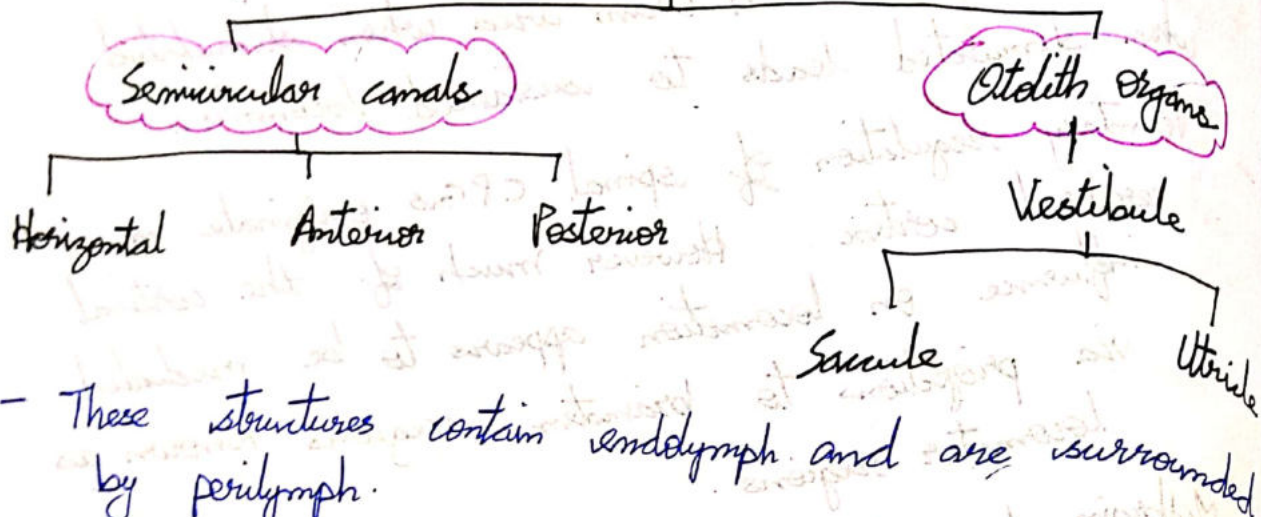


- Vestibular apparatus detects linear and angular acceleration.
- Signals from VA allow the body to make adjustments in body posture to maintain balance and trigger head and eye movt to maintain visual image on retina.

Vestibular Apparatus



- These structures contain endolymph and are surrounded by perilymph.
- The three semicircular canals on one side are matched with the corresponding coplamar canals on the other side of the head.

This arrangement allows the sensory epithelia in corres. pairs of canals on the two sides to cooperate in sensing acceleration of the head about three nearly orthogonal axes in space.

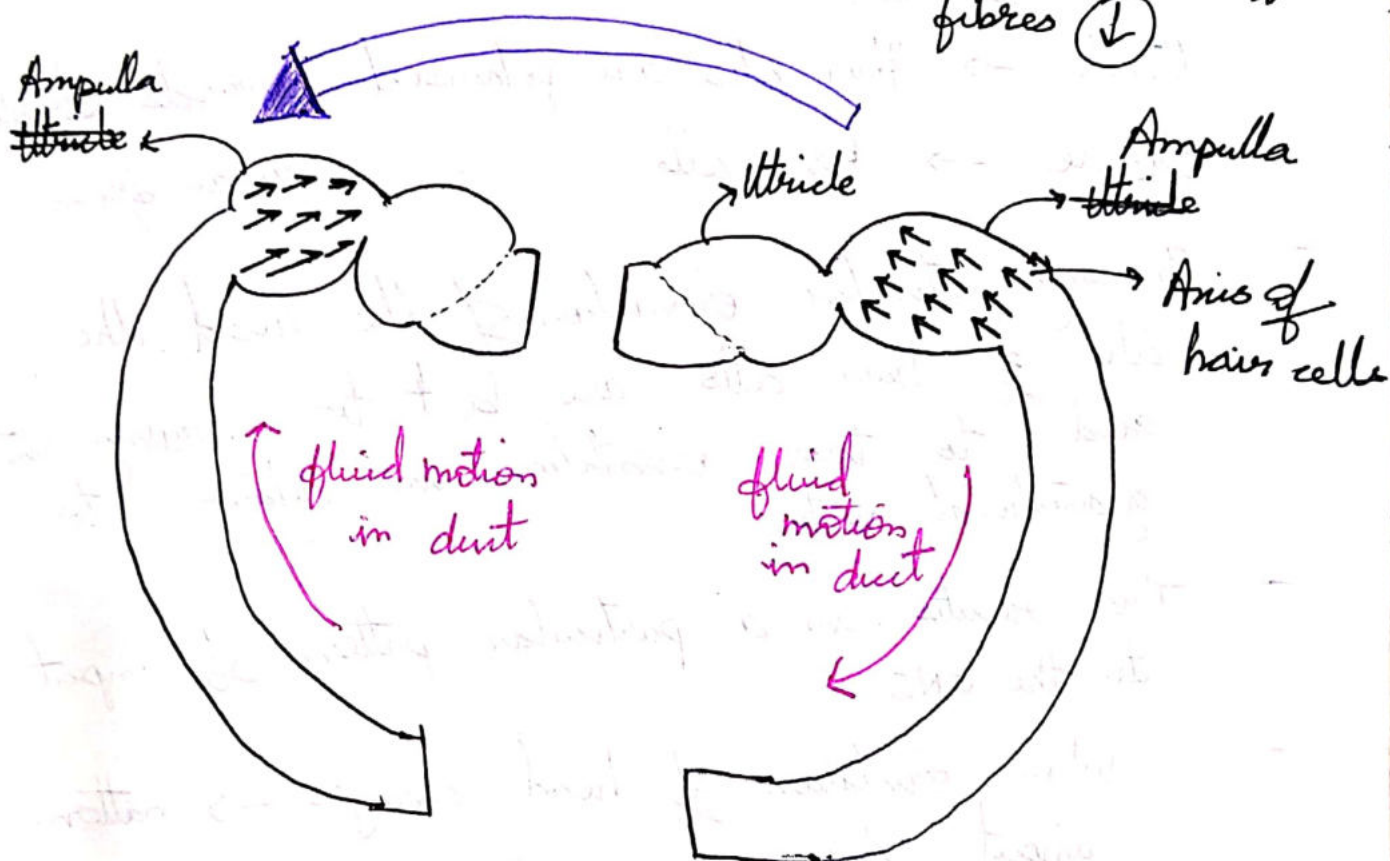
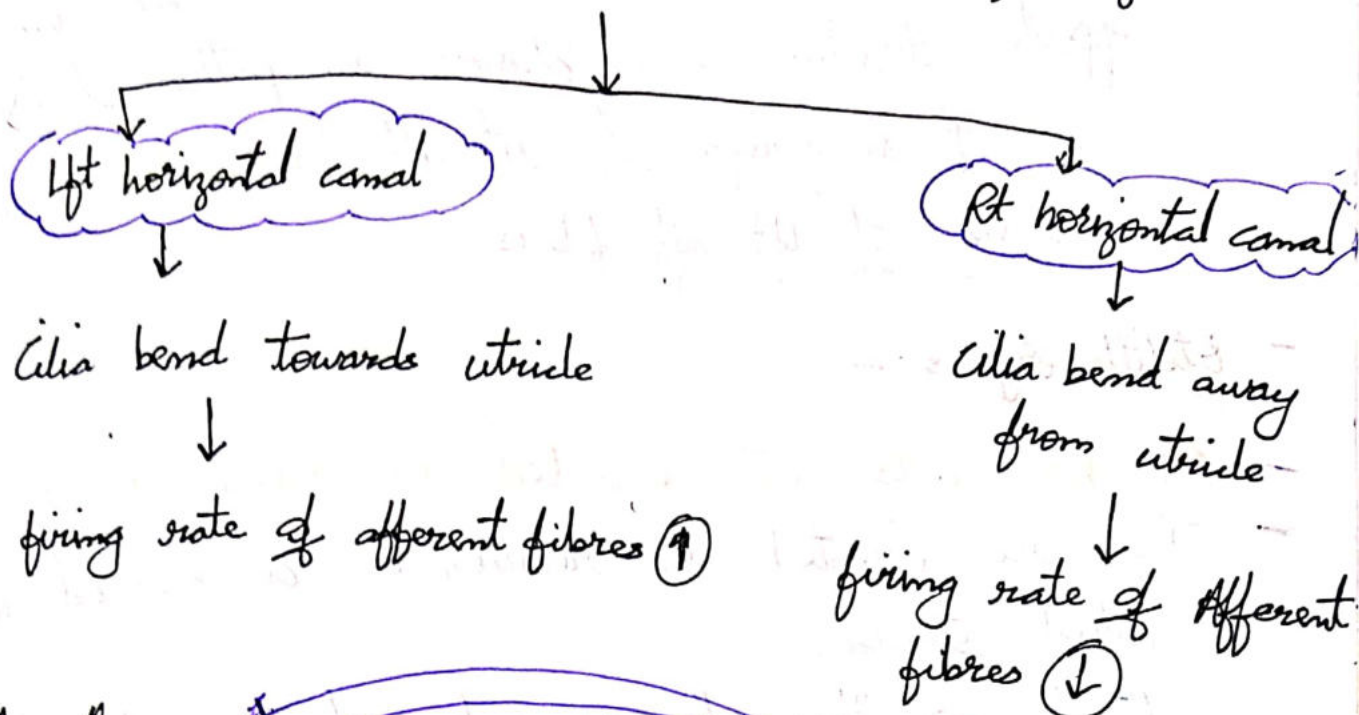
- The ampulla of canals - sensory epithelia - *Crista ampullaris*
Crista ampullaris - A ridge transverse to the long axis of the canal covered by epithelium consisting of vestibular hair cells.

The cilia are embedded in gelatinous substance called cupula - cupula + crista occlude the lumen of ampulla completely.

- The specific gravity of cupula & endolymph ~~is same~~ is the same. Hence only angular acceleration deflects the cupula and cilia - unaffected by linear acceleratory forces such as gravity.
- The sensory epithelia of otolith organs
 - Utricle - oriented Horizontal
 - Sacculae - oriented vertically
- The gelatinous mass in which cilia are embedded contains numerous otoliths ("ear stones") - calcium carbonate crystals - specific gravity twice that of endolymph
- gelatinous mass + otoliths - otolithic membrane.
- Otolithic membrane moves when subjected to both linear and angular acceleration.
- Vestibular hair cells are innervated by primary afferent fibres of Vestibular Nerve.
- The cell bodies of these 1^o afferents are located in Scarpa's ganglion - Neurons are bipolar.

- Endolymph - high $[K^+]$ Hair cells - functionally polarised.
- When stereocilia are bent towards the highest kinocilium conductance of the apical membrane increases for cations $\rightarrow K^+$ enters $\rightarrow$ vestibular hair cell depolarises.
When opposite occurs $\rightarrow$ hair cell hyperpolarised.
- The hair cells release an excitatory neurotransmitter [glutamate or aspartate] tonically so that afferent fibres on which it synapses has a resting discharge.
- When hair cell depolarises $\rightarrow$ release of neurotransmitter $\uparrow$ discharge rate of afferent fibre $\uparrow$.
- Semicircular canals :-
- Angular acceleration of head produces minute movements of endolymph.
- The inertia of endolymph resists the initial acceleration. This pushes the cupula $\rightarrow$ cilia bends $\rightarrow$ discharge rate of vestibular afferents changes.
- All the cilia in a given crista are oriented in the same direction.
- In the horizontal canal - cilia oriented towards utricle. Other canals - cilia oriented away from utricle.
- Let us take an example of horizontal canals to demonstrate how angular acceleration is detected.

Inertia of endolymph $\uparrow$ pressure towards right side as acceleration left begins



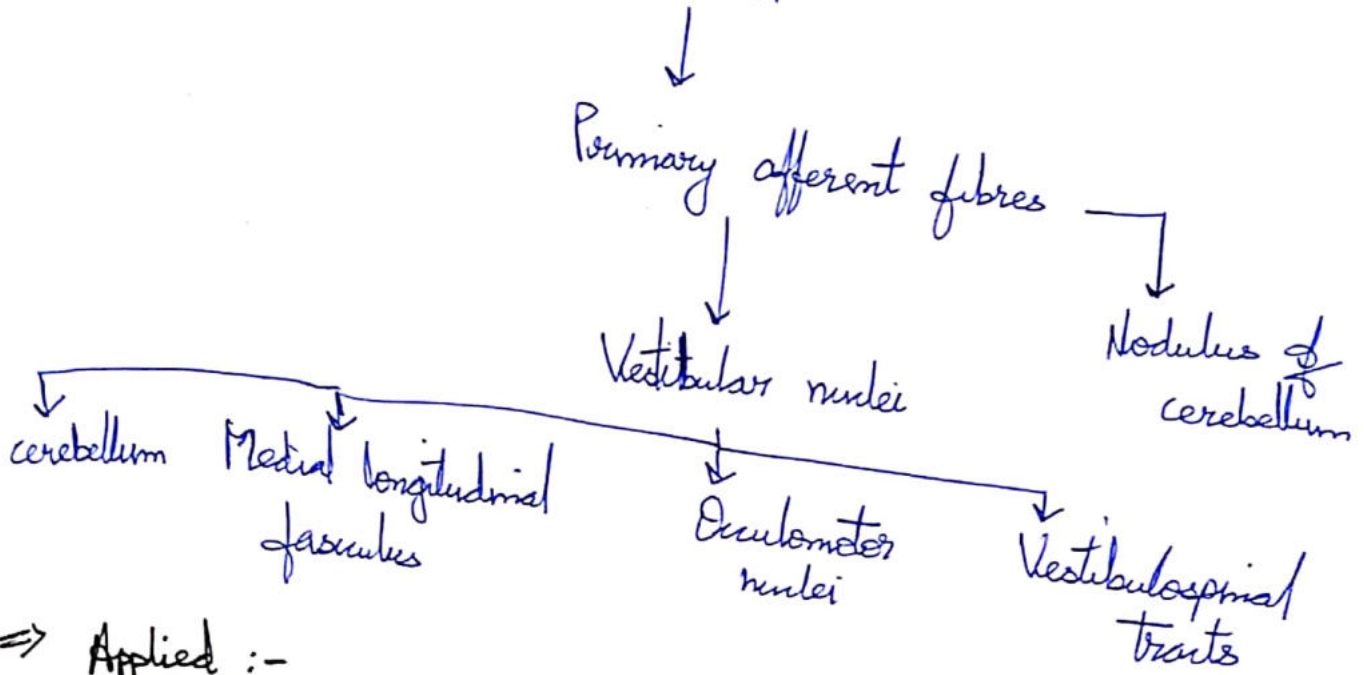
no acceleration $\rightarrow$ no force ~~on~~ on cupula.

- When the rotation stops $\rightarrow$ inertia of endolymph creates a force on both cupulas but in opposite direction $\rightarrow$ change in pattern of firing i.e. $\uparrow$ in firing of right afferent fibres & $\downarrow$ in firing of left afferent fibres.

Otolith organs:-

- All hair cells not oriented in same direction
- They are oriented in relation to a curved ridge called striola.
Utricule $\rightarrow$ Hair cells are polarised towards striola
Saccule $\rightarrow$ Hair cells " " away from "
- In any particular orientation of the head the cilia of hair cells are bent to varying extent and to their orientation in relation to gravitational vector.
- This results in a particular pattern of input to the CNS
- When orientation of head changes $\rightarrow$ pattern of input changes $\rightarrow$ sense of movement produced.

Vestibular Apparatus



⇒ Applied :-

Irritation of Membranous labyrinth → **Meniere's disease**
 Nystagmus
 Vertigo
 Nausea