Sizing up implants that banish the silence

"To be deaf is a greater affliction than to be blind." With those words Helen Keller, who was both deaf and blind, articulated the isolation that engulfs a person who has lost the ability to hear. For some profoundly deaf people, however, cochlear implants can pierce the silence.

Unlike hearing aids, which merely amplify sound, these implants transduce sound into electrical signals and deliver that message to the nerve cells near the cochlea, the spiral-shaped part of the inner ear. Thus cochlear implants can help deaf people who do not benefit from a hearing aid.

Yet, when it comes to picking the best implant for a particular patient, doctors had been reduced to a guessing game. A new study shows that a certain type of cochlear implant provides superior benefits for most profoundly deaf people.

There are two main types of cochlear implants. Multichannel devices rely on more than one electrode to stimulate discrete areas of the inner ear; single-channel implants employ just one electrode to send messages to all parts of the cochlea at once. Noel L. Cohen and Susan B. Waltzman of the New York University School of Medicine in New York City and their colleagues at seven Department of Veterans Affairs hospitals wanted to evaluate the efficacy of single-channel and multichannel cochlear implants.

They recruited 80 profoundly deaf people, all of whom had lost their hearing as adults. The team gave all recruits a battery of sophisticated hearing tests at the start of the study. Then the researchers randomly assigned the participants to receive one of three brands of implants. Patients underwent an operation to implant the electrode part of their assigned device. After surgery, the recruits wore a headset that acts as a microphone and carried a portable sound processor about the size of a cigarette pack. At various points after the procedure, the researchers gave all participants the same hearing tests and noted any improvement.

The team discovered that all recruits could hear some sounds with their implants. However, people who received the multichannel implants proved more likely to experience significant improvement than those who got the single-channel model. Of the people who got the multichannel devices, 19 of 30 (63 percent) who got one model and 18 of 30 (60 percent) who received a second model could distinguish some words and sentences. By contrast, just one of 20 patients (5 percent) who got the single-channel model could do the same. The team reports its findings in the Jan. 28 New England Journal of Medicine.

People who gained the most from the implants went from nearly complete deafness to an ability to hear people talking on the telephone, a situation in which deaf people cannot get any visual cues by reading lips, notes coauthor Susan G. Fisher of the Hines (Ill.) Veterans Affairs Medical Center. In most cases, recruits with implants could pick up a few words and use that information to supplement their lip-reading skills, she says.

This is the first prospective, randomized trial of cochlear implants, notes Thomas Balkany of the University of Miami (Fla.) School of Medicine. Such trials provide more reliable information than retrospective trials, which study old medical charts to see how hearing ability changed after a patient received an implant, he notes.

Despite the promise offered by cochlear implants, they do not provide people with a complete solution to hearing loss. "Caution in interpreting these findings is prudent in view of the wide range of results among patients," Balkany writes in an editorial that accompanies the study. "Even when improvement is substantial, patients' ability to hear does not approximate that of normal subjects."

The study doesn't address the social issue raised by cochlear implants, Balkany adds. Some deaf people object to the use of such implants, arguing that deafness is a way of life and not a disability.

– K.A. Fackelmann

Getting lead atoms into carbon nanotubes

A year ago, stuffing a buckytube with atoms to make an ultrathin wire seemed a highly speculative proposition. Now researchers have found that these microscopic, sealed carbon tubes, when heated in the presence of lead, can open up to suck in molten material.

"The nanotubes thus act as molds for the fabrication of . . . wires, some of which are less than 2 nanometers in diameter," P.M. Ajayan and Sumio Iijima of the NEC Fundamental Research Laboratory in Tsukuba, Japan, report in the Jan. 28 Nature.

This advance follows in rapid succession Iijima's discovery of buckytubes in 1991 (SN: 11/16/91, p.310), the finding by his colleagues at NEC of a method for mass-producing these layered tubules (SN: 7/18/92, p.36), and the computer simulation-based prediction by Jeremy Q. Broughton and Mark R. Pederson of the Naval Research Laboratory in Washington, D.C., that these cylindrical, all-carbon molecules would act as molecular drinking straws (SN: 11/14/92, p.327).

"It's nice corroboration, so I'm rather excited by it," Broughton says. "I think it's just the beginning of a whole new technology."

Ajayan and Iijima proceeded by depositing lead particles, from 1 to 15 nanometers in diameter, on the surfaces of carbon tubules. Then they heated the samples in air for about 30 minutes, keeping the temperature constant at approximately 400°C, which is above lead's melting point.

The researchers discovered that after the heating step, a small fraction of the tubes contained solid material. They also observed that the ends of the partially filled carbon tubes – originally capped – were now open. However, when the samples were heated in a vacuum instead of in air, tube tips remained closed and little filling occurred.

"This suggests that opening of the tips involves a chemical reaction between the metal, oxygen, and the carbon that makes up the tubes," the researchers note. "The outer and capped portions of the inner tubes are apparently attacked and destroyed during the heating in air, following which molten material is drawn inside by strong capillary forces."

"Clearly, it's a very delicate thing, because the lead is able to eat away the endcaps but not the rest of the tubes," Broughton says.

Rodney S. Ruoff and his colleagues at SRI International in Menlo Park, Calif., also have been studying the possibility of introducing various elements into nanotubes. They plan to take a closer look at the effect of oxygen on the reactivity of tube ends. "This could allow preferential etching of the ends to make nanostraws," Ruoff says.

The NEC researchers are as yet unsure whether the filling itself is pure lead or a solid compound formed by the reaction of lead with carbon and oxygen. Moreover, "the solidification of molten material in such constrained geometries could conceivably be very different from that in the bulk, and new phases might be formed," they say.

Meanwhile, physicists Jae-Yel Yi and Jerzy Bernholc of North Carolina State University in Raleigh used a supercomputer simulation to show that boron or nitrogen atoms can be inserted directly into the carbon-atom sheets that make up buckytube walls. This finding suggests that buckytubes can be engineered to have certain characteristics, much as the addition of trace amounts of various elements to a semiconductor alters its electrical properties. Yi and Bernholc report their results in the Jan. 15 Physical Review B.

However, the step from partially filled buckytubes to "quantum" wires so narrow that electrons must, in effect, pass down them in single file remains a large one. To start with, researchers have to deal with such problems as the lack of uniformity in buckytube sizes and the potential difficulty of separating filled from empty tubes.

– I. Peterson