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A connection between dentine and hearing?

Sir, I have been struck recently by the similarities between the sensory mechanisms of the cochlea and those of dentine, and wondered if other *BDJ* readers had also noted this connection.

In most sensory receptors, a stimulus is directly coupled to impulse traffic. The hydrodynamic theory, widely accepted to be the explanation for dentine sensitivity, is clearly unique as it proposes that a stimulus at an exposed dentinal surface is indirectly coupled (via tubular fluid movement) to electrical activity within intradental nerves.

However a similar mechanism also exists within the ear. Evidence suggests that sound waves are channelled through the auditory canal of the outer ear to reach the tympanic membrane, which subsequently vibrates. These vibrations are conducted along the ear ossicles to cause the oval window of the cochlea to also vibrate.

Movement of the oval window causes fluid movement (of the perilymph) within the cochlea, which results in the basilar membrane oscillating. The Organ of Corti sits on the basilar membrane and contains hair cells, each with a set of steriocilia projecting from their upper surfaces.

The vibrational movement of the basilar membrane is conducted to the Organ of Corti and causes the steriocilia of the hair cells to oscillate. This causes mechanosensitive, non-selective ion channels within the steriocilia to open. Given that the surrounding endolymph contains a high concentration of potassium (K^+), it is thought that K^+ enters the hair cell and produces electrical activity.

Calcium ions also enter and trigger the release of a synaptic transmitter, which depolarises cochlear afferent neurones.

These fibres subsequently carry auditory information to the brainstem. Although the principles of hydrodynamic dentinal sensitivity appear different from those that underpin sensory transduction in the remainder of the peripheral nervous system, they are clearly not exclusive to the dental system.

For instance in both dentine and cochlear hair cells, an intermediate stage involving fluid movement is thought to indirectly couple a stimulus to impulse activity. Furthermore extracellular fluids rich in K^+ are involved in both cochlear and dentinal sensory transduction, which in itself is quite unusual as most extracellular fluids tend to have low concentrations of K^+.

Similarly, electrical activity in the cochlear and dentinal systems is initiated by an influx of K^+ through mechanosensitive ion-channels. Although such ion-channels are often involved in the generation of impulses, Na^+ tends to be the predominant ion that passes through the channel to initiate an action potential.

However, given the unique composition of the fluid surrounding cochlear hair cells and intradental neurones, the environment favours K^+ entry to initiate impulse activity.

I wonder if other colleagues have also considered these similarities? I am also led to ponder whether further advances are to be made in both hearing and dental physiology to the advantage of patient care.

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