Medical Xpress

Study: Second cochlear implant can restore two important facets of binaural hearing

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(PhysOrg.com) -- Cochlear implants are electronic devices that stimulate auditory nerves directly, bypassing damage in the inner ear, and thus restoring some hearing. Although cochlear implants have revolutionized the treatment of deafness, many users have trouble understanding speech, particularly in crowds.

That prevents implants from fulfilling their primary task: breaking the isolation that can accompany deafness.

Scientists who are studying implants have found that two implants are better than one, and a key to that improvement comes from the ability to detect the source of the sound.

In a study published this week in the Journal of the Acoustical Society of America, Ruth Litovsky, an associate professor of communicative disorders and director of the binaural hearing and speech lab at the Waisman Center at the University of Wisconsin-Madison, showed that deaf adults with two cochlear implants regained some ability to localize sound.

Some of the 11 adults she studied had been deaf since early childhood.

Hearing people use subtle differences in the intensity and timing of the vibrations reaching their ears to identify where a sound is coming from. This "binaural" hearing has obvious benefits for personal safety. But because it also helps to focus our attention on a speaker in a noisy room, binaural hearing is critical to social relationships.

In the study, Litovsky found that adults with two implants, even those who had been deaf since early childhood, could detect differences in sound intensity. Adults who had lost their hearing as older children or adults could also detect subtle differences in the timing of sound arrival at the two ears. "This paper shows that people who have been deaf for decades can retain sensitivity to important binaural cues," Litovsky says, "especially if they had normal hearing before becoming deaf."

Even though the study is more proof that cochlear implants can help after decades of deafness, adults who had a longer experience with hearing were substantially better at locating the source of a sound. Like many neural systems, "use it or lose it" applies to auditory systems, Litovsky says. Auditory nerves degenerate if they are not stimulated.

When cochlear implants were first introduced about a decade ago, adults or older children often received a single implant, Litovsky says. Now, the trend is to implant two devices at a much earlier age. Both measures are consistently tied to better outcomes.

Although both timing and intensity help us find the source of a sound, timing seems more important. Yet Litovsky finds commercial implants a bit sloppy in their timing. "Differences in timing between the two ears are calculated in the brain stem, where the neurons expect the information to be highly synchronized, but current implant processors are not designed to be synched. You might think a few millionths of a second would not matter, but the brain doesn't deal well with 'wrong' time differences."

The study used research processors, made by Litovsky's collaborator, Richard van Hoesel of the Bionic Ear Institute in Melbourne, Australia, to deliver electrical impulses to the auditory nerve with more accurate timing.

Because some of the adults in the study could locate the source of sound even after decades of deafness, commercial implants with better timing could improve the ability to localize sound. "These people have retained the ability to perceive the microsecond difference in timing between the two ears, but current implants are not giving them that information," says Litovsky.

And because localizing sound is critical to the ability to focus on one speaker among many, future implants may reduce social isolation even more effectively, Litovsky says. "Using these research processors, our study participants could distinguish location; the circuits in the brain have retained that ability. That gives me hope that if we can build this type of processor into commercial implants, implant users can function more like hearing people."

Litovsky, who has spent years studying the effectiveness of cochlear implants, recently was awarded a $2.9 million grant from the National Institutes of Health to study how the brain changes when hearing is restored through two implants.

Among brain researchers, it's axiomatic that treating at a younger age or sooner after the loss of hearing will produce better results, but the current study shows that the brain can learn to interpret sensations after decades of silence. "Even people who are deaf from birth and implanted as adults can have access to some binaural hearing," says Litovsky.

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