Symptom: Declining Cochlear Implant Performance

By Hamid R. Djalilian, MD

The parents of an 8-year-old patient call the office about their son's cochlear implant (CI), reporting decreased performance.

The child was born with moderately severe hearing loss and was binaurally aided at 6 months of age. His speech developed, but, when he was about 5, that development plateaued.

After some workup and reprogramming of his hearing aids, the patient underwent cochlear implantation on the left side at age 6. His speech and performance on auditory tasks improved significantly over the next 18 months.

Over the last six months, however, performance again plateaued. A CT scan is performed; the image is shown on the right.

What is your diagnosis? See p. 14.

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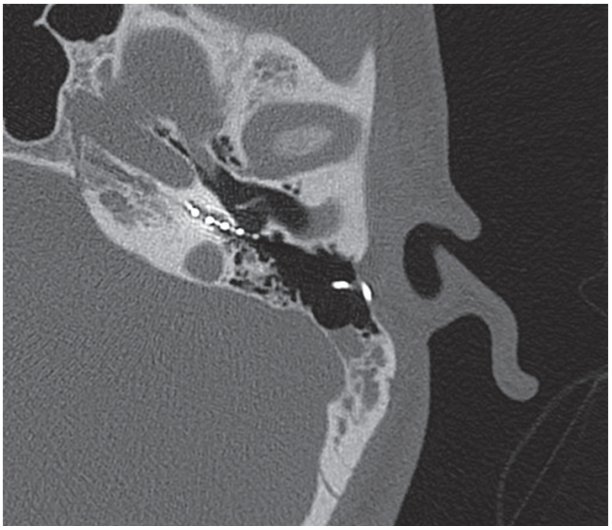

In this axial CT image of our patient's left cochlea, two electrodes can be seen outside the basal turn.

Diagnosis: Cochlear Implant Electrode Migration

By Hamid R. Djalilian, MD

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Currently, cochlear implants are approved by the Food and Drug Administration (FDA) for adults who have severe hearing loss and speech recognition scores on the Hearing in Noise Test (HINT) with appropriately fitted hearing aids of 50 percent or less in the ear to be implanted and 60 percent or less in the opposite ear.

For children, the criterion is a score of 30 percent or less on age-appropriate speech recognition testing or lack of auditory progress.

Recently, the FDA's Ear, Nose, and Throat Devices Panel of the Medical Devices Advisory Committee recommended approval of a hybrid cochlear implant that stimulates high-frequency regions for patients who have very poor high-frequency hearing and moderate or better low-frequency hearing.

A hybrid cochlear implant enables recipients to use the device for their high-frequency hearing and a hearing aid for low-frequency hearing.

PERFORMANCE INDICATORS

How well a cochlear implant performs primarily rests on three factors: the number of surviving spiral ganglion cells, the brain's plasticity and ability to acquire language, and the rehabilitation undertaken.

The longer the duration of auditory deprivation, the lower the number of spiral ganglion cells, and, therefore, the poorer the performance. Certain etiologies of deafness, such as meningitis or inner ear anomaly, also are associated with a lower count of spiral ganglion cells.

> Initial workup of a patient with declining performance in a cochlear implant includes remapping the electrodes and checking the integrity of each.

Postlingually deafened patients generally have a faster return to speech understanding, but prelingually deafened patients require long-term auditory/speech rehabilitation to reach the same level. Children who attend sign language-only schools rarely acquire speech, while those in an aural/oral school most likely do.

Although most factors associated with postoperative cochlear implant performance are patient related, a decline after good initial performance is usually because of the implant itself.

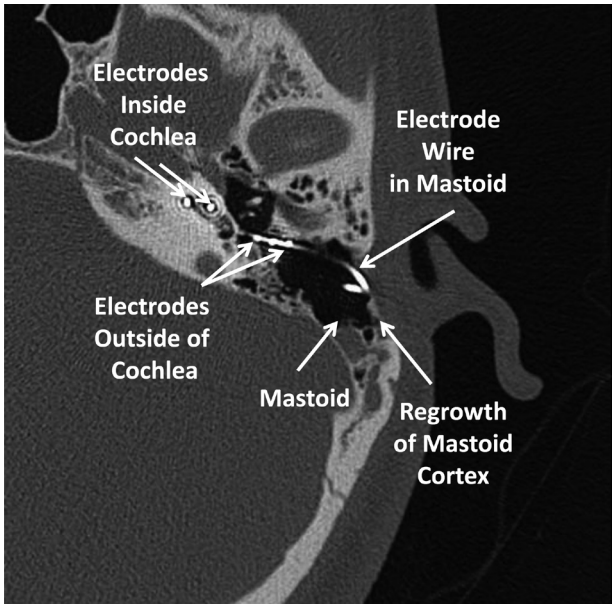

Figure 1. *This axial CT image of the left cochlea shows three of the electrodes that are outside the cochlea. A few electrode contact points are visible inside the cochlea. Mastoid cortex regrowth (white line) can be seen with the wire in the mastoid.*

This deterioration could be due to a loss of electrode function, an open electrode, a shorted electrode, or migration of the electrode.

Bony growth within the cochlea (labyrinthine ossification) is another possible cause. Such growth can occur after a reaction to the electrode, which can result from prior meningitis or traumatic insertion of the electrode, with bone dust or blood entering the cochlea.

PINPOINTING THE CAUSE

Initial workup of a patient with declining performance in a cochlear implant includes remapping the electrodes and checking the integrity of each. Sometimes, assistance from the implant manufacturer is necessary to do higher-level testing of the device.

If no causes are found, an x-ray or CT scan of the temporal bones is performed to check for the position of the electrode.

In this patient, testing showed that the four basal electrodes did not cause stimulation of the spiral ganglion cells. As a result, a CT scan of the temporal bones was obtained.

In the CT scan, four electrodes were outside the cochlea. *Figure 1* shows three of these four electrodes.

A review of the operative report indicated that two electrodes were initially outside the cochlea because of an incomplete cochlear partition, which causes a shortened cochlea (*see Figure 2*).

This finding meant that, over time, two other electrodes had migrated out of the cochlea, most likely due to bony regrowth of the mastoid cortex. The bony regrowth had pulled the looped wire out of the mastoid, causing the electrode tip to migrate out of the cochlea by a few millimeters.

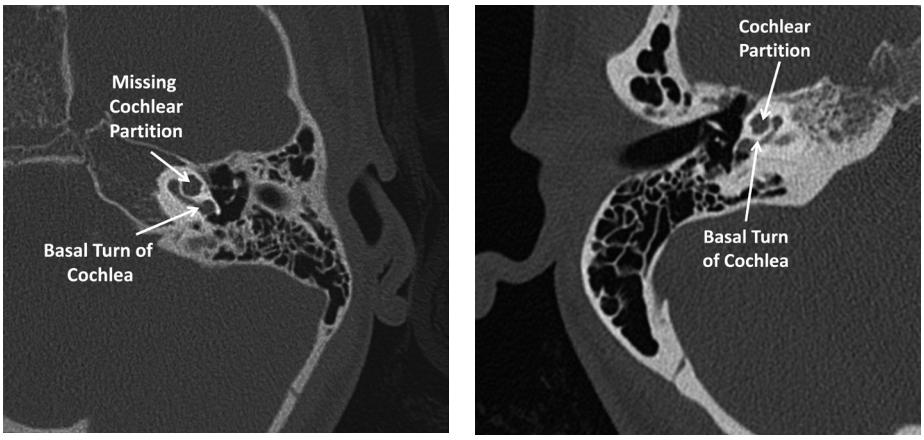

Figure 2. *Left: The axial CT image of the left temporal bone shows the incomplete partition between the second and third turn of the cochlea. Right: The axial CT image of the right cochlea shows the cochlear partition between the second and third turn of the cochlea (faint white line).*

PERFORMING THE SURGERY

A few points have to be taken into account when performing a revision cochlear implant surgery.

Most importantly, unipolar cautery, which is used to control bleeding, should not be employed in revision cochlear implant surgery. Electrocautery in a monopolar fashion can lead to a high degree of electric discharge within the cochlea, causing loss of spiral ganglion cells.

Also, most of the work in revision surgery is conducted to free the device. As a last step, the electrode is pulled out and replaced immediately with the new electrode.

Pulling the electrode out early can cause a collapse of the fibrous tunnel within which the electrode lies, making the insertion of the second implant very difficult.

Depending on the cochlear anatomy, a shorter electrode may be chosen if the initial electrode did not fit within the cochlea. In this patient, a 24-mm electrode was placed instead of the initial 30-mm electrode.