New findings on the workings of the inner ear

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The sensory cells of the inner ear have tiny hairs called stereocilia that play a critical part in hearing. It has long been known that these stereocilia move sideways back and forth in a wave-like motion when stimulated by a sound wave. After having designed a microscope to observe these movements, a research team at Karolinska Institutet in Sweden has discovered that the hairs not only move sideways but also change in length.

The discovery, which was made in collaboration with scientists at Baylor College of Medicine in Texas, USA provides new fundamental knowledge about the mechanisms of hearing. It is presented in the online scientific journal *Nature Communications*.

Before we can perceive speech, music and other sounds, the sound waves must be converted into electric impulses in the auditory nerve, a process mediated by the sensory cells of the inner ear. Previous studies revealed that sound causes a lateral movement of the tiny hairs that project from these cells that opens and closes mechanically sensitive ion channels to create the sensation of hearing.

It is impossible the study the movement of the human cilia because the sensory cells are deeply embedded in thick bone, but in guinea pigs and gerbils the inner ear is surrounded by thin bone. Using a special in-house designed microscope, the scientists have been able to observe the sound-induced ciliary motion.

"This revealed something surprising – that the hairs not only bend sideways but also change in length," says Dr Anders Fridberger, docent and physician at the Centre for Hearing and Communication Research at Karolinska Institutet's Department of Clinical Science, Intervention and Technology. "These longitudinal changes have an important effect on the process of converting sound waves into electrical signals, which is necessary for hearing."

The scientists show that the stereocilia's ability to change length was greater when the electric potential around the sensory cells was low, which is known to happen in connection with noise damage and age-related hearing loss. The voltage drop causes the hairs to become overly soft, thus impairing ear function.

"Our findings might possibly help us understand why the ear doesn't work as well in such cases," says Dr Fridberger. "And maybe one day they can be put to use in the development of a new treatment for impaired hearing. If we can use a drug to restore the cilia's normal stiffness we could make the ear work better, but this is something for the distant future, if it is even possible. What we must do now is to discover the exact mechanism that controls ciliary stiffness."

More information: 'Sound-induced length changes in outer hair cell stereocilia', Pierre Hakizimana, William E. Brownell, Stefan Jacob och Anders Fridberger. *Nature Communications*, online 2 October 2012, doi: 10.1038/ncomms2100

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