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How Cochlear Implants Help Restore Hearing

December 2, 2005

(The New York Times News Service) -- Scientists say they've discovered why the electronic hearing devices called cochlear implants restore hearing for some, but not others.

It's a finding that could help reopen the world of sound for many deaf people.

"We think we have identified the main bottleneck for input in the auditory system," says David K. Ryugo, a professor of otolaryngology and neuroscience at Johns Hopkins University.

That bottleneck is a structure called the "endbulb of Held," which contains a large number of synapses: points where signals pass from one auditory nerve cell to another.

The Hopkins researchers made their discovery by outfitting congenitally deaf cats with cochlear implants and transmitting electrical impulses through the implants for three months.

Then they compared the nerves in the endbulb of Held in normal cats, the implanted cats and congenitally deaf cats that did not get implants.

"In stimulated deaf cats, endbulb synapses resembled those from normal-hearing cats," the researchers wrote. "If these cats had not received such treatment, their synapses would have remained pathologic."

The study explains why human cochlear implants don't always work, Ryugo says. "There is a window of opportunity with congenital deafness, and the window shuts just before puberty," he says. "Now we have an idea of what goes wrong to prevent the use of cochlear implants after puberty."

But it's an early idea, Ryugo says. "We're a long way off from being able to fix these synapses with drugs or other treatments, but at least we've identified the target," he notes.

The next phase of research will be "to go in and identify which molecules change," Ryugo says. "Once we know the molecular nature of the players, we can start to think about how to modify

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them."

The potential impact is great, Ryugo says.

"What we know is that about 5 million Americans are candidates for cochlear implants," he says. "They are bilaterally deaf. If you yell in their ear, they don't hear you. About 200,000 cochlear implants have been made worldwide, so there is a tremendous discrepancy between who needs them, and who has them. There are many people who could benefit if we had a way of fixing synapses."

The findings appear in the Dec. 2 issue of Science.

To Thomas N. Parks, a professor of otolaryngology and neuroscience at the University of Utah, the study "does really provide another justification for implanting children with cochlear implants."

The study also emphasizes the importance of the endbulb of Held, Parks says. "It is very important in speech perception and sound localization -- the two greatest problems in hearing loss," he says. "Having this circuit intact and functioning seems to be important for the higher levels of auditory function. This study shows that a device that has relatively few risks can preserve these synapses."

What's more, the study points to the value of extended use of the implants, Parks says. "It offers the potential that implants put into children would preserve the structural features of the sound system that could lead to a better long-term outcome," he says.

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