Medical Xpress

Discovery of hair-cell roots suggests the brain modulates sound sensitivity

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The hair cells of the inner ear have a previously unknown "root" extension that may allow them to communicate with nerve cells and the brain to regulate sensitivity to sound vibrations and head position, researchers at the University of Illinois at Chicago College of Medicine have discovered. Their finding is reported online in advance of print in the *Proceedings of the National Academy of Sciences*.

The hair-like structures, called stereocilia, are fairly rigid and are interlinked at their tops by structures called tip-links.

When you move your head, or when a sound vibration enters your ear, motion of fluid in the ear causes the tip-links to get displaced and stretched, opening up ion channels and exciting the cell, which can then relay information to the brain, says Anna Lysakowski, professor of anatomy and cell biology at the UIC College of Medicine and principal investigator on the study.

The stereocilia are rooted in a gel-like cuticle on the top of the cell that is believed to act as a rigid platform, helping the hairs return to their resting position.

Lysakowski and her colleagues were interested in a part of the cell called the striated organelle, which lies underneath this cuticle plate and is believed to be responsible for its stability. Using a high-voltage electron microscope at the National Center for Microscopy and Imaging Research at the University of California, San Diego, Florin Vranceanu, a recent doctoral student in Lysakowski's UIC lab and first author of the paper, was able to construct a composite picture of the entire top section of the hair cell.

"When I saw the pictures, I was amazed," said Lysakowski.

Textbooks, she said, describe the roots of the stereocilia ending in the cuticular plate. But the new pictures showed that the roots continue through, make a sharp 110-degree angle, and extend all the way to the membrane at the opposite side of the cell, where they connect with the striated organelle.

For Lysakowski, this suggested a new way to envision how hair cells work. Just as the brain adjusts the sensitivity of retinal cells in the eye to light, it may also modulate the sensitivity of hair cells in the inner ear to sound and head position.

When the eye detects light, there is feedback from the brain to the eye. "If it's too bright the brain can say, okay, I'll detect less light -- or, it's not bright enough, let me detect more," Lysakowski said.

With the striated organelle connecting the rootlets to the cell membrane, it creates the possibility of feedback from the cell to the very detectors that detect motion. Feedback from the brain could alter the tension on the rootlets and their sensitivity to stimuli. The striated organelle may also tip the whole cuticular plate at once to modulate the entire process.

"This may revolutionize the way we think about the hair cells in the inner ear," Lysakowski said.

Provided by University of Illinois at Chicago