ORGAN OF CORTI

The organ of Corti or spiral organ is a specialized sensory epithelium that allows for the transduction of sound vibrations into neural signals. The organ of Corti itself is located on the basilar membrane. The organ of Corti rests on the basilar membrane and contains two types of hair cells: inner hair cells and outer hair cells.

Inner hair cells, about 12,000 in total, transduce sound from vibrations to neural signals via the shearing action of their stereocilia. Outer hair cells serve a function as acoustic pre-amplifiers which improve frequency selectivity by allowing the organ of Corti to become attuned to specific frequencies, like those of speech or music. Outer hair cells (OHC) occur in three rows near the oval window, increasing to five rows near the apex of the cochlea. There is a single row of inner hair cells (IHC) of about 3500 cells in total. The latter have one linear array of short stereocilia, while OHC each have a curved row of longer stereocilia.

The tips of the tallest stereocilia of the OHC are embedded in the tectorial membrane, an acellular layer extending over the spiral organ from the modiolus . The tectorial membrane consists of fine bundles of collagen (types II, V, IX, and XI), associated proteoglycans and other proteins and is formed during the embryonic period from secretions of cells that come to line the adjacent region called the spiral limbus.



Both outer and inner hair cells have afferent and efferent nerve endings, with IHC much more heavily innervated. The cell bodies of the afferent bipolar neurons are located in a bony core of the modiolus and constitute the spiral ganglion.

Two major types of columnar supporting cells are associated with the hair cells of the spiral organ. **Pillar cells** are stiffened by bundles of keratin and outline a triangular, tunnel-like space between the outer and inner hair cells—another structure important in sound transduction. **Phalangeal cells** intimately surround and directly support both inner and outer hair cells, almost completely enclosing each IHC but only the basal ends of the OHC.



Stereocilia of cochlear hair cells detect movements of the spiral organ. Sound waves collected by the auricle of the external ear cause the tympanic membrane to vibrate, which causes movement of the ossicles in the middle ear. The large size of the tympanic membrane compared to the oval window and the mechanical properties of the ossicle chain connecting these two membranes allow for optimal transfer of energy between air and perilymph, from sound waves to vibrations of tissues and fluid-filled chambers.

MEDICAL APPLICATION

DEAFNESS

Deafness can result from many factors, which usually fall into two categories.

(1) Conductive hearing loss involves various problems in the middle ear which can reduce conduction of vibrations by the chain of ossicles from the tympanic membrane to the oval window. A common example is otosclerosis, in which scar-like lesions develop on the bony labyrinth near the stapes which inhibit its movement of the oval window. Infection of the middle ear (otitis media) is common in young children, usually progressing from an upper respiratory infection, and can reduce sound conduction due to fluid accumulation in that cavity.

(2) Sensorineural deafness can be congenital or acquired and due to defects in any structure or cell from the cochlea to auditory centers of the brain, but commonly involves loss of hair cells or nerve degeneration.