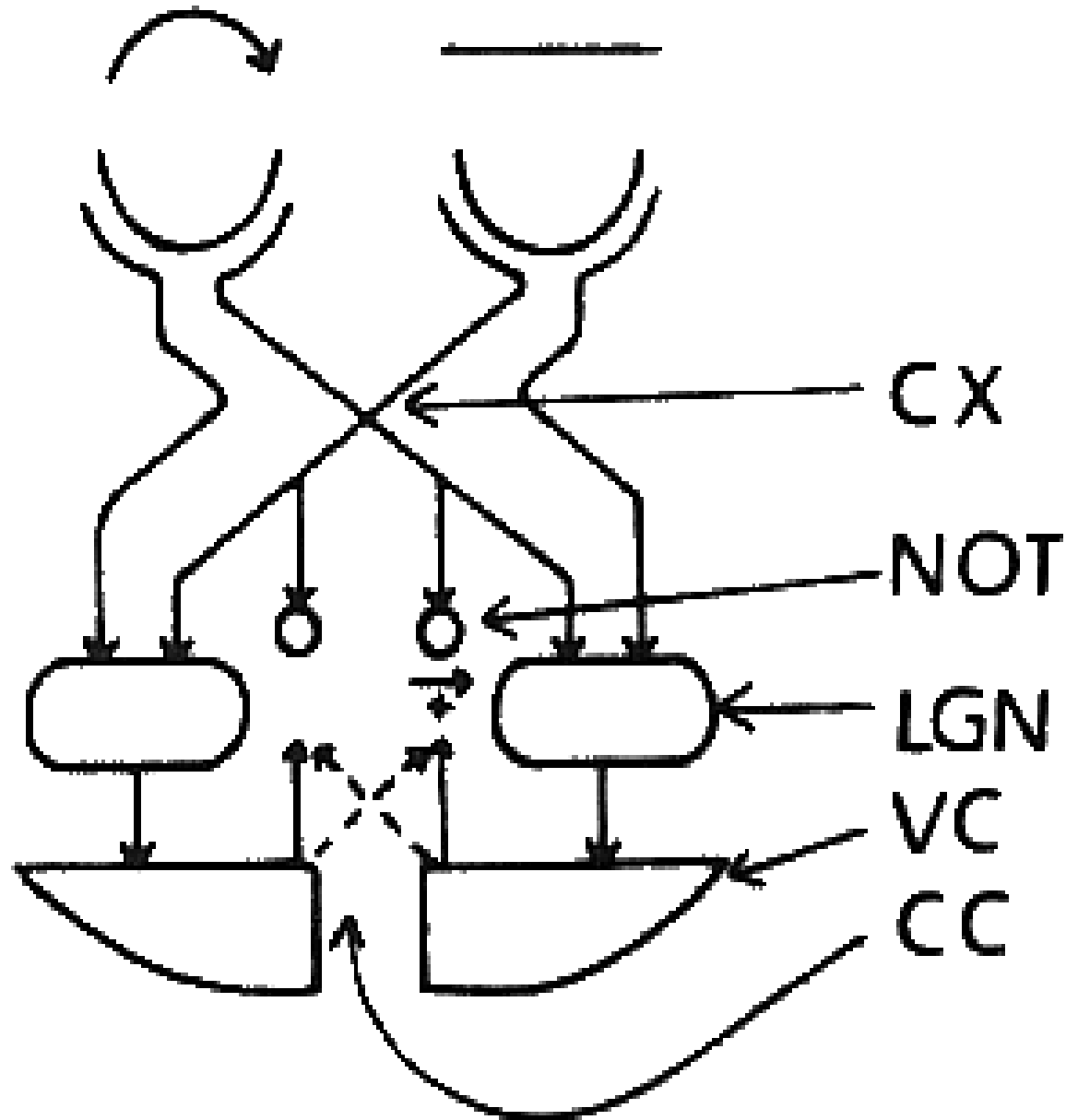
Extraocular Muscles



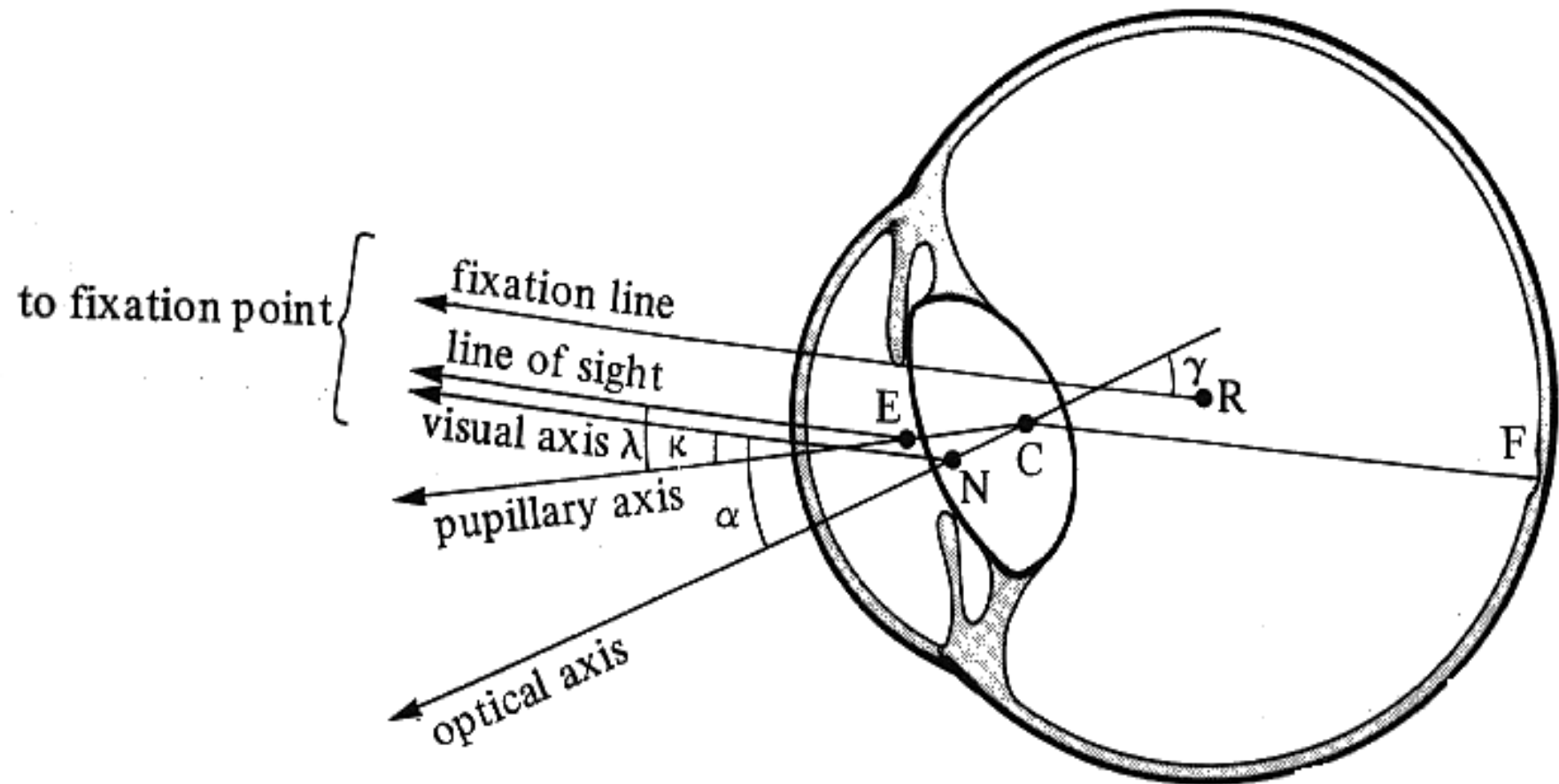
Accessory Optic Tract Nuclei



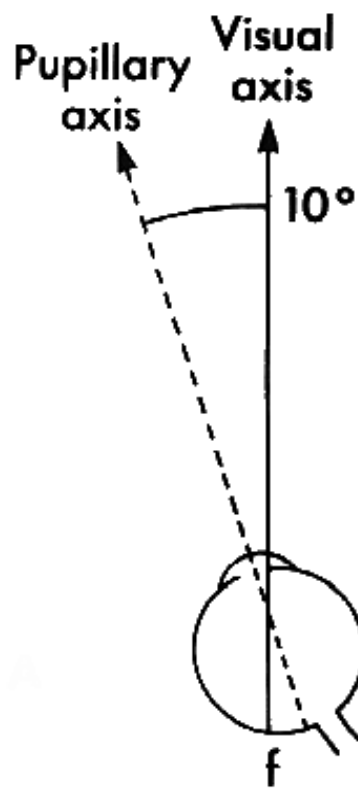
N Infants OKN Pathways



Visual Angles



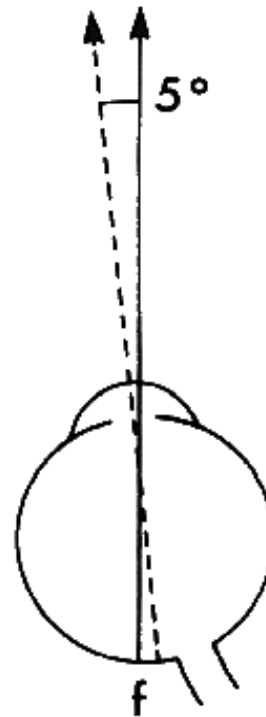
Angle Lambda (Kappa)



Neonate



Visual axis



Adult



Visual axis