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Take your lunch break back!

How Anatomy-Based Fitting and ESRT can help improve clinic efficiency

Barb Foster, AuD MED-EL, USA

Cache Pitt, AuD Utah State University



Objective vs. Subjective Measures

• Objective Measures

- ✓ Impartial
- ✓ Quantifiable
- ✓ Recorded with diagnostic instruments

• Subjective Measures

- ✓ Based on individual awareness
- ✓ Patient's interpretation of what they 'know' or remember
- ✓ Limited language to describe (peds, long-term deafened recipients, recipients for whom English is a second language, etc.)

Application of Objective Measures

- **ECAPs (e.g. AutoART, NRI, NRT)** – determine responsiveness of nerve at cochlear level
- **ESRT** – responses correlate with upper loudness levels (verifies mapping)
- **EABR** – evaluate function of the auditory pathway after CI surgery
- **ECoG** – Monitor hearing preservation (e.g. intra-op during electrode insertion)
- **Anatomy-Based Fitting (post-op OTOPLAN)** – Adjusting frequency bands to the electrode position in the cochlea
- **SSD Test Protocol** – Measurement of speech understanding and binaural listening skills in SSD CI users without a specialized test environment

Objective Measures with MED-EL

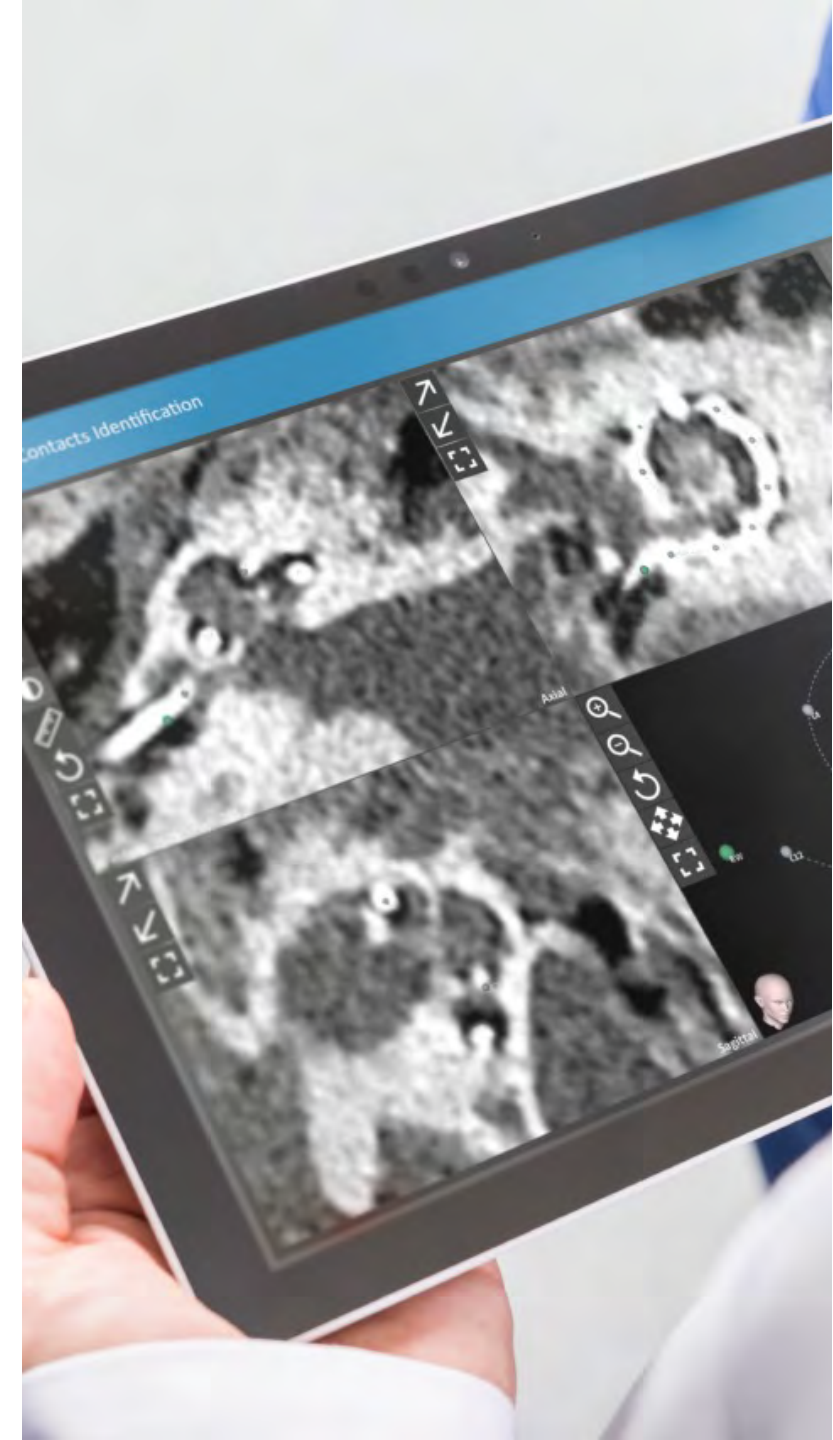
- ESRT
- Anatomy-Based Fitting



Anatomy-Based Fitting

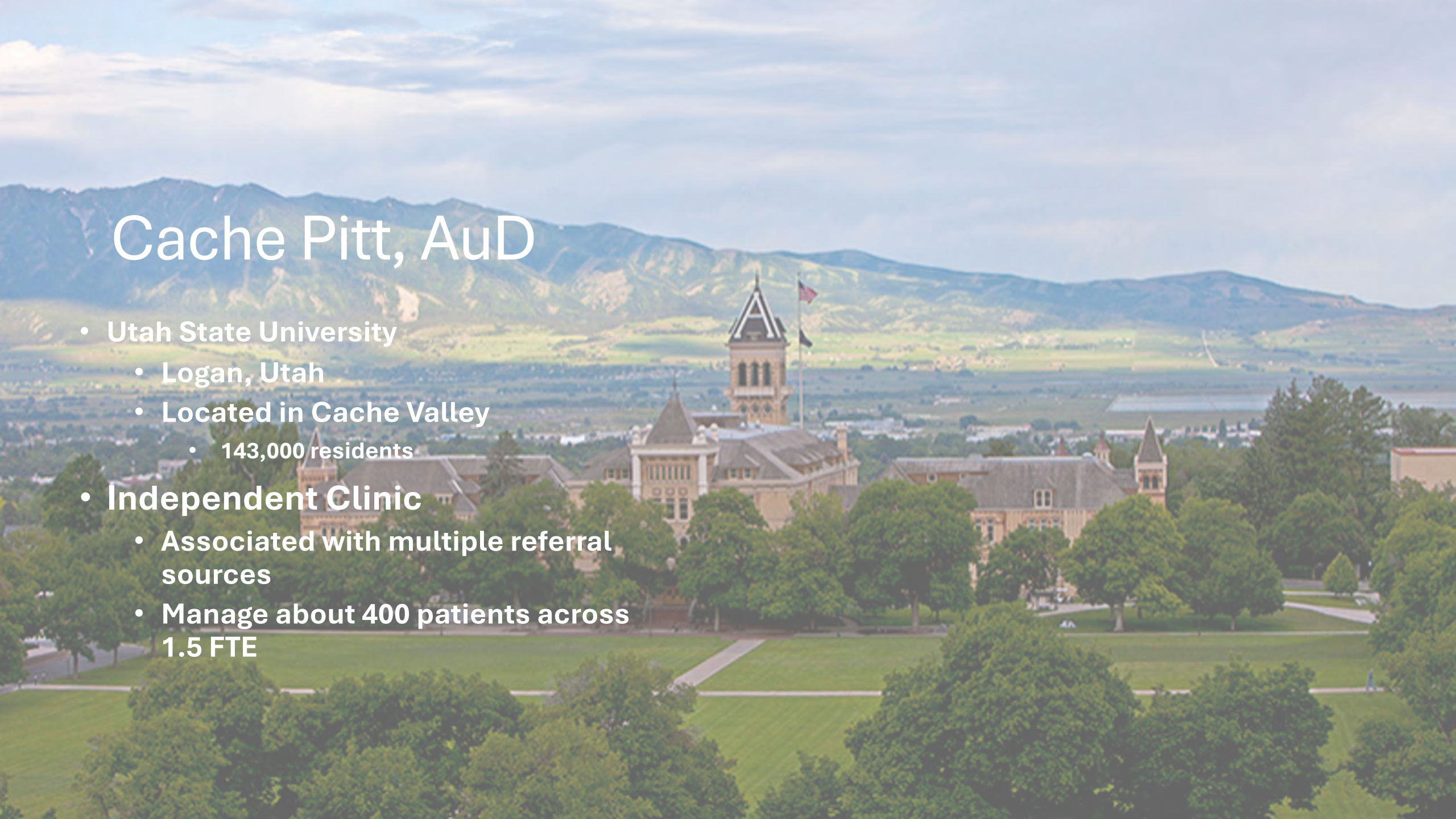
Data Requirements

- Post-operative CT/CBCT scan
- Post-op analysis performed in OTOPLAN or by MED-EL's OTOPLAN On Demand service
 - Automatic contact detection does all measures rapidly and automatically
- Data exported from OTOPLAN as XML file
- XML file imported into MAESTRO



Cache Pitt, AuD

- **Utah State University**
 - Logan, Utah
 - Located in Cache Valley
 - 143,000 residents
- **Independent Clinic**
 - Associated with multiple referral sources
 - Manage about 400 patients across 1.5 FTE



Clinic Needs



Change people's lives by providing best possible outcomes in an efficient and effective environment, while also training the next generation of audiologists

Balance



Need to see as many patients as possible. Fund the program.
Provide patient-centered care.
Provide best possible outcomes

What Has Impacted Our Efficiency?

- ESRT
 - At activation
 - Eliminates at least 1-2 visits
- Implementation of advancements in technology
 - OTOPLAN
 - Anatomy-Based Fitting protocol
- Partnering with manufacturer
 - Connecting patients with manufacturer to answer questions, etc.

Electrically-Evoked Stapedius Reflex Thresholds (ESRT)

- ESRT was reported in the late '90's
- When I was first introduced to it and asked our center why we didn't do it
 - Not everyone has eSRT
 - You must have normal middle ear function to do it
 - You must have special equipment
 - You must be an octopus to do eSRT
- Continued with loudness scales, then along came ECAPs (e.g. ART, NRI, NRT)
- In about 2010, Jace Wolfe extended a challenge

ESRT

- After a matter of a couple of weeks of doing ESRT on everyone, I was convinced of its superiority
 - People preferred the ESRT-based map
 - Patient complaints were resolved with ESRT
 - I became confident in their user settings and being able to say, go get used to it and come back if necessary
- I set on a path of doing ESRT on every patient I saw, which has lasted since then
- I also kept track of the data
- Published a paper on the long-term stability of ESRT



Long-Term Stability of ESRT

- Student needed a project, and I had a lot of data
- Took a few years to publish
- Study outcomes
 - ESRT is stable over time
 - Measurements are reliable and repeatable
 - Typically elicited below UCL
 - Established a relationship of eSRT with MCL's

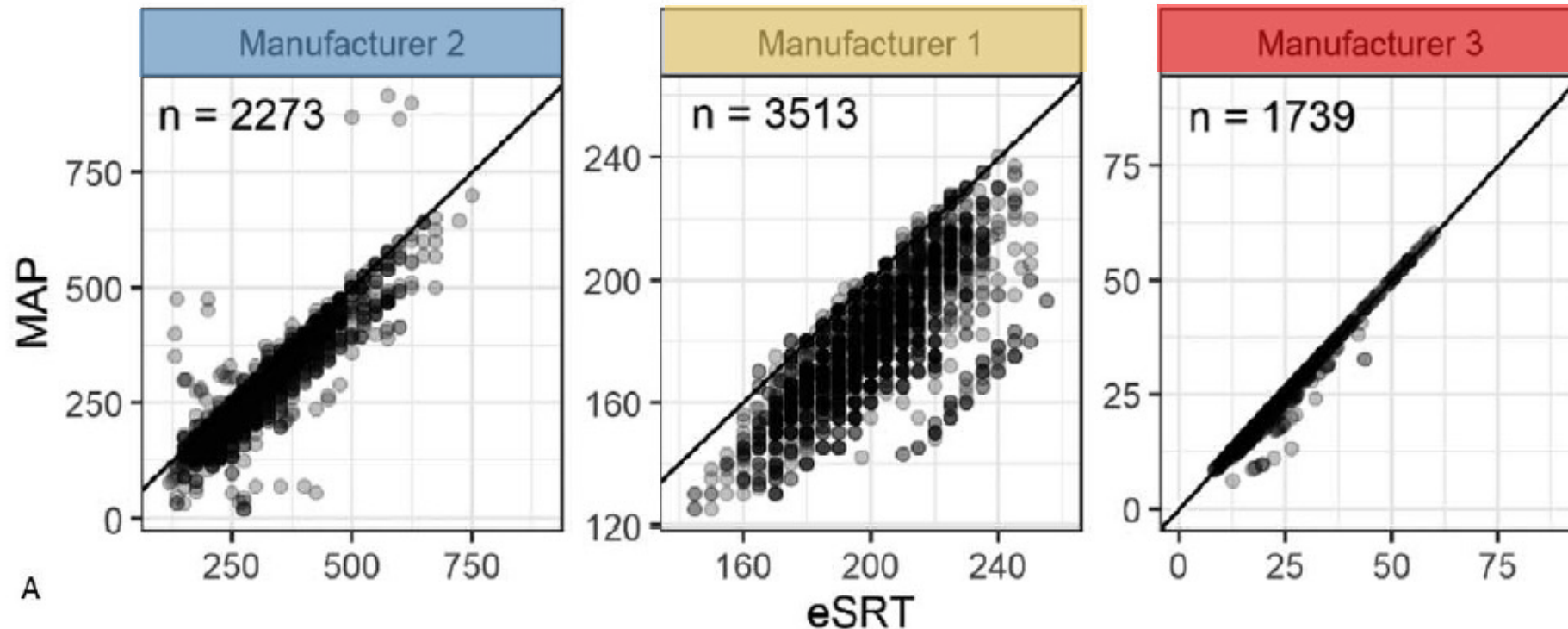


The Long-Term Stability of the Electrical Stapedial Reflex Thresholds

Reviewed 205 patients (age 13 months to 86 years)

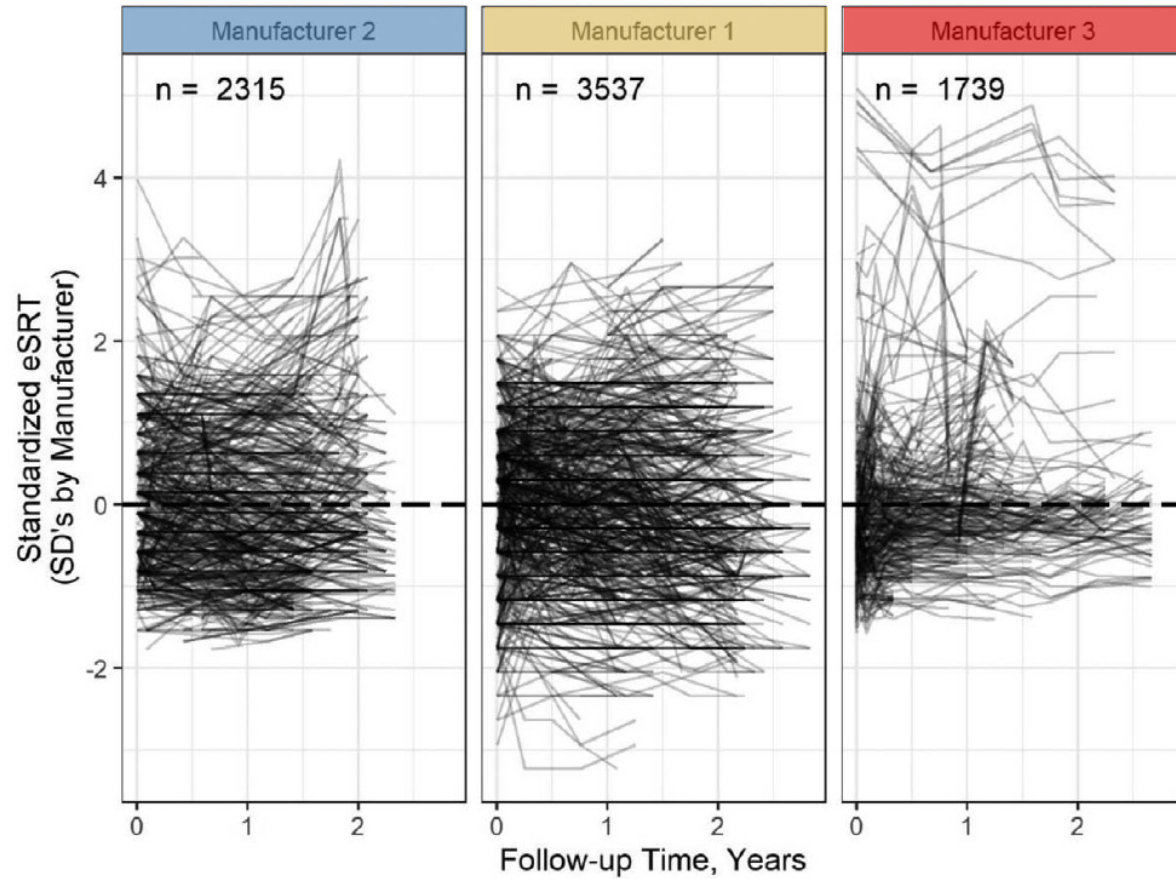
- Assess the correlation between ESRT level and MAP level (majority performed ipsi)

Electrode Values for All Visits

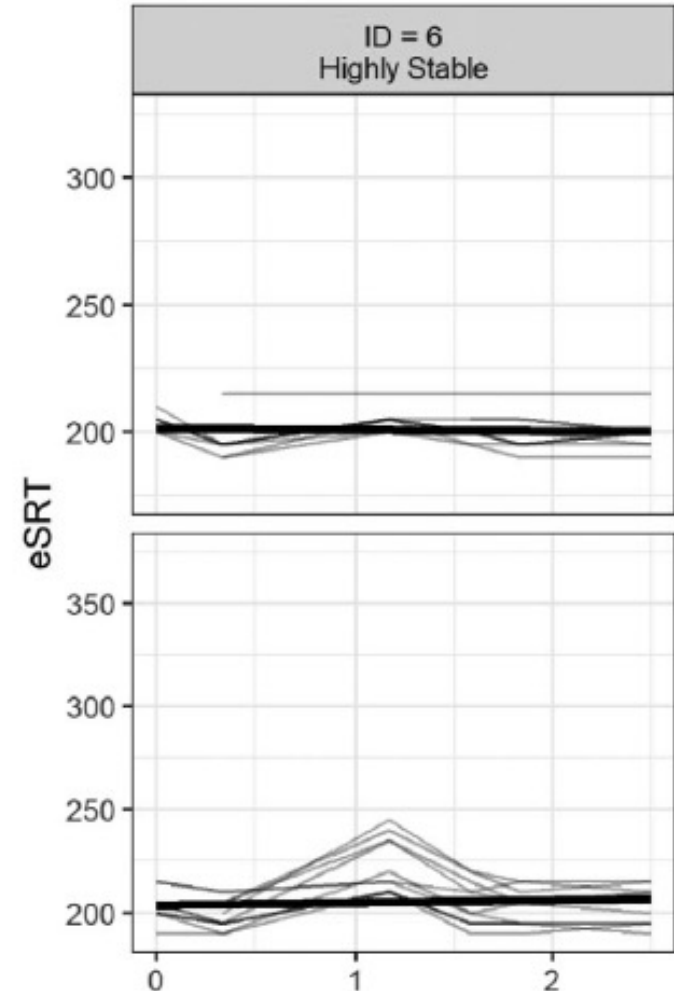


Reflex Stability

ESRT levels should remain stable over time



(Pitt et al., 2021; Abbeele et al., 2012; Allum et al., 2002)



Impact of ESRT on my clinic

- Provided me with more confidence and certainty in mapping
 - Much like Speech Mapping and Real Ear
- Patients were happier, complaints about sound quality decreased
- Appointment times decreased
 - It's faster to do ESRT than to ask for opinions that result in indecision and uncertainty
 - Can comfortably schedule bilateral MED-EL patient in one hour, completing ESRT on both ears, aided tones, and aided speech discrimination
 - Bilateral MED-EL – plan on about 10-15 minutes to complete eSRT

Impact of ESRT use

- After doing ESRT so much, I was finding myself teaching other professionals how to do ESRT
- My Intro to CI class needed a resource for teaching students and people were regularly reaching out asking how to do ESRT
- Made YouTube videos teaching basics of ESRT
 - <https://www.youtube.com/watch?v=NMBDHgMAxUI>



My method of doing ESRT for MED-EL

- We have GSI Tymptstar Pro
- ESRT Task Screen
 - Records ESRT over time
 - Not subject to any changes you make in the fitting screen
- Probe Tone Frequency
 - Default for MED-EL is 226
 - If you don't get a response, change it to 1000 Hz



My method of doing ESRT for MED-EL

- Recording Ear
 - Can be ipsi/contra, although data supports that the likelihood of getting a response increases slightly in the contra condition
 - Bilateral CI, both ears have had surgery
 - If SSD – do contra
- Follow-up patients
 - I increase ESRT to previous responses per channel (make sure to not present ESRT on any deactivated channels)
 - I start on channel 1 and go through every active channel
 - On channel 1, I lower MCL well below previous response to not alarm the patient, every other channel I start where I had a previous response
 - I mark ESRT ("R") at the first response using an ascending approach

My method of doing ESRT for MED-EL

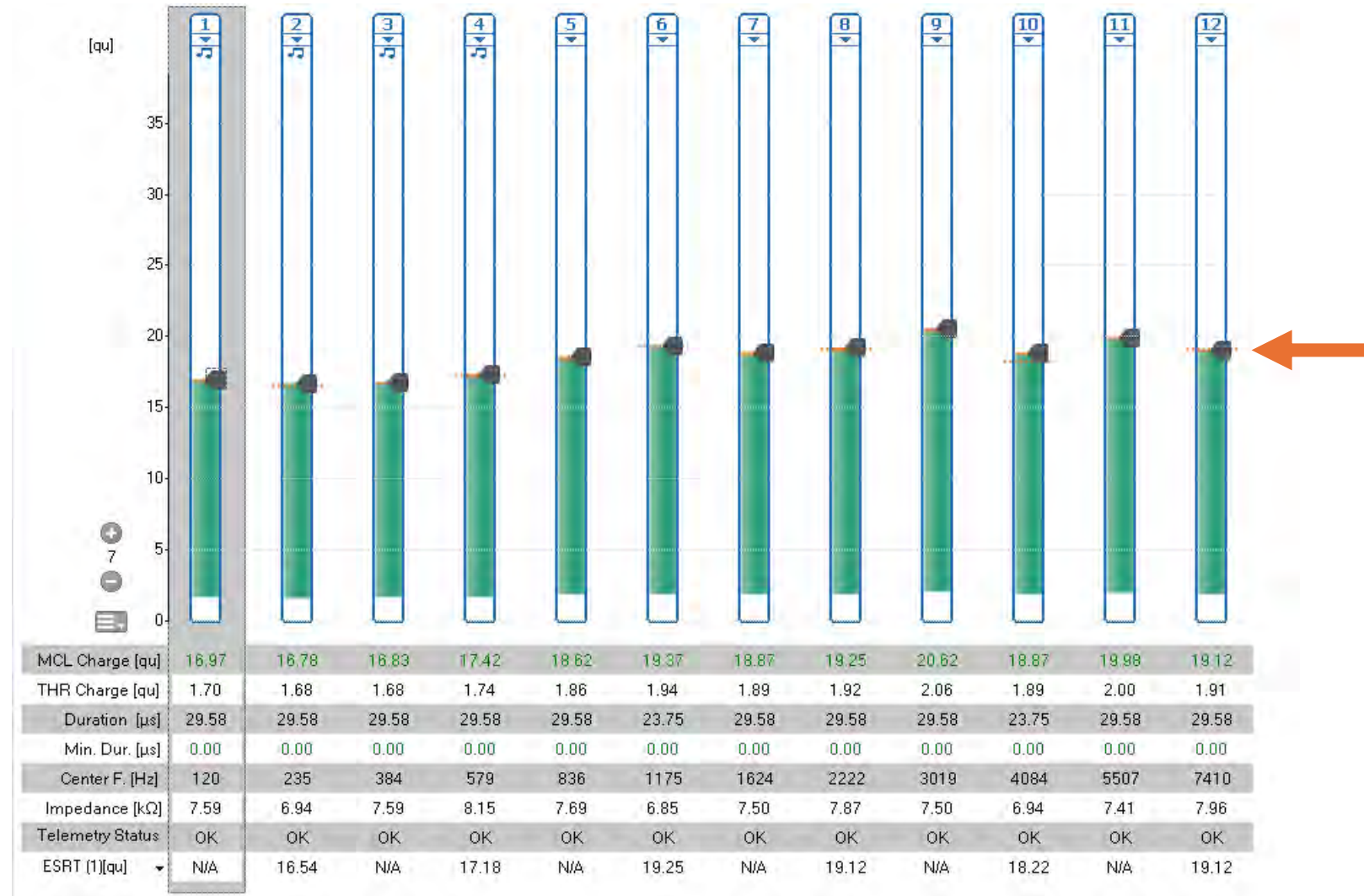
- I used to delay doing ESRT so that the patient could get used to volume
- Now I do ESRT at activation with good success
 - SSD typically just go for it
 - Long-term hearing loss, I go live at about 10qu MCL across the array, and slowly increase until patient cries uncle. If MCL are great than 15qu, then I try ESRT
 - Start ESRT about 10qu until you have your first observed response, then you can use that response to inform where you can start the next channel

My method of doing ESRT for MED-EL

- Tricks I've learned
 - Keep the patient occupied with a task
 - Kids/youth – watch a movie
 - Adults – read, use their phone
 - It helps some adults to sit more still by having them watch the reflex decay line
 - Record your set-up parameters in your chart note so you don't reinvent the wheel every time
 - Earmold impression material is great for those probe tips that keep pushing their way out

Using ESRT

- Select most current ESRT in the fitting screen and match MCL's to ESRT
 - Most patients are happy wearing MCL's at ESRT.
 - finding that SSD patients are wanting MCL's a bit higher than ESRT to balance the CI with their normal hearing ear



Impact of ESRT on Clinic Efficiency

- Shorten appointment times
 - Not spending as much time asking for patient input
 - Outside of certain complaints (talking in a barrel, too sharp), I typically send people home to get used to new program
- Minimizing number of appointments
 - Follow-up less frequently, leaving openings for more patients
- Activation appointments reduced
 - If I can get ESRT at activation, I probably won't see them again until 1 month
 - Dropping 1-2 appointments from activation schedule



Considerations of Implementing Anatomy-Based Fitting



Candidacy Discussion

USU practice

Discussions of internals have changed over time

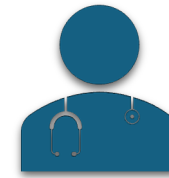


Who to recommend for ABF

Difficult to treat patients?

New recipients?

Does having experience influence perception of ABF?



USU experience

All new CI recipients

Targeted difficult to treat recipients

Now I talk about it with all patients I see in the clinic, regardless of listening experience

Anatomy-Based Fitting Experience

One year of
experience

Includes 2 difficult to
treat patients

New recipients

Experienced users

Adults

Teens

No children yet, but
due to lack of
opportunity, not
intentional choice

Anatomy -Based Fitting Observations



Deeper/more bass – 100%



Sounds like natural hearing
(notably with SSD recipients)



Difficult to fit

1 has stopped
emailing and
scheduling
appointments
1 rejected ABF

Challenges

- Biggest challenge for our center is coordination
 - Lack of on-site referring physician leads to delay in accessing images
 - Most significant for new recipients & timing with appointments
- Quality Imaging

Case Examples

Case Studies



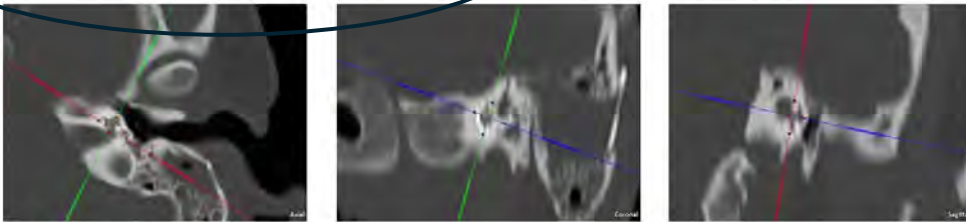
Patient A.

- Sudden SSD following SCUBA accident July 2022
 - After ascending she noted no hearing in her left ear
 - Treated medically and then seen for a CI evaluation in March 2023
 - Surgery was 7/21/23 and activation was 8/1/23
 - MCL's fit to ESRT at activation
 - ABF protocol fit on 8/30/23
 - Angular insertion depth (via OTOPLAN) = 567°

Patient A. – Post Op

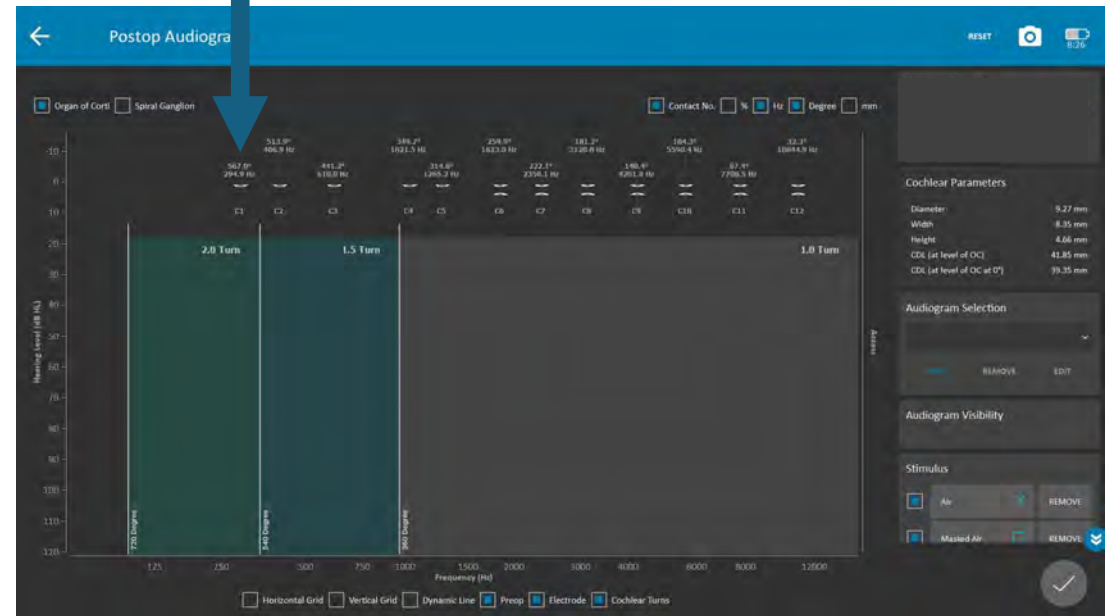
Cochlear Parameters Post Op

- Diameter (A Value): 9.3mm
- Height (H Value): 4.7mm
- Width (B Value): 8.3mm
- Estimated CDL with hook region: 41.8mm
- Estimated CDL at round window: 39.3mm

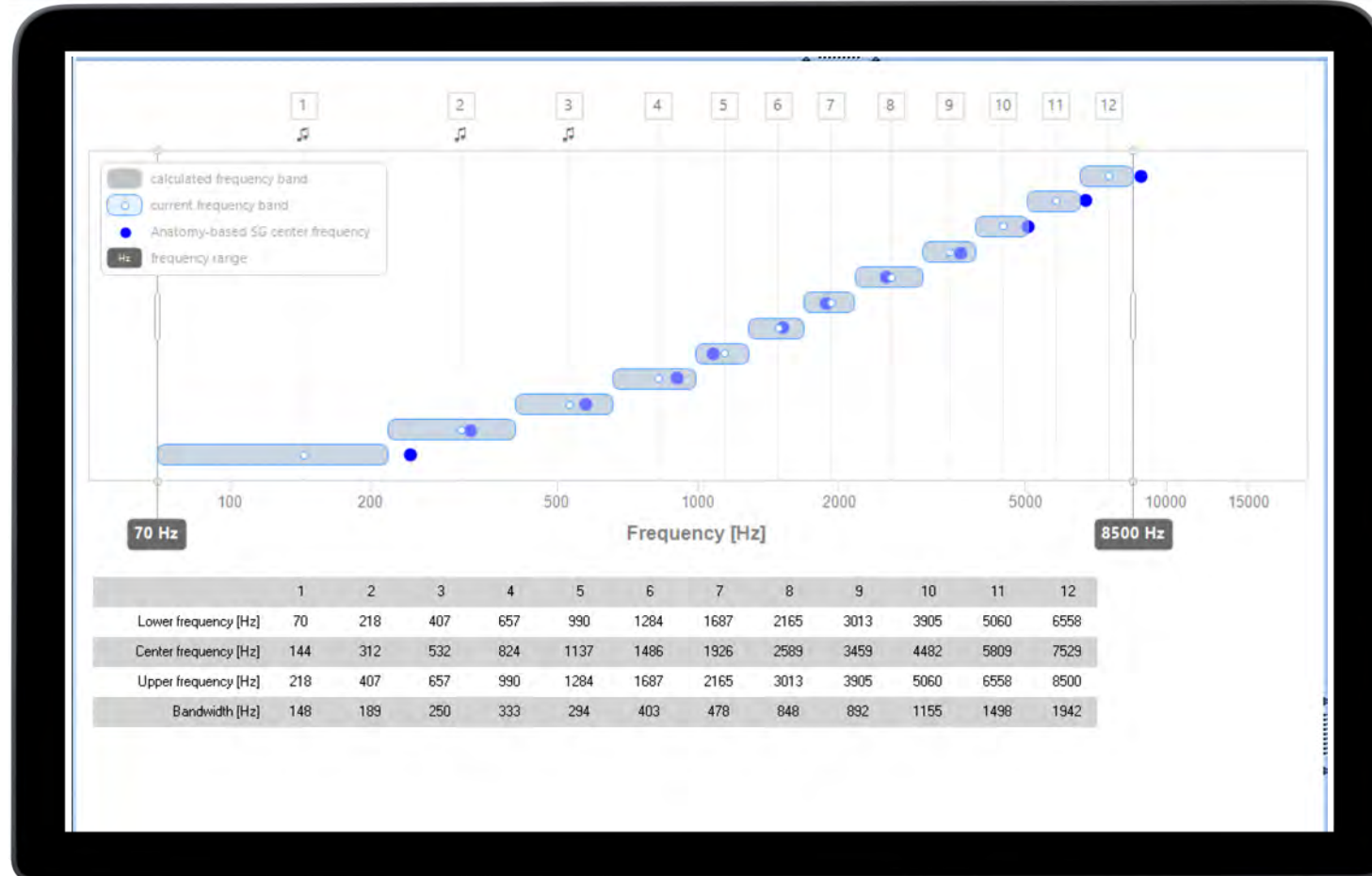


Estimate of Electrode Insertion Depth

Angular Insertion Depth:
567.0°



Patient A.



Patient A. comments at 2 months post ABF activation



At first, couldn't tell the difference



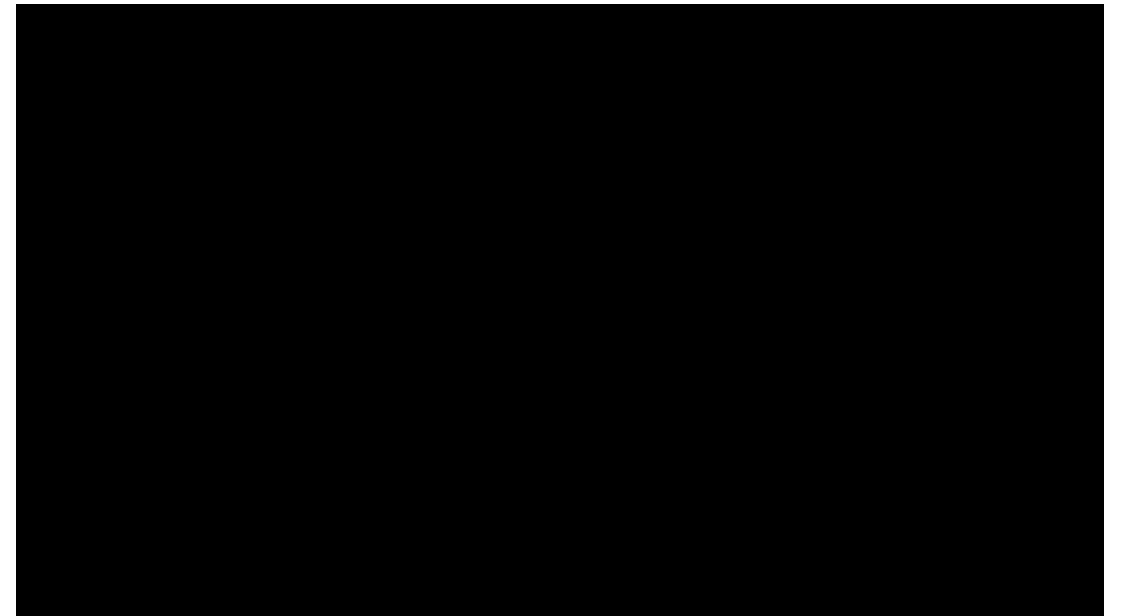
After getting home, difference was apparent



Sounds "normal"



It just sounds better



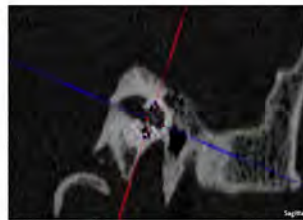
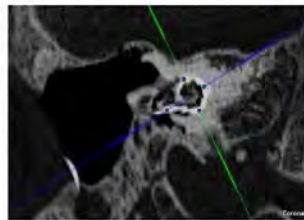
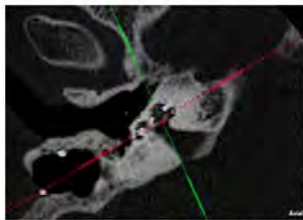
Patient P.

- Unilateral Ménière's Disease identified in 2018 at age 41
- Candidacy Eval in August 2021
- Surgery (FLEXSoft) in October 2021
- ABF protocol implemented in December 2023

Patient P.

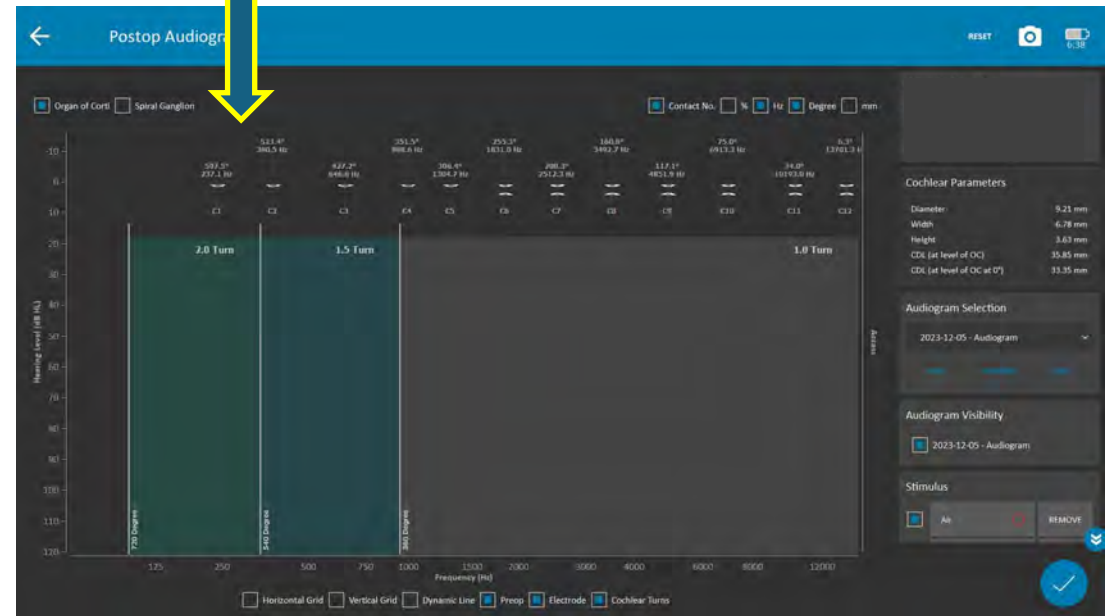
Cochlear Parameters

- Diameter (A Value): 9.2mm
- Height (H Value): 3.6mm
- Width (B Value): 6.8mm
- Estimated CDL with hook region: 35.8mm
- Estimated CDL at round window: 33.3mm

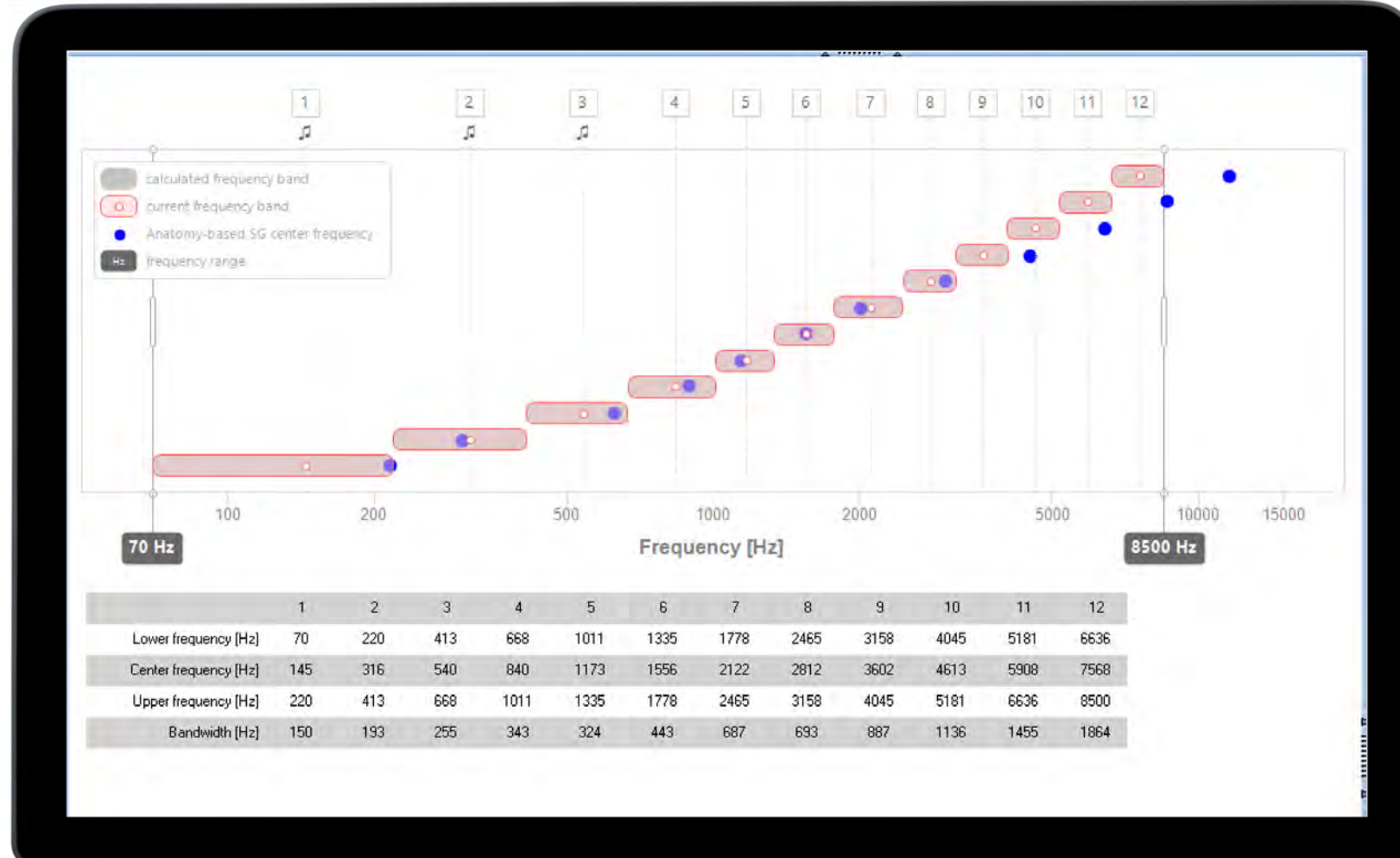


Angular Insertion Depth:
597.5°

Estimate of Electrode Insertion Depth

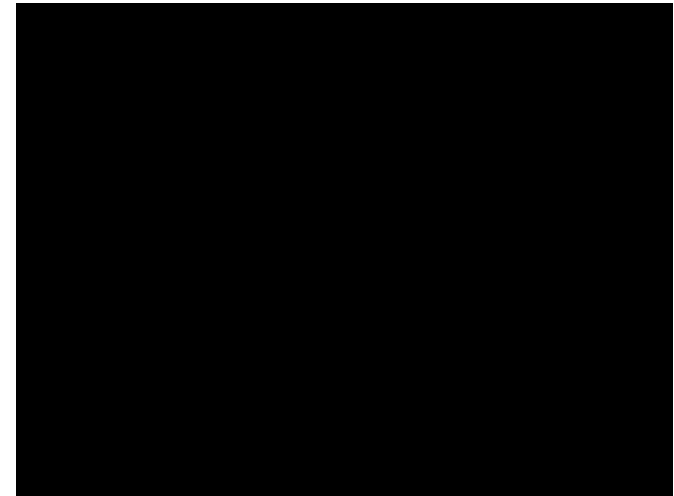


Patient P.



Patient P.

- Reaction
- At first, didn't notice a difference
- Once hearing his old map, after using ABF map, SHUT UP!
- More tone
- More noticeable difference than he remembers experiencing



Patient D.



Progressive hearing loss,
secondary to CMV



CI surgery in 11/2015 at age
4

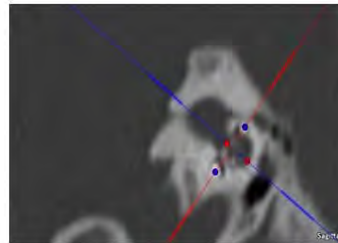
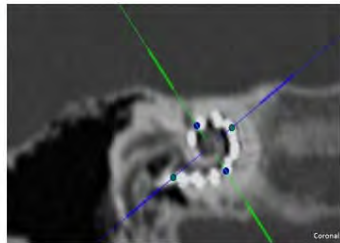
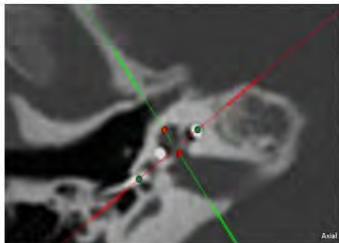


Flex 28 in both ears

Patient D.

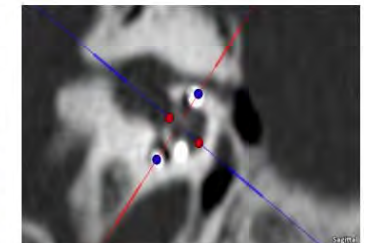
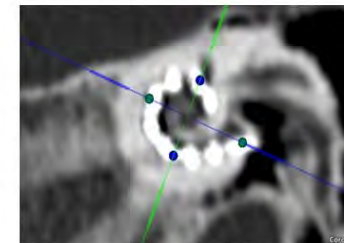
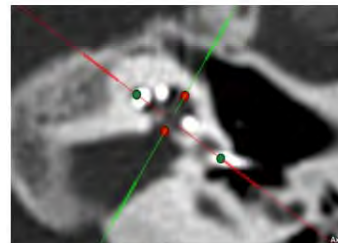
Right Cochlear Parameters

- Diameter (A Value): 9.4mm
- Height (H Value): 3.3mm
- Width (B Value): 6.3mm
- Estimated CDL with hook region: 34.5mm
- Estimated CDL at round window: 32mm



Left Cochlear Parameters

- Diameter (A Value): 9.1mm
- Height (H Value): 3.3mm
- Width (B Value): 6.4mm
- Estimated CDL with hook region: 34.3mm
- Estimated CDL at round window: 31.8mm



Patient D. – Estimate of Electrode Insertion Depth

Right

Angular Insertion Depth:
499.0°

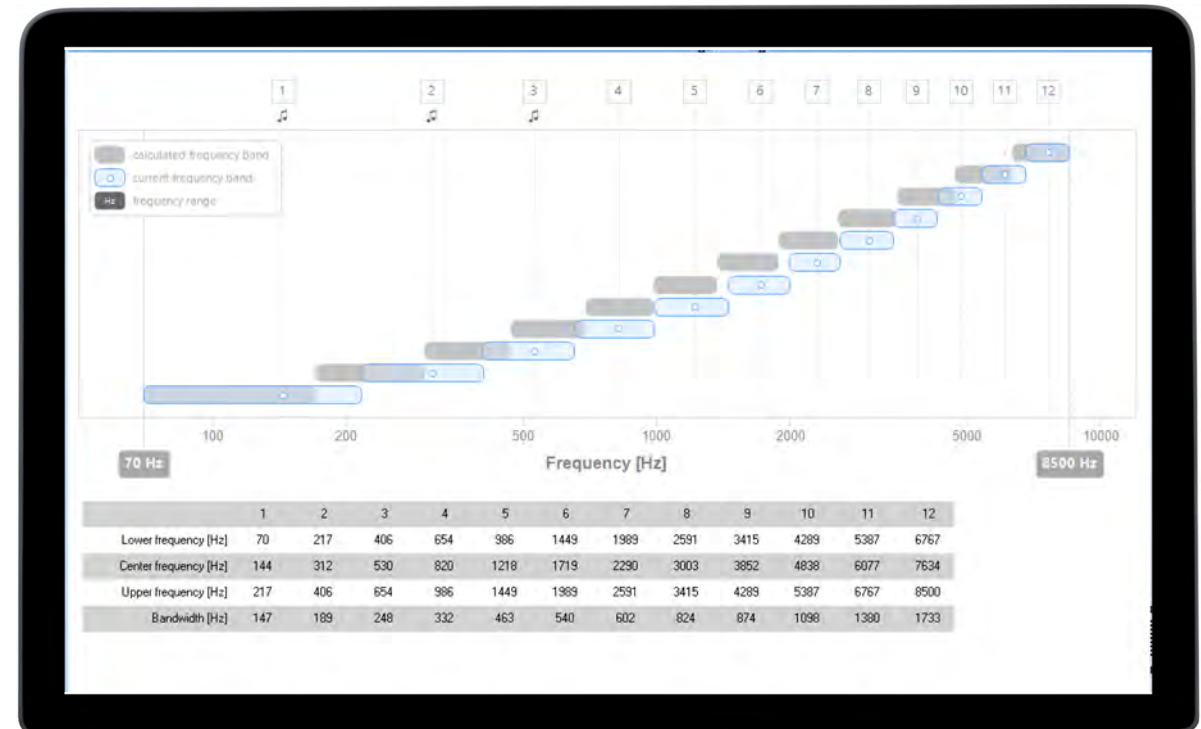


Left

Angular Insertion Depth:
584.6°

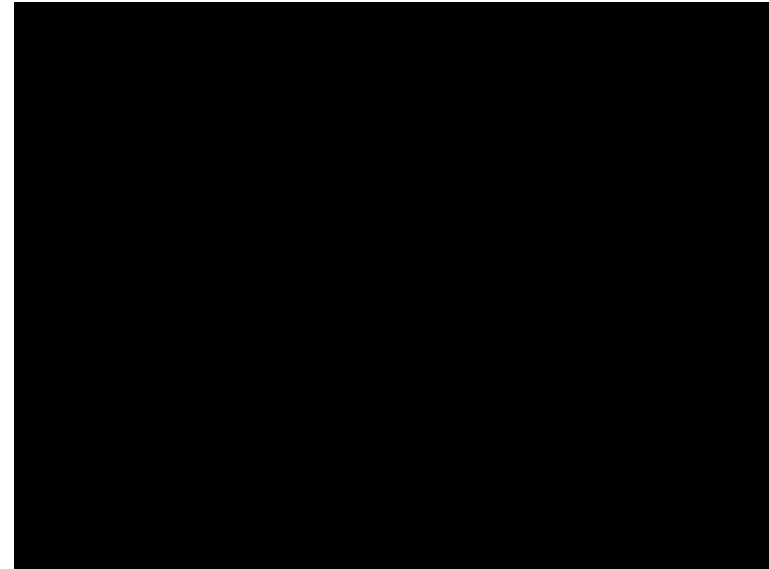


Patient D.



Patient D.

- Reaction
- Sounded funny, low pitch
- Understanding well
- Waiting to hear back on use



Patient B.,

- History of bilateral otosclerosis and stapedectomy
- Wore HA in left ear only
- Baha at some point
- Right CI at age 66 (2016) FLEX 24
- Left CI at age 69 (2019) FLEX 28
- Very unsatisfied with sound quality and discrimination

Patient B's Sound Quality Complaints

'Tunnel'

'Garbled speech'

Can't understand my wife

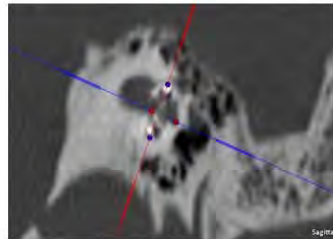
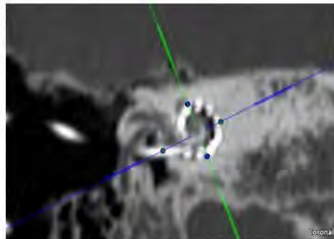
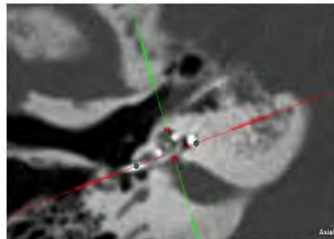
Bass is so overpowering can't hear melody
in hymns at church

Patient B's Cochlear Parameters

Right – FLEX 24

Cochlear parameters

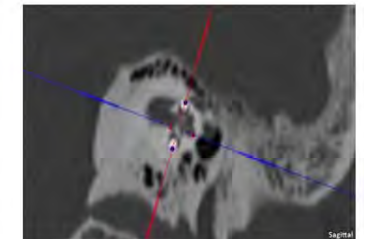
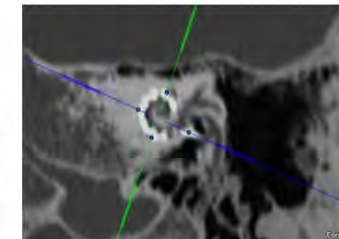
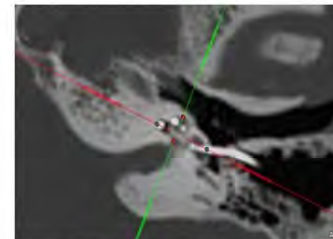
- Diameter (A Value): 9.9mm
- Height (H Value): 4.2mm
- Width (B Value): 7.7mm
- Estimated CDL with Hook Region: 40.4mm
- Estimated CDL at Round Window: 37.9mm



Left – FLEX 28

Cochlear parameters

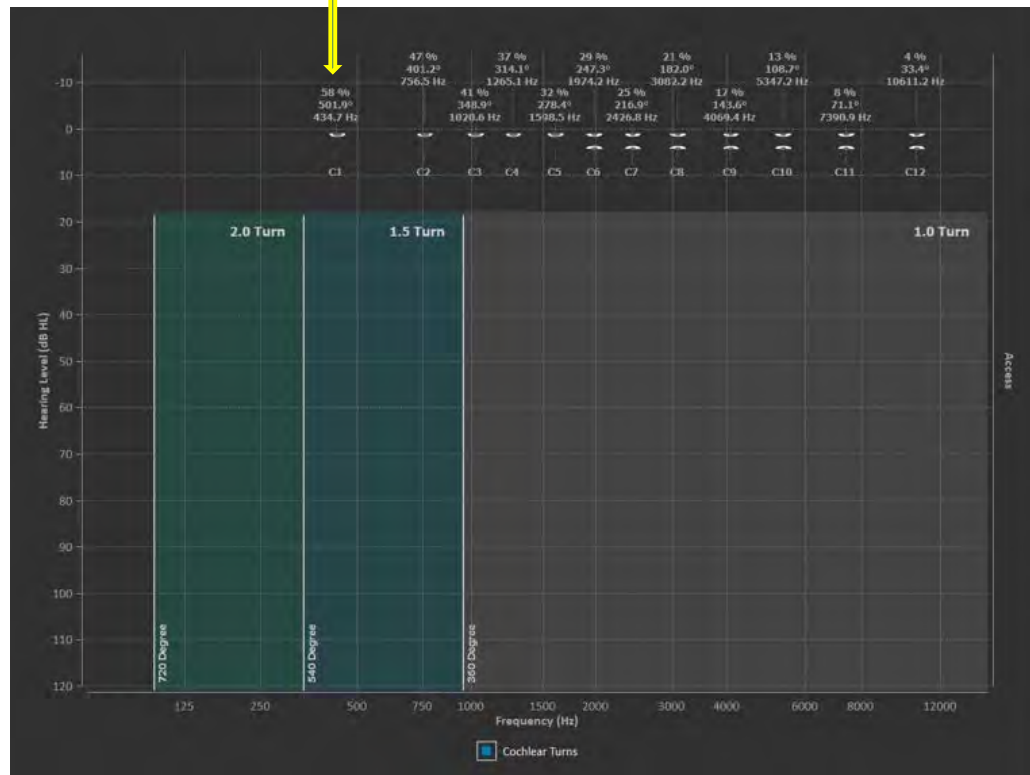
- Diameter (A Value): 10.3mm
- Height (H Value): 4.5mm
- Width (B Value): 8.0mm
- Estimated CDL in Hook Region: 41.9mm
- Estimated CDL at Round Window: 39.4mm



Patient B. – Estimate of Electrode Insertion Depth

Right

Angular Insertion Depth:
501.9°

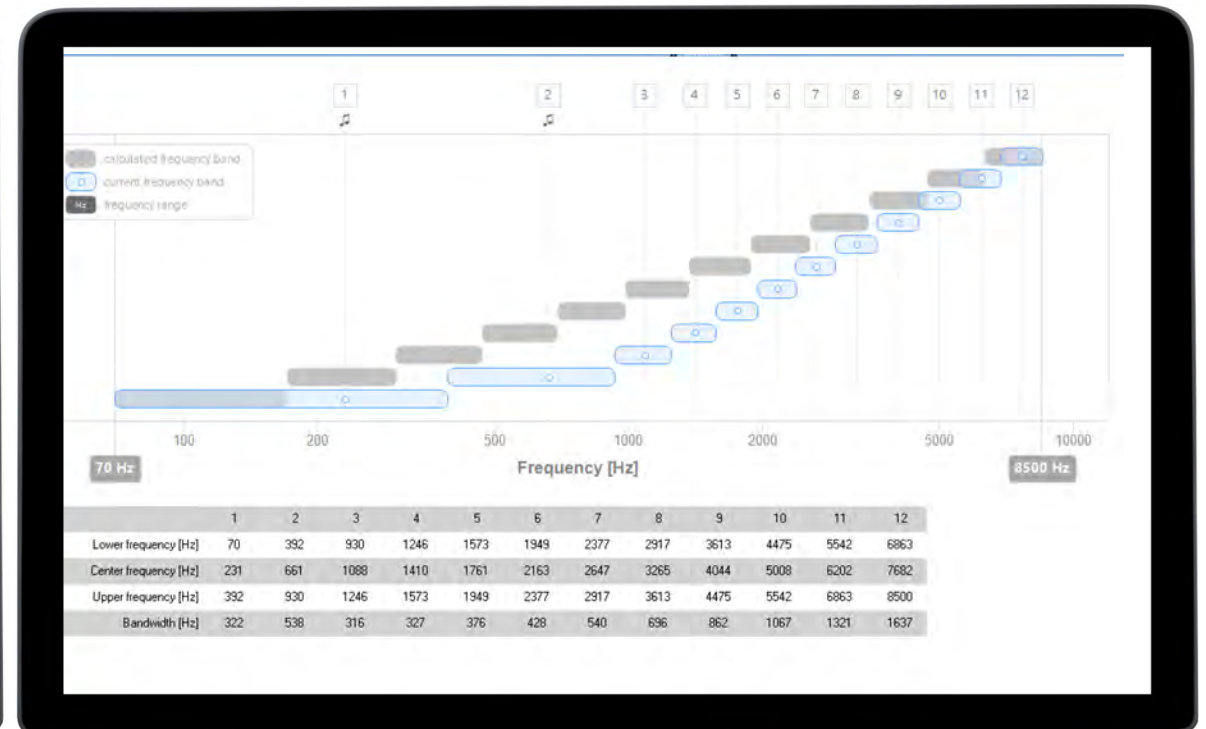
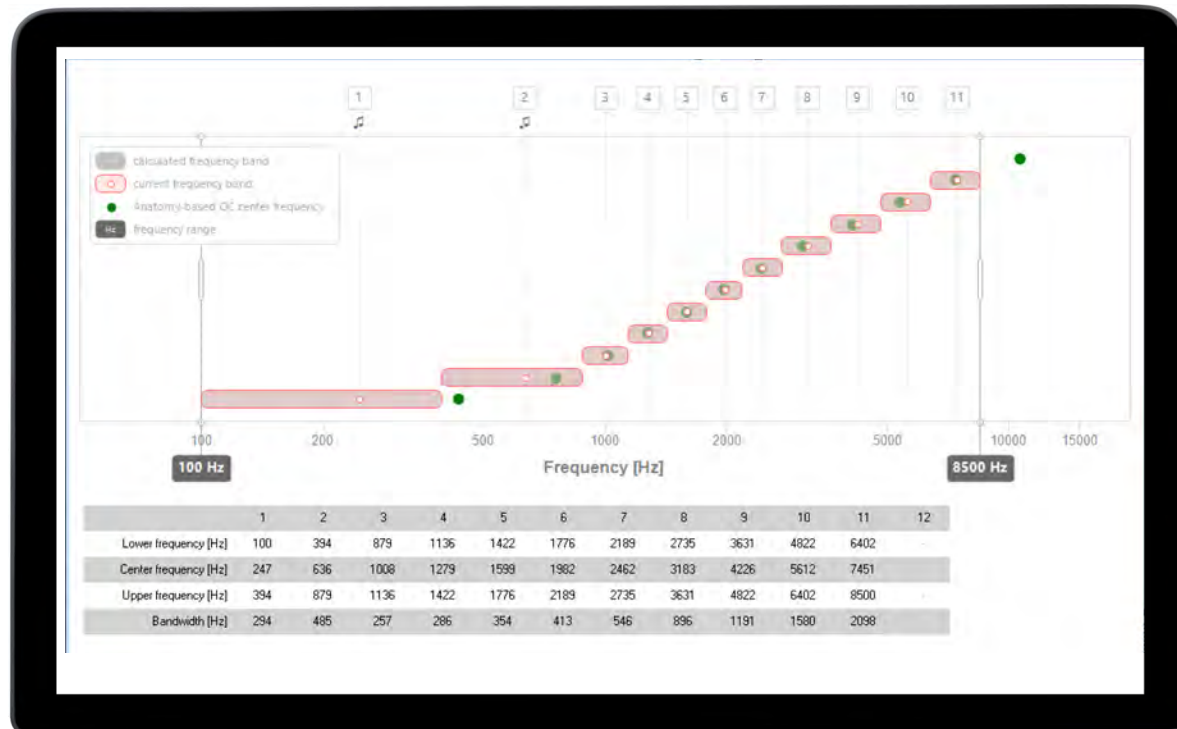


Left

Angular Insertion Depth:
536.6°

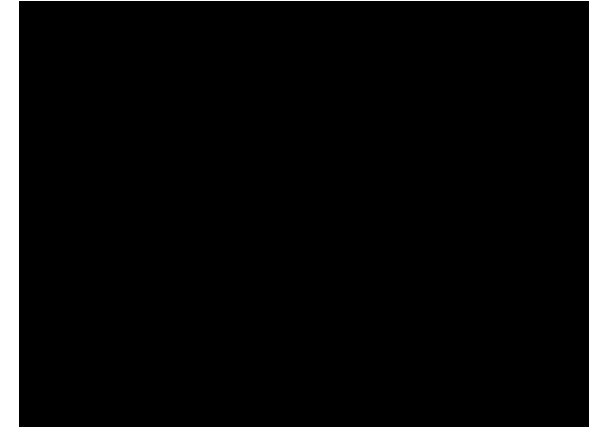


Patient B.

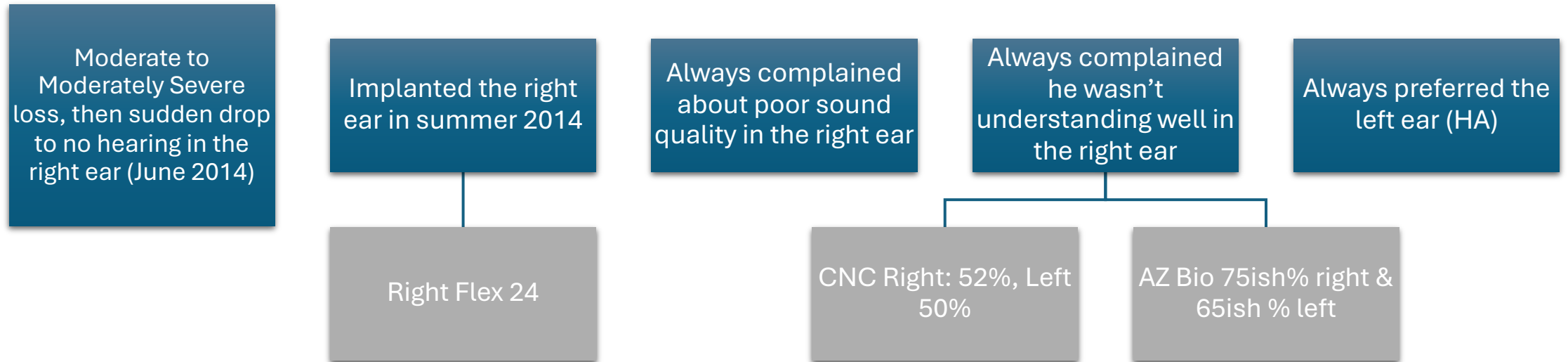


Patient B.

- 100% better – ‘best I’ve ever had’
- Everybody is still deep, but
 - Not in tunnel
 - Not under water
 - Not garbly
- I can understand speech
- I can understand my wife better
- Can follow the melody of a song



Patient G.



Patient G.

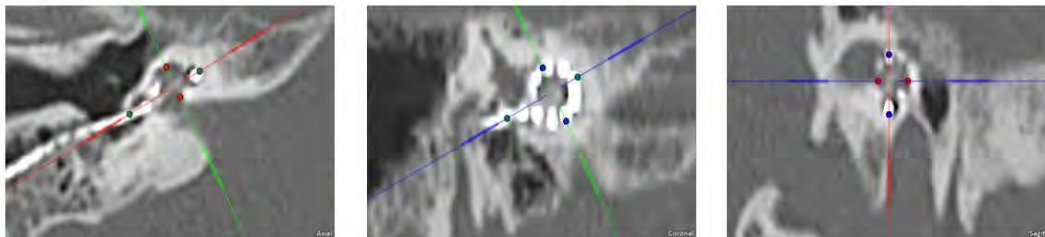
- CNC scores for left ear were always poor, Gary chose to implant the left ear
- Left FLEXSoft
 - Summer 2023
- ABF August 2023
- Immediately did not like
- Wore for one month
 - Did not go to activities (class reunion, etc.) because he couldn't understand
- In clinic observation he was not understanding well, as soon as ABF was deactivated, he understood well

Patient G's Cochlear Parameters

Right – FLEX 24

Cochlear parameters

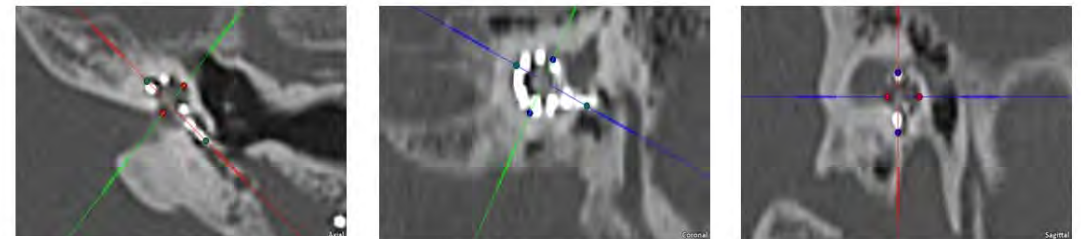
- Diameter (A Value): 10.3mm
- Height (H Value): 3.9mm
- Width (B Value): 6.8mm
- Estimated CDL with Hook Region: 37.3mm
- Estimated CDL at Round Window: 34.8mm



Left - FLEXSoft

Cochlear parameters

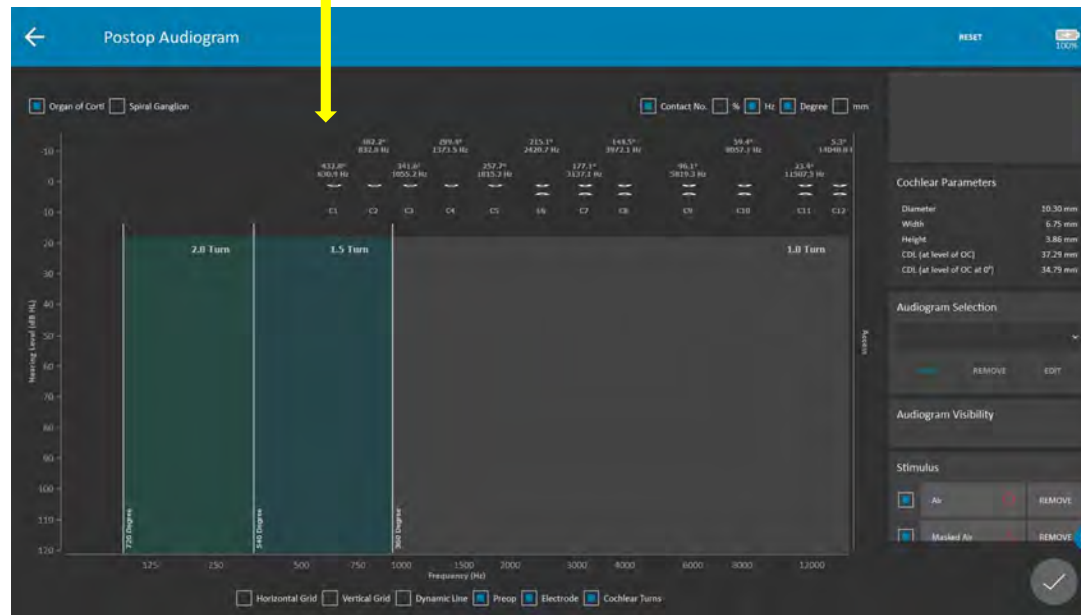
- Diameter (A Value): 10.2mm
- Height (H Value): 4.1mm
- Width (B Value): 6.7mm
- Estimated CDL with Hook Region: 36.9mm
- Estimated CDL at Round Window: 34.4mm



Patient G's – Estimate of Electrode of Insertion Depth

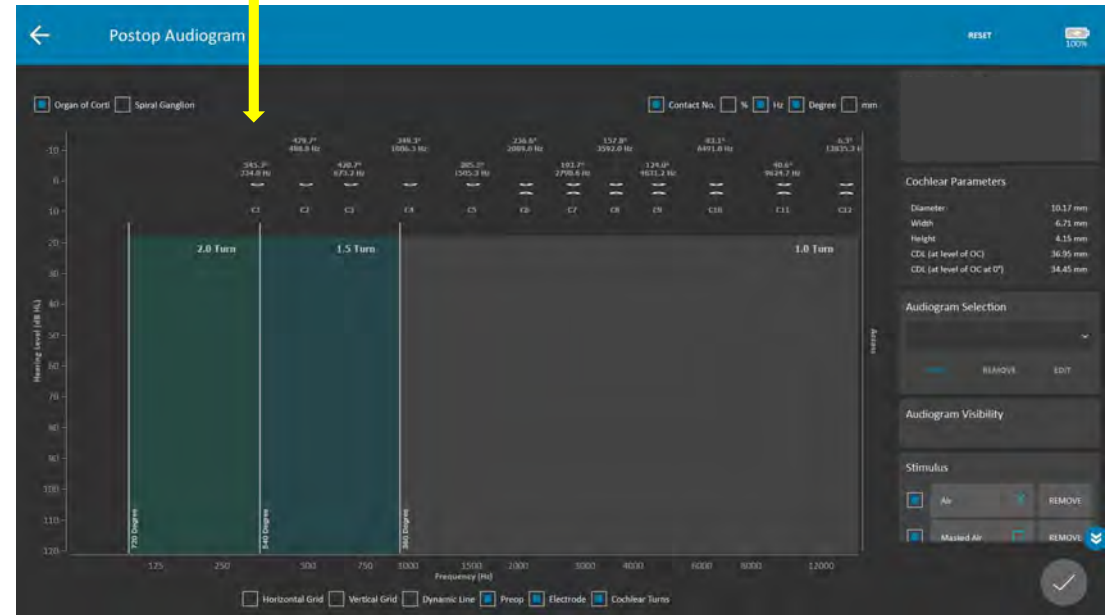
Right

Angular Insertion Depth:
432.8°

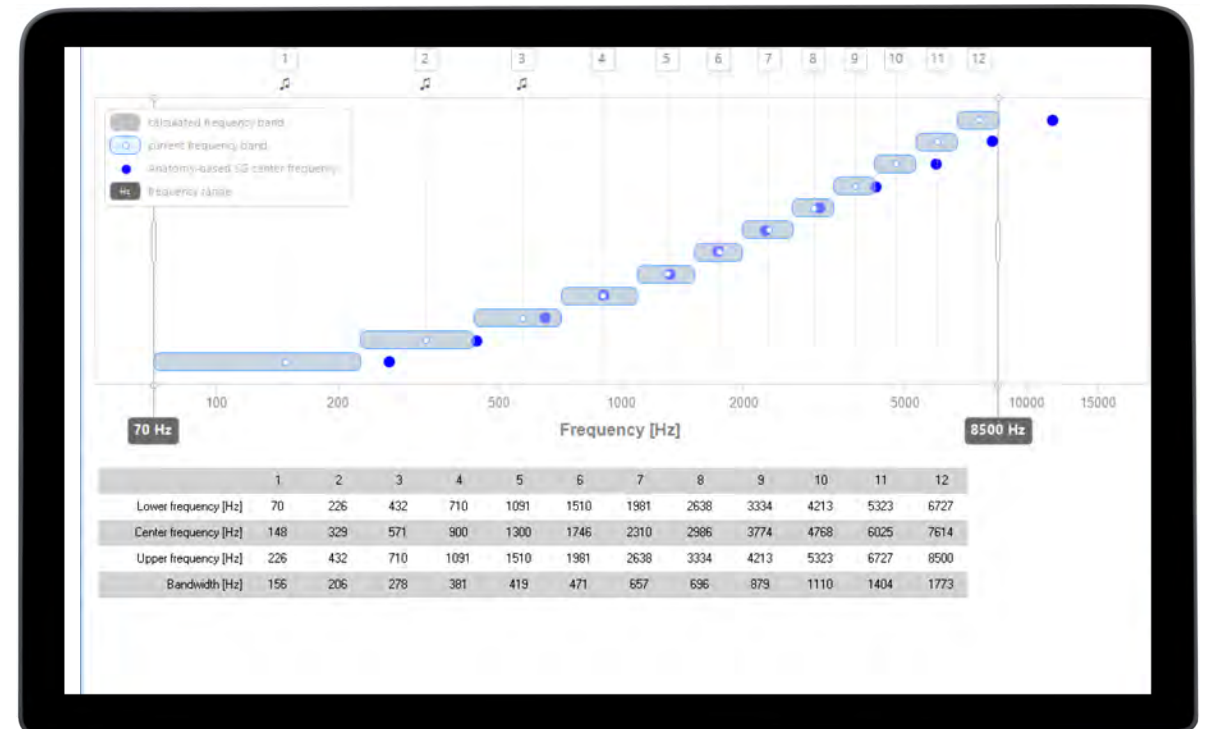


Left

Angular Insertion Depth:
545.3°



Patient G.



Patient G.

Comments

- All he ever said was that he couldn't understand speech
- Wore it for one month
- Did daily rehab

Still a head scratcher, but not giving up on it yet

Clinical Application

WHAT DOES
ABF DO FOR
THE PATIENT?

HOW DO YOU
MEASURE
BENEFIT?

WHO SHOULD
USE ABF?

IS IT WORTH
DOING?

Of course!

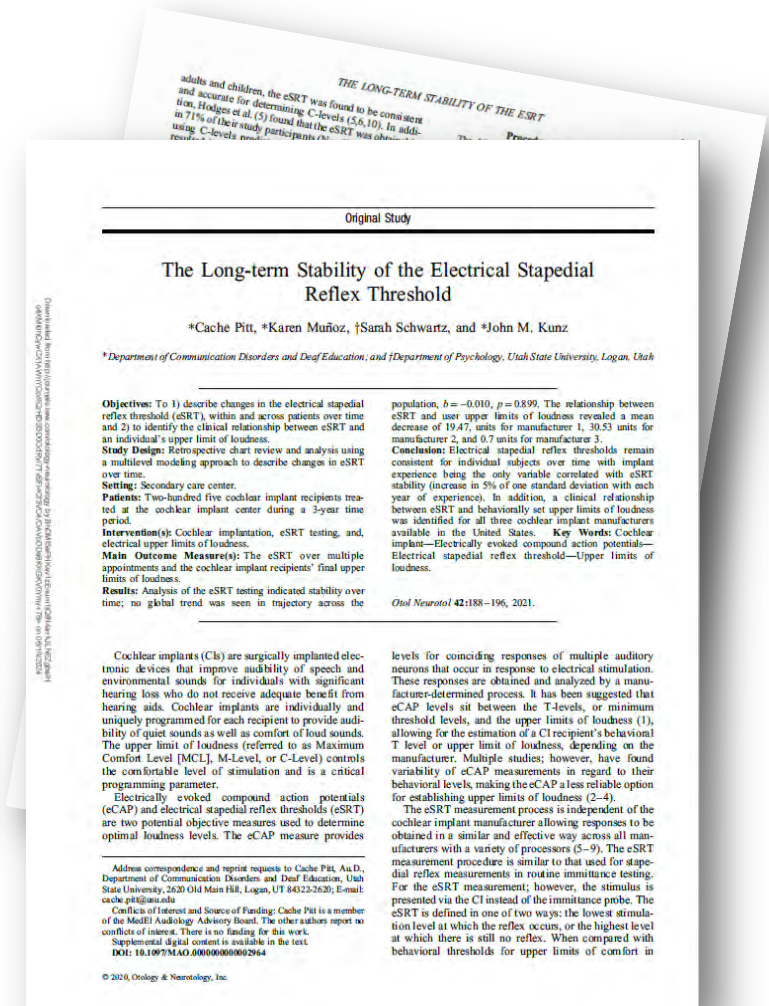
Summary - Benefits of using Objective Measures

- ✓ Impartial
- ✓ Quantifiable
- ✓ Reduces guesswork based on patient's potentially unreliable responses
- ✓ Allows you to make informed decisions based on actual data!
- ✓ Can save you clinic time – take your lunch break back!



Resources:

- MAESTRO Software Quick Guides on Objective Measures
- AudiologyOnline Webinars from MED-EL
 - Anatomy-Based CI Fitting: Matching the Natural Ear Like Never Before
 - Cochlear Implants & SSD: An Easy Approach to Audiologic Assessment
 - Optimizing Bimodal Fitting
 - MED-EL CIs & ESRTs: Protocol and Case Studies from Chattering Children
 - CI & SSD: Protocol and Case Studies from Baylor College of Medicine
- Your MED-EL Team
- OTOPLAN On Demand Team: otoplan.us@medel.com
- YouTube videos teaching basics of ESRT:
 - <https://www.youtube.com/watch?v=NMBDHgMAxUI>
- Pitt, Cache; Muñoz, Karen; Schwartz, Sarah; Kunz, John M.. The Long-Term Stability of the Electrical Stapedial Reflex Threshold. *Otology & Neurotology* 42(1):p 188-196, January 2021. | DOI: 10.1097/MAO.0000000000002964



A modern office interior featuring a white reception desk in the foreground. On the wall behind the desk is the large red "MED 9 EL" logo. To the left, a staircase with a red metal frame and glass railing leads upwards. In the background, there are glass-walled offices and a red "EXIT" sign above a doorway. A small seating area with white chairs and a potted plant is visible on the left.

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