The motion of the basalmost (high-frequency) end of the papilla increases near 5 kHz. This increase is largest for the basalmost 50 μm of the papilla, and decreases steadily to nothing over the next 100 μm. (2) Focal plane #2

ABSTRACT

Supported by NIH Research Grant R01-DC00238. D.M. Freeman was supported in part by the W.M. Keck Career Development Professorship. A.J. Aranyosi was supported in part by a training grant to the Harvard/MIT Speech and Hearing Sciences Program.

Mechanical Properties of the Basilar Papilla of Alligator Lizard
A.J. Aranyosi and Dennis M. Freeman

Massachusetts Institute of Technology
Massachusetts Eye and Ear Infirmary
Harvard/MIT Speech and Hearing Sciences Program

3-D IMAGING OF EXCISED PAPILLA

1. ACQUIRE 2D IMAGES AT MULTIPLE FOCAL PLANES
2. ASSEMBLE INTO 3D IMAGES
3. RESLICE 3-D IMAGES

PAPILLA MOTION VARIES WITH POSITION AND FREQUENCY

Motion varies with frequency and longitudinal position

- Lateral (x) position (μm)
- Longitudinal (y) position (μm)
- Transverse (z) position (μm)

Motions scaled by 5x relative to position

- Displacement peaks near 5 kHz
- Peak is largest at basal end
- Lateral (x) motion is similar on the neural and abneural sides
- Transverse (z) motion is larger on the abneural side
- Longitudinal (y) motion is small

Lateral Motion Lags Transverse Motion

ABNEURAL
NEURAL

Excitatory Stimulus Varies With Lateral Position

- Motion is largest for abneural hair bundles

Motion is similar on the neural and abneural sides

- Lateral variations in the excitatory component of motion do not account for 30 dB range of thresholds
- Increased papilla motion in the base near 5 kHz may increase the sensitivity of high-CF hair cells
- Phase lag of lateral relative to transverse motion resembles that of a second order low-pass filter
- Individual structures within the mammalian cochlea may also exhibit multiple modes of motion

Does the Basilar Papilla Simply Rotate?

In models, basilar papilla motion is simple rotation. In measurements more complex motions have been seen. How does the basilar papilla move? Does papilla motion account for limitations of models? A 30 dB range of thresholds. "Extra" low-pass filter needed in models.

Does the Basilar Papilla Exhibit Multiple Modes of Motion?

Multiple modes of motion play a role in most models of cochlear mechanics. Does the alligator lizard cochlea have multiple modes of motion? Are these modes important for hearing?