Complex Cochlear Implant Cases

MANAGEMENT AND TROUBLESHOOTING

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Contents

Preface

In the pursuit of a graduate level degree in audiology, coursework related to cochlear implants is typically limited. As a result, many audiologists practicing in the realm of cochlear implants learn on the job, while not knowing best practices or proper methods for treating their patients. If the appropriate procedures were followed, the possibility of improved outcomes, the prevention of mapping errors, and overall increase in quality of life might be realized. Our program regularly receives emails, phone calls, and messages on various social media platforms from all around the world regarding how to properly manage different cases, whether or not a patient is a candidate for a cochlear implant, or how to troubleshoot a difficult situation. In responding with as much detail as possible, we realized there has never been a textbook focused on case studies pertaining to issues in mapping because of various medical conditions, equipment issues, improper programming, lack of objective methods, and more. This applies to both pediatric and adult cases.

The more that clinics add cochlear implant services without properly trained cochlear implant audiologists, the possibility of improper practice will continue to exist. No matter the level of confidence felt in the pursuit of mastery in cochlear implants, it is important to keep an open mind and continue to learn. When a clinician ceases the desire to acquire new concepts and ideas, both patients and clinician regress in ability. It is the hope of our team that this book may be used as a reference to help solve various cases that may otherwise go unresolved, or provide ideas to help troubleshoot others.

The case studies cited are adapted from actual clinical interactions with cochlear implant recipients, candidates, and the counseling of the parties involved. Although a general template was followed for each case, all contributing authors were encouraged to tell the story of each case in their own way, while being informative and detailed about the issues and their resolution. Because of this variability, the reader may notice a shift in the focus of audience from case to case. This is not intended to confuse the reader but rather to appeal to all levels of experience in working with cochlear implants, from graduate students to advanced clinicians. It also may lead to a slight variability in the overall structure of each case.

This book was created not as a way to fix every case but to give audiologists programming cochlear implants instances that may relate to a complex patient they are currently seeing, and possibly provide ideas of how to solve their issues. The contributing authors are all experienced, well-regarded, and established clinicians working in high volume cochlear implant centers, including many providing services in teaching at university hospital clinic settings.

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CHAPTER 1

Role of Middle Ear Status in Cochlear Implant Programming

Jordan Alyse Coffelt and Sarah E. Warren

CLINICAL HISTORY AND PRESENTATION

This case describes a 58-year-old male with a long-standing bilateral severe-to-profound hearing loss. He had a history of familial hearing loss and significant noise exposure including several incidences of high level impulse sounds related to his career in law enforcement. He used hearing aids for approximately 15 years prior to implantation and reported a gradual decline in benefit from traditional amplification. Otologic history included chronic otitis media in the right ear beginning in his mid-40s. The patient reported a traumatic perforation of the right tympanic membrane around age 50, that resulted from falling off a boat and into water. The perforation required surgical treatment with a tympanoplasty. A right pressure equalization (PE) tube was placed several years later due to continued chronic middle ear dysfunction. At the time of the cochlear implant candidacy evaluation, the patient's right PE tube was no longer in the tympanic membrane and a pinpoint perforation was noted centrally. The patient denied otologic problems and surgeries for the left ear. The patient was found to meet cochlear implant candidacy criteria with a score of 0% correct on the AzBio Sentences in Quiet in the best-aided condition. Due to chronic middle ear dysfunction in his right ear, a decision was made to implant the patient's left ear.

Cochlear implantation was performed without incident four months following the candidacy evaluation. Electrode placement was confirmed with interoperative x-ray and neural response telemetry. The patient was seen 16 days post-cochlear implantation by the ear, nose, and throat (ENT) physician. Ear microscopy revealed an atelectatic tympanic membrane for the left (implanted) ear during the clinic visit; however, the physician reported the patient was cleared for activation. The patient was successfully activated approximately 1 week later.

In the first month following activation, the patient reported a bilateral, nonauditory, "popping" sensation he believed to be related to changes in middle ear pressure. Otoscopy revealed a retracted and erythematic tympanic membrane for the left ear consistent with ENT physician microscopy throughout the first month of the activation series. Otherwise, the patient's initial stimulation series appointments were unremarkable. He demonstrated full-time use of the device, commitment to aural rehabilitation, and appropriate auditory progress. Of note, the patient was fit with a linked contralateral super-power behind-the-ear (BTE) hearing aid in the right ear two months post initial stimulation.

Following the initial activation period, the patient reported intermittent changes in speech understanding, describing speech as "sounding scrambled" for several days at a time. These instances would have sudden onset and resolution. During the first nine months with the cochlear implant, the patient requested four additional appointments in addition to the Center's usual initial stimulation series appointments to address the changes in sound quality. The patient's descriptions of sound quality were varied and described as "echoey," "muffled," and "tinny" during his additional appointments. Remapping by setting T-levels using a count-the-beeps method and setting C-levels using a loudness scale alleviated patient sound quality complaints during each session. The most significant changes to programming levels were consistently seen for electrodes located in the middle of the array. Approximately nine months postactivation, the patient presented again to the clinic with complaints of sudden changes in sound quality and decreased subjective benefit.

INITIAL AUDIOLOGICAL TESTING

At this appointment, otoscopy revealed the known perforation in the right tympanic membrane and a cloudy tympanic membrane with no identifiable cone of light or anatomical structures for the left ear. Tympanometry was consistent with the known perforation in the right ear and middle ear dysfunction in the left ear. Results are shown in Figure 1–1.

A visual inspection and listening check of the Nucleus 7 sound processor revealed no obvious device problems or microphone malfunctions. The

Tympanometry
(226 Hz PROBE)

	R	L
Type	B	B
Peak Pressure (daPa)		
Ear Canal Volume (mL)	4.7	2.5
Static Compliance (mL)		
Peak Height (mL)		
Gradient (daPa)		

Figure 1–1. Tympanometry measures at time of chief complaint.

patient's microphone cover was preventively changed; however, the patient reported this resulted in no subjective change in the poor sound quality.

Impedance measures were within normal limits (Figure 1–2), and no significant changes were noted compared to previous measurements. The patient's initial map (Map 28), seen in Figure 1–3, was used as a baseline when setting T and C levels. His initial map was largely unremarkable except for a relatively narrow dynamic range.

T levels were measured for electrodes 22, 19, 16, 15, 14, 11, 10, 8, 6, 4, 2, and 1 using a Hughson-Westlake audiometric technique (Wolfe & Schafer, 2014). Threshold was defined using a "count the beeps" method when the stimulus was correctly identified for 100% of the presentations. T levels of unmeasured electrodes were interpolated based on the values obtained on the measured channels. C levels were set in bands of three electrodes and adjusted to the patient's most comfortable listening level. C levels were then swept across the array to confirm comfort and loudness balance. Measured T and C levels resulted in a map with a significant change in the dynamic range for electrodes 18–11. Of note, the patient indicated there was a perceptual change in sound quality for individual electrodes 17–15 when setting C levels;

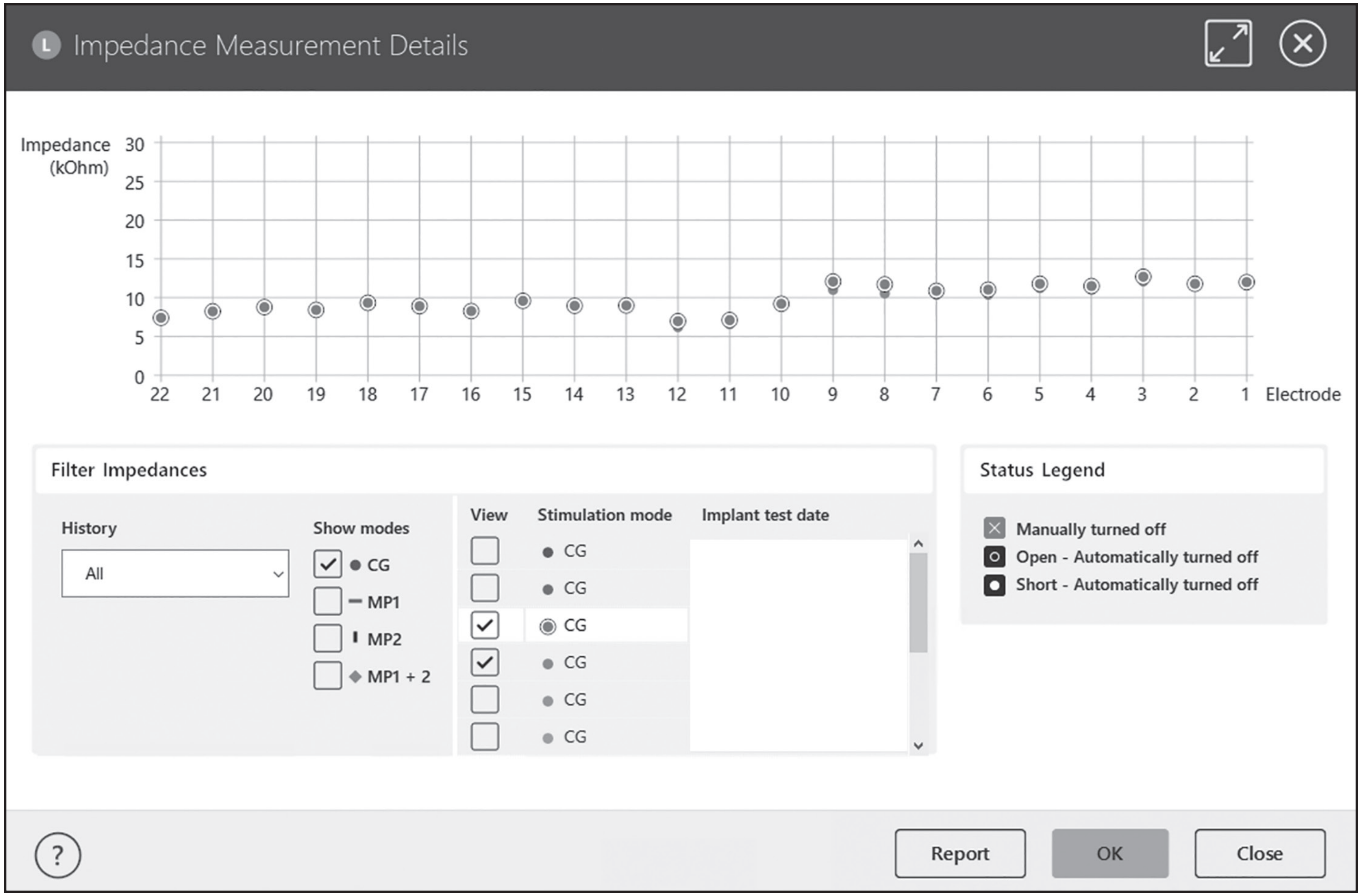

Figure 1–2. Impedance measures at time of chief complaint. Courtesy of Cochlear Americas.

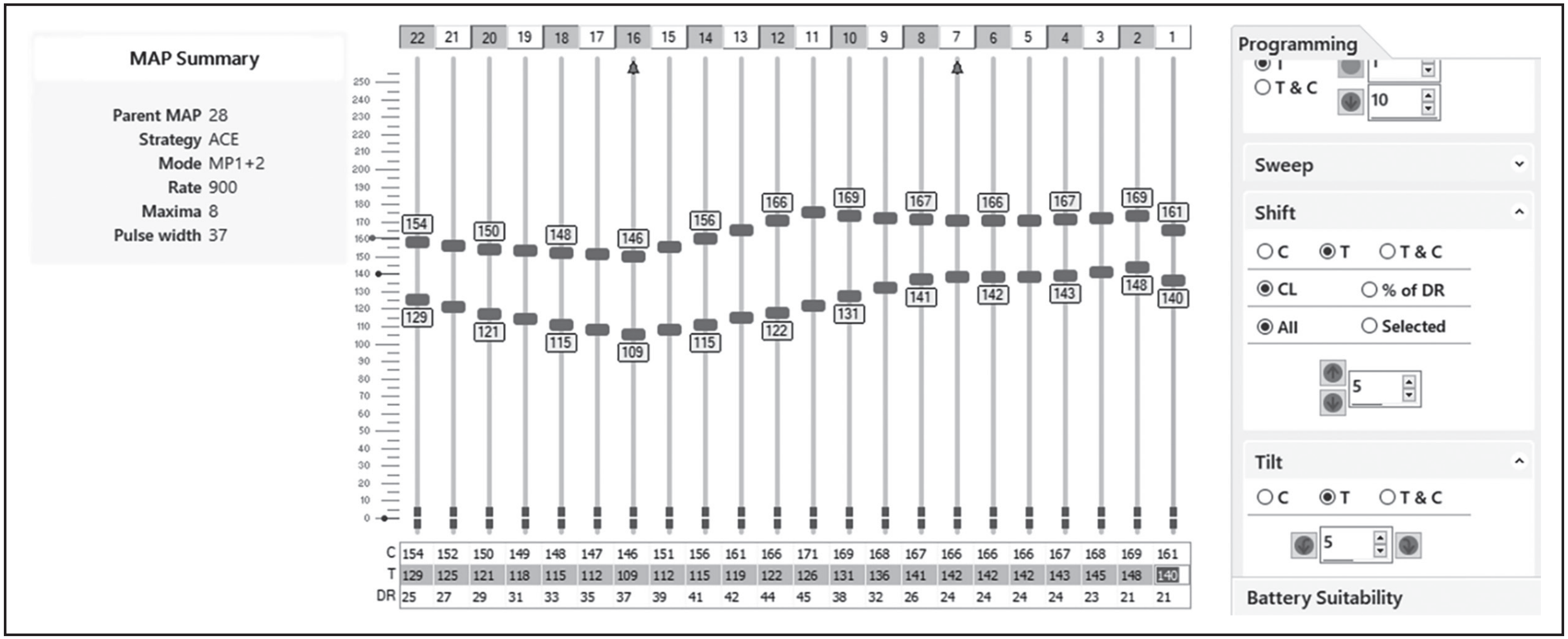

Figure 1–3. Patient's initial cochlear implant map. Courtesy of Cochlear Americas.

he described the presentations as sounding like a “buzz” rather than a tone at all stimulation levels within his dynamic range. The patient’s measured T and C levels and the map obtained in the presence of middle ear dysfunction can be seen below in Figure 1–4.

Aided audiometric threshold testing with warble tones in the soundfield was completed using the patient’s initial program. These results revealed thresholds that were flat and in the mild hearing loss range. Aided threshold testing can be seen in Figure 1–5. An aided speech recognition threshold (SRT) was found at 30 dB HL.

Next, aided speech perception testing was performed in two conditions:

1. With the map created using measured T and C levels in the presence of middle ear dysfunction (Map 30, seen in Figure 1–4)
2. With incoming programming settings (Map 28, seen in Figure 1–3)

The patient’s speech perception abilities were assessed using monosyllabic words and sentences in quiet with the left cochlear implant in isolation. Testing was completed at 60 dBA SPL with the patient seated at 0 degrees azimuth and 1 meter from the soundfield speaker. Speech measures were completed using the recordings from the New Minimum Speech Test Battery. Results are below in Table 1–1.

Speech perception measures were then repeated in the same condition with his initial settings. Results are below in Table 1–2. Subjectively, the patient reported using less listening effort when using his initial map and preference for his incoming programming settings.

Although the differences in the CNC word scores were not critically different (Carney & Schlauch, 2007), they were clinically significant for monosyllabic words and aligned with patient report of listening ease and preference. Following speech perception testing, the patient’s sound processor was programmed using his previous map (Map 28) and a referral was made to his ENT physician for middle ear management.

CASE HISTORY QUESTIONS AND DISCUSSION FOR THE READER

1. **What red flags appear in the patient’s case history? Why? Do those red flags represent issues that may be causing the patient’s complaints? What initial ideas do you have that may resolve the patient’s issues?**

The patient presented with a history of middle ear dysfunction and observed instances of tympanic membrane retraction. Additionally, his subjective report of fluctuations in speech perception abilities and intermittent report of differing sound quality when setting C levels for electrodes in the