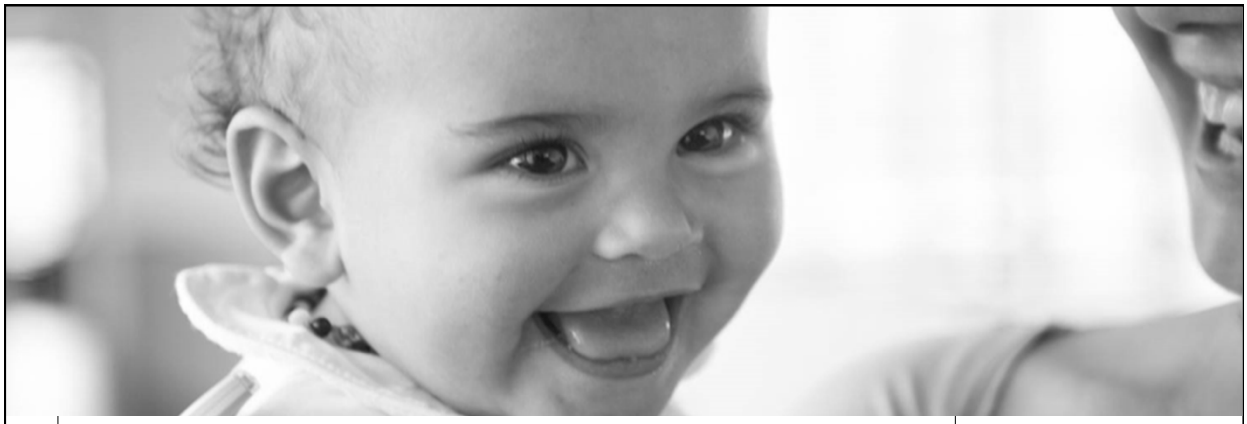

MED-EL Cochlear Implants & Electrical Stapedial Reflex Thresholds (ESRTs)

Protocol and Case Studies from Chattering Children/The River School

MED EL

Learning Outcomes

- After this course, learners will be able to diagram the auditory mechanism that elicits ESRT measures.
- After this course, learners will be able to list the equipment required to perform ESRTs on a cochlear implant (CI) recipient.
- After this course learners will be able to describe some clinical tips for working obtaining ESRTs in the pediatric population.

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MED EL

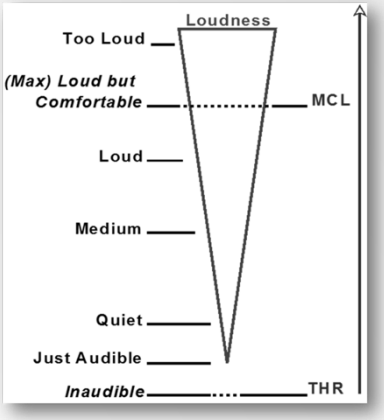
Fitting Fundamentals with MED-EL

Clinicians' priority (in general) should be to focus on measuring accurate Maximum Comfortable Loudness (MCL) levels.

- All other parameters can potentially be left at default
- For some patients, other parameters may be important

MED EL

Question:



"If MCL is set to Maximum does that mean the patient is hearing at Maximum loudness?"

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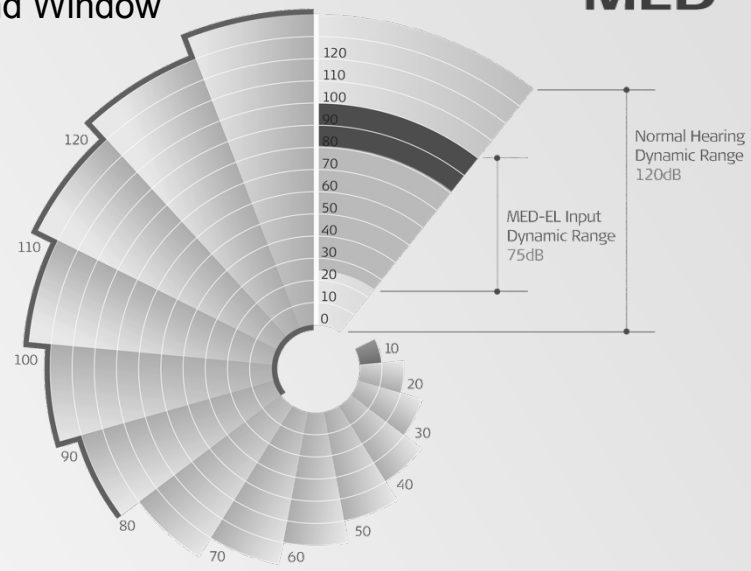
With MED-EL, patients hear at MCL level when…

- User volume setting is set to 100%
  AND
- Input level is ~105 dB SPL

At all other times, stimulation occurs below MCL

(Stoebich et. al, Ear & Hearing 1999; 20; 104 – 116)

AGC/Adaptive Sound Window



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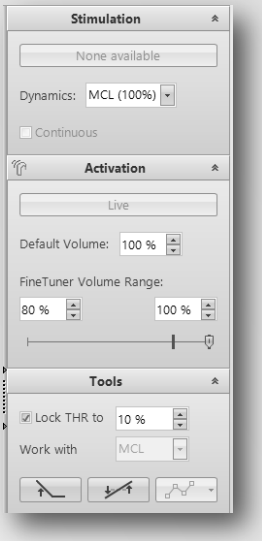
Setting Threshold (THR)

- Not a critical parameter for speech perception performance
  - **Should be inaudible**
- Setting options
  - Measure behaviorally and set below audibility
  - Quick fit approaches
    - Leave at default of 8 - 10%



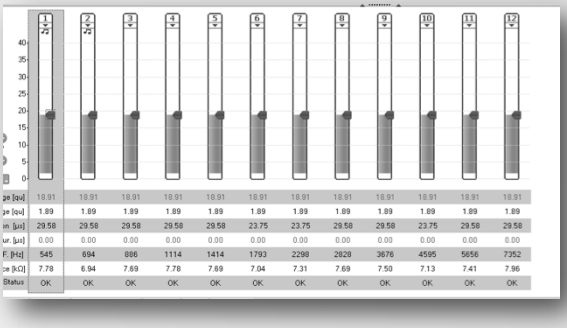
General Fitting Considerations

Average MCL level:

- **8 to 15 qu** (first fitting)
- **15 to 25 qu** (stabilized map)

~Be careful with high stimulation

- Overstimulation
- Poor speech discrimination/ performance
- Facial Nerve Stimulation (FNS)



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MED-EL Fitting Reminders

- MCL = most important parameter
- THR = must be inaudible
- Default volume at 100%
- Watch for outliers
- Audiogram results at ~25 - 30 dB are normal

Fitting goal

Provide access to sound with the appropriate balance of:

- ✓Comfort
- ✓Satisfaction
- ✓Performance

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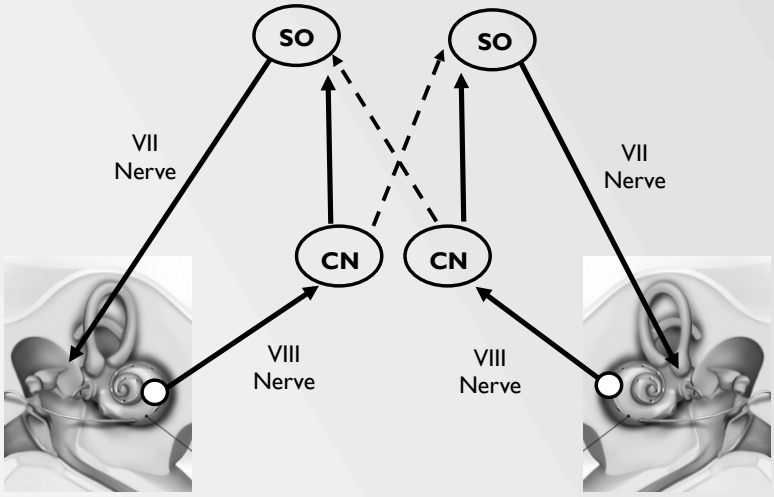
ESRT Pathway



ESRT

ESRT

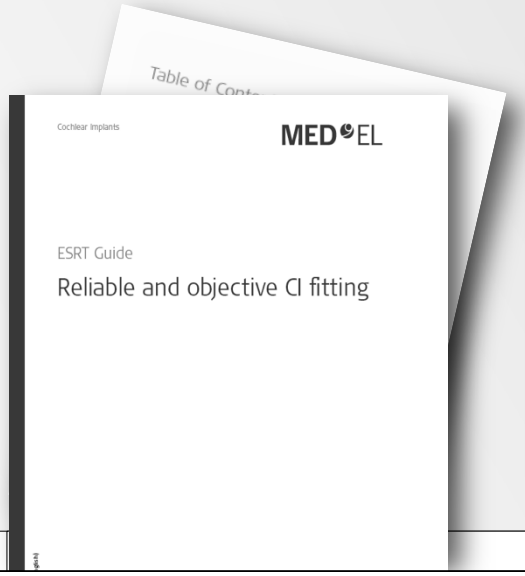
- Not always present
- High correlation between ESRT and MCLs
- Verifies appropriately-fit maps

Kosaner, et. al (2009, 2018)

ESRT

MED EL

ESRT Guide



ESRT in the Trenches:
A Practical Guide to Implementing ESRT in a Pediatric Setting

Sydney Bednarz, AuD
Julia Reid, AuD

CHATTERING CHILDREN

THE RIVER SCHOOL

Presented in partnership with

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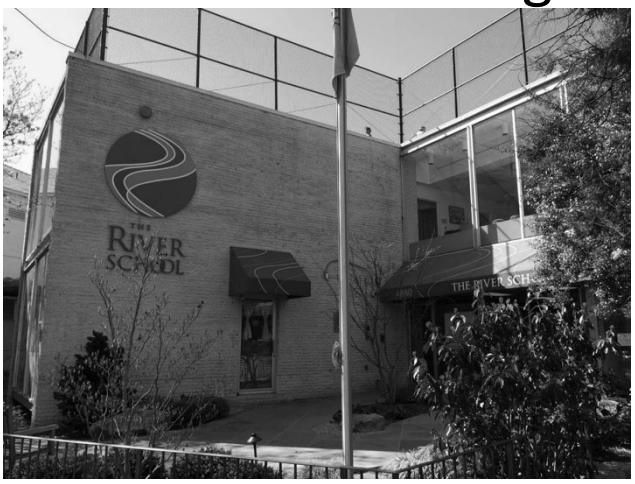
Our Clinic Protocol

The River School & Chattering Children



Our Typical CI Protocol

- During the First Year
  - Activation
  - 2 weeks
  - 4 weeks
  - 9 weeks
  - 3 months
  - 6 months
  - 9 months
  - 1 year
- After the First Year
  - If concerns, every 3 months
  - 1-8 years old: Biannually
  - >9-10 years old: Annually
- Booth testing
  - Warble tones starting at 4 weeks
  - Speech as soon as possible

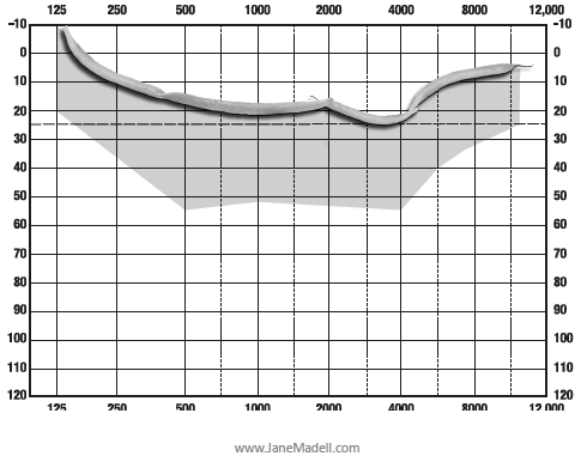
When We Use ESRT

- Begin at 2-week or 1-month follow-up
  - Fill in electrodes as needed at further mapping visits
- If it has never been measured on an existing patient
- Transfer patients
- Patient complains that things are too loud overall
- Patient's dynamic range is really narrow
- Annually *
  - ESRTs increase over the first year of implant use (Gordon et al, 2004; Kosaner et al, 2009)
  - ESRTs stabilize over time (Kosaner et al, 2009)

Verification of Mapping

Threshold Determination

- Warble Tones
- Ling 6 Sounds



Source: Jane Madell, used with permission.

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CONTINUED

Verification of Mapping

Speech Perception

- Words
- Sentences – Quiet and Noise
- Closed Set → Open Set
- Picture Pointing → Speech Production
- Scoring
  - Word Score
  - Phoneme Score

Details

- 1 meter away from speaker
- 60 dB SPL
- Speech front, Noise front
- Recorded Materials (if possible)
- Based off of the Pediatric Minimum Speech Test Battery (PMSTB)

(Ulher et al, 2017)

Pediatric Minimum Speech Test Battery

- Parental Questionnaires
- VRISD
- ESP Patterns, Spondees, Monosyllables
- PSI Words & Sentences
- MLNT/LNT
- CNC
- BKB Quiet
- Baby Bio
- BKB SIN
- Baby Bio Noise

MLNT/LNT

If <25% STOP

If 25-79%, CNC, repeat at follow-up

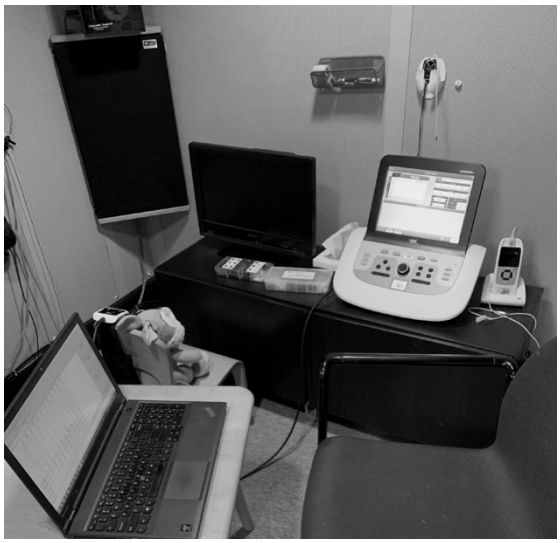
If >80% twice: CEILING, CNC

(Ulher et al, 2017)

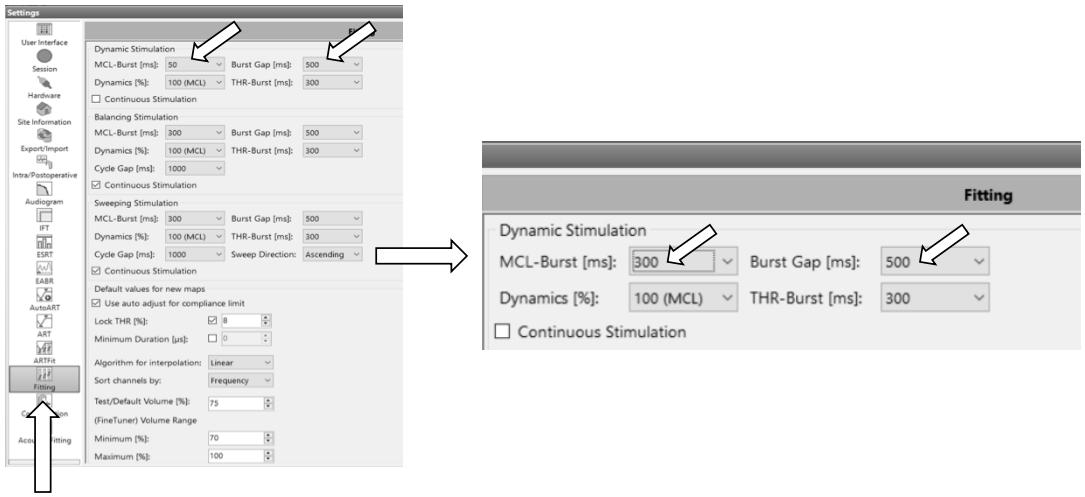
ESRT at Our Clinic

Room Set-up

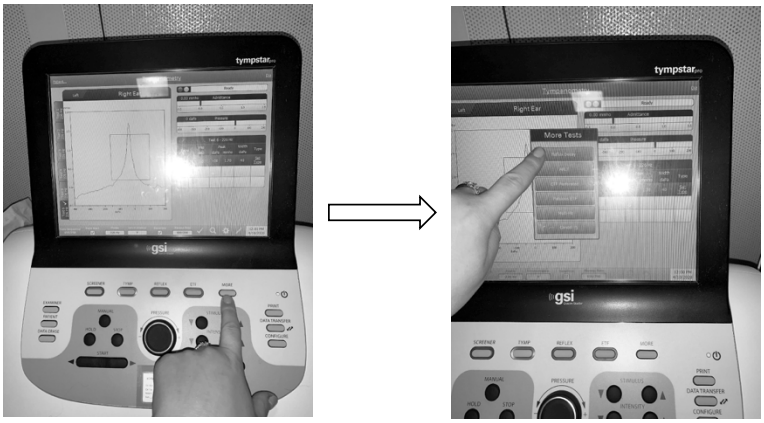
- Child-sized chair for patient
- TV Screen for distraction
- GSI Tympstar Pro
- Programming Laptop
  - on a child sized table
- Clinician's Chair
  - May or may not be an adult-sized chair
  - … OR sitting on the ground



Parameter Adjustments



ESRT Step by Step



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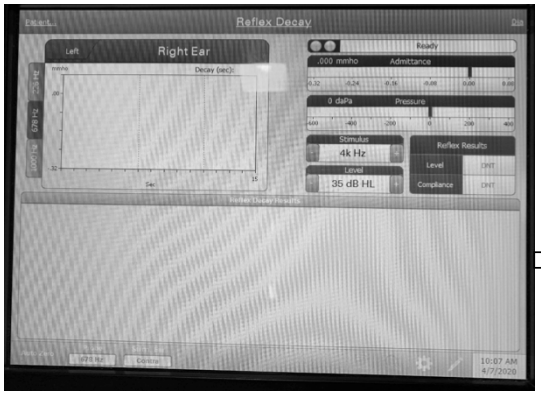
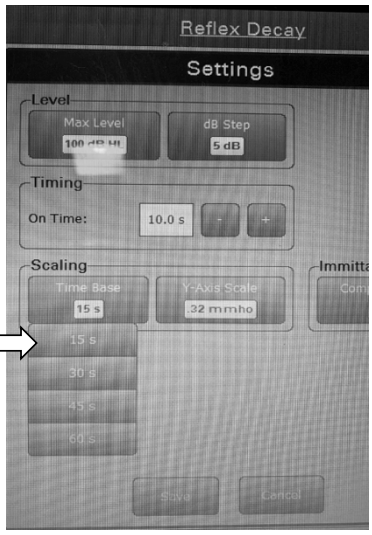
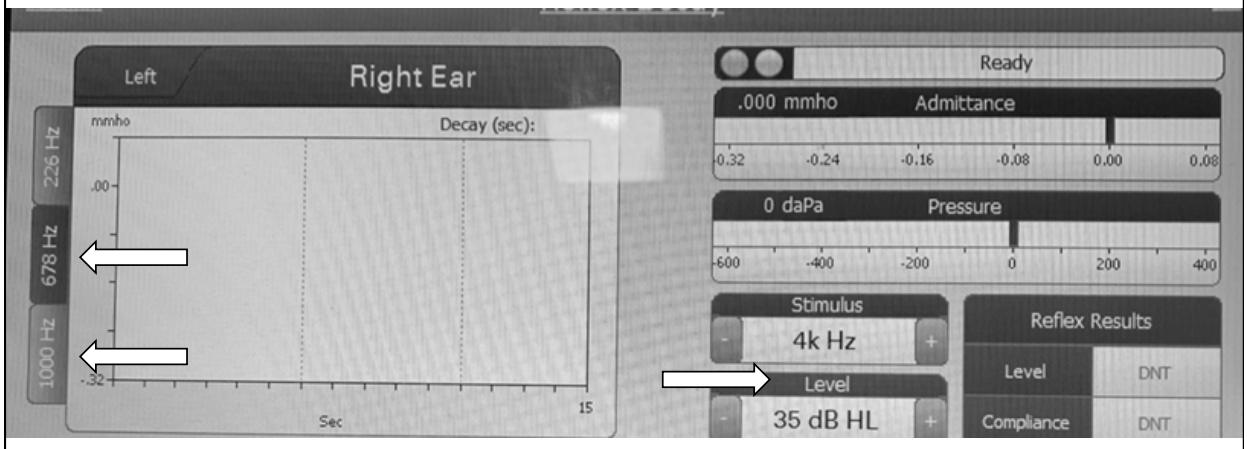
ESRT Step by Step





ESRT Step by Step



(Wolfe et al, 2017; Carranco et al, 2019)

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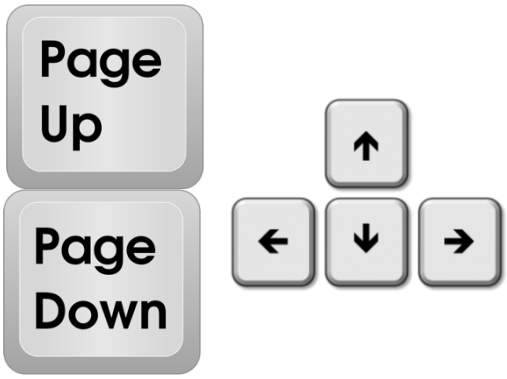
CONTINUED

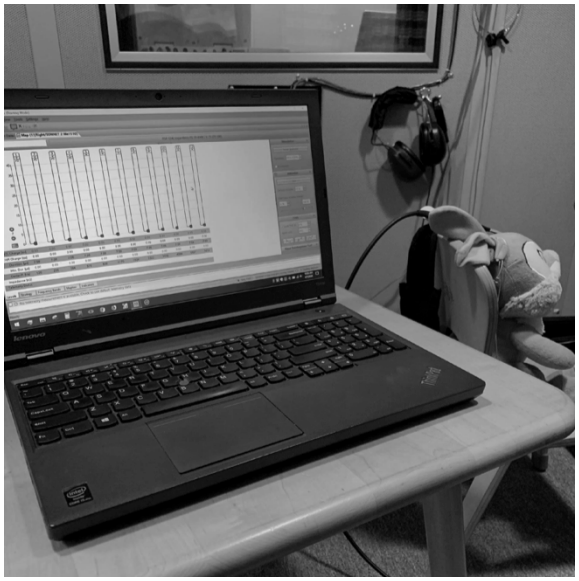
ESRT Step by Step

ESRT Step by Step

- Connect the child's processor to the programming computer using the Max interface
- If the child is bilateral or bimodal, the opposite ear's device should be removed
- Be sure patient/child is still and avoids excessive movements such as swallowing

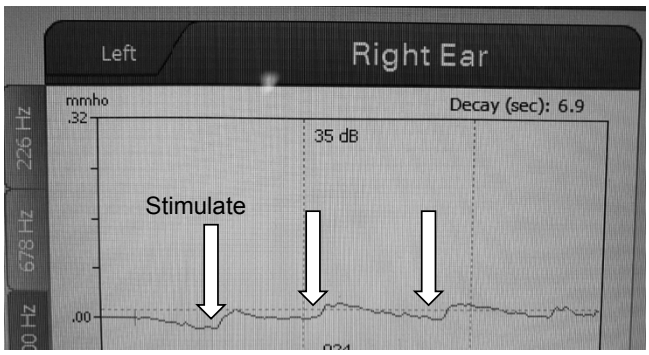
Using the Fitting Tab





ESRT Step by Step

- Look for a time-locked response on the tympanometer
- Response may be up-ward deflecting or down-ward



Benefits & Challenges

Benefits of ESRT

- Helps set M levels during programming
- Ensures not over or under-stimulating children who cannot other report loudness
- Correlates to target thresholds for Ling sounds for MED-EL
- Can be used with any manufacturer
  - MED-EL typically has a 1:1 ratio for where you measure ESRT and MCL levels
- Mostly stable over time
  - Annually tested to verify stability

Common Challenges

- Keeping the child still or from talking
  - "Catch a bubble!"
  - Screen time
- Limited ESRT responses across the array
  - Fill in the gaps at subsequent programming sessions
- Admittance Issues
  - Maintaining a seal
  - Maintaining zero pressure
    - Adjust pressure dial
  - Middle Ear Issues, PE Tubes, perforation, etc.

Billing & Coding

National Correct Coding Initiative (CCI)

Column 1 *CPT Procedure (one)*	Column 2 *Paired With (one)*	Can be performed on same date? Yes/No		If so, use what modifier? [2]
		Office setting	Hospital outpatient setting[1]	
92601	92507, 92508, 92521, 92522, 92523, 92524, 92550, 92567, 92568, 92570, 92585, 92586, 92602, 92626	Y	Y	-59
92601	92552, 92553, 92555, 92556, 92557, 92558, 92561, 92562, 92563, 92564, 92565, 92571, 92572, 92575, 92576, 92577, 92579, 92582, 92583, 92584, 92587, 92588, 92596, 92597, 92603, 92604, 97755, 0208T, 0209T, 0210T, 0211T, 0212T	N	N	N/A

ASHA (n.d.)

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92601	92552, 92553, 92555, 92556, 92557, 92558, 92561, 92562, 92563, 92564, 92565, 92571, 92572, 92575, 92576, 92577, 92579, 92582, 92583, 92584, 92587, 92588, 92596, 92597, 92603, 92604, 97755, 0208T, 0209T, 0210T, 0211T, 0212T	N	N	N/A

ASHA (n.d.)

Presented in partnership with

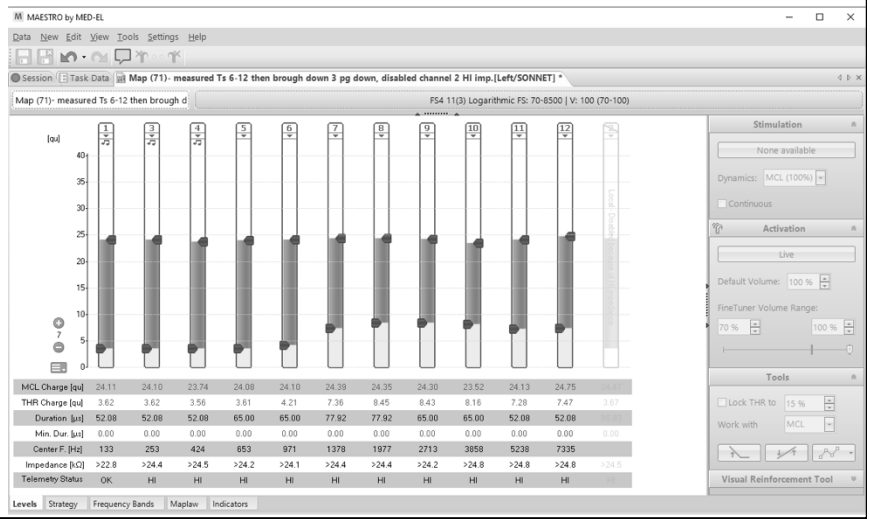
Case Studies

Case Study # 1

- 4 year, 8 month old male
- Underwent cochlear implant surgery for the RIGHT ear on July 15, 2016 and received a MED-EL SYNCHRONY cochlear implant
  - Activated on September 16, 2016 with the SONNET BTE cochlear implant processor
- Underwent cochlear implant surgery for the LEFT ear on December 30, 2016 and received a MED-EL SYNCHRONY cochlear implant cochlear implant
  - Activated on February 14, 2017 with a SONNET BTE cochlear implant processor
- Left revision surgery on August 21, 2019
  - Activated on June 9, 2019
- Uses RONDO processors as back ups

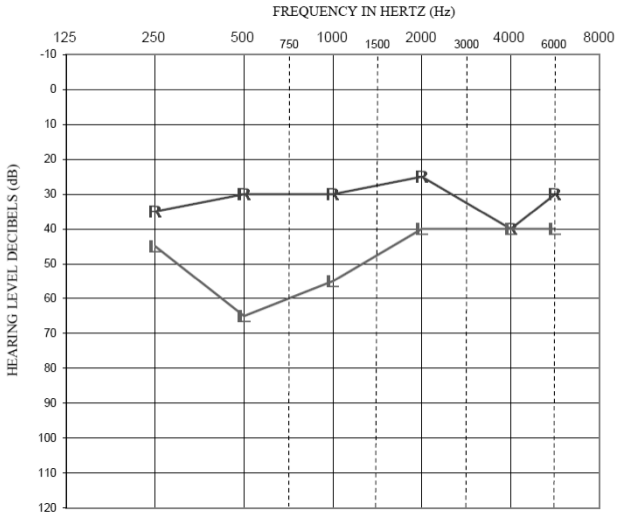
Case Study #1

- Pre-ESRT map (71)
  - Measured Ts
  - Flat map as per recommended



Case Study #1

- Pre-ESRT map (71)
- NU-CHIPS AU- 80%
  - DNT individual ear
- Ling thresholds
  - mm- 35 dB
  - oo- 65 dB
- Datalogging- 7 hours/ day
- Prior to re-implantation



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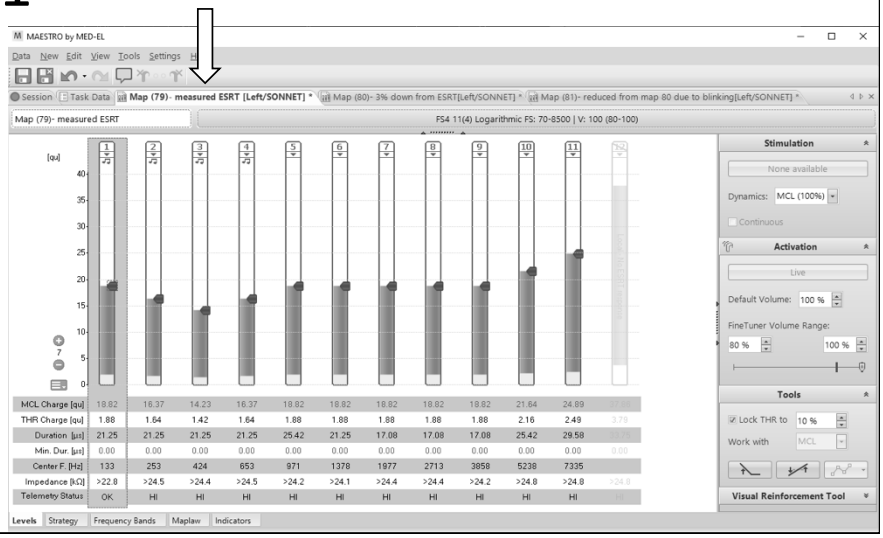
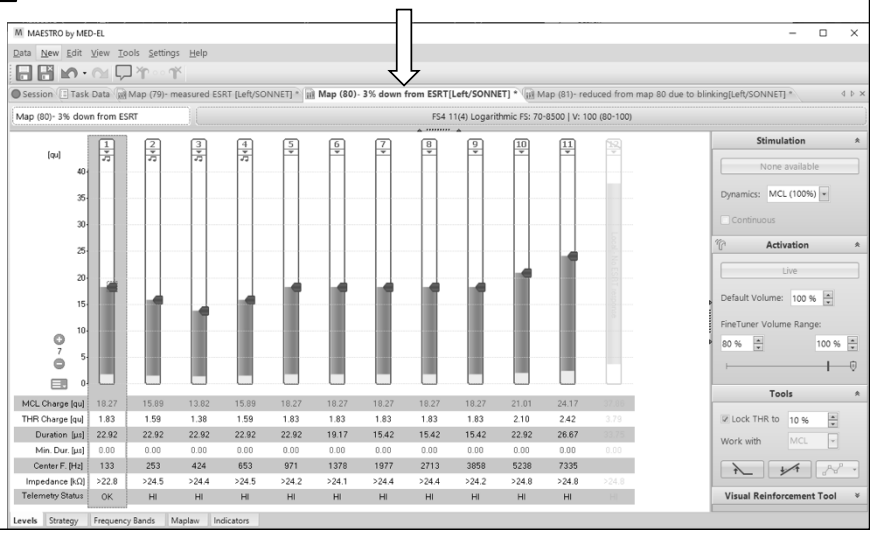
Case Study #1

- ESRT map (79)
  - Ts locked at 10%



Case Study #1

- ESRT based map (80)
  - Ms reduced 3%
  - Ts locked at 10%



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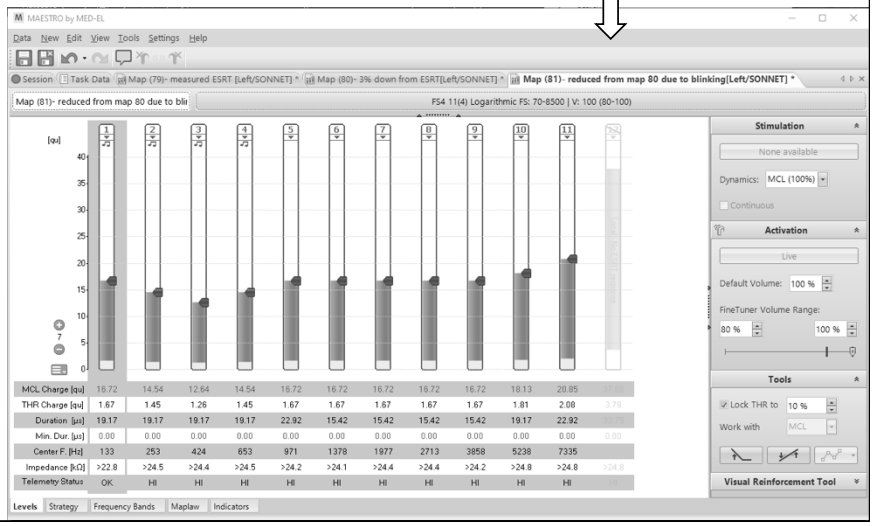
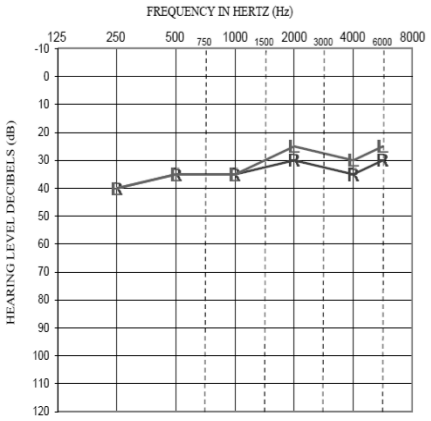
Case Study #1

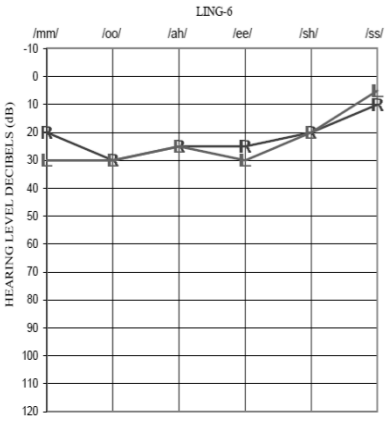
- ESRT based map (81)
  - Ms reduced 15%
  - Ts locked at 10%



Case Study #1

- 4 months post re-activation
- ESRT based map (81)
- NU-CHIPS Left-20%
- Datalogging- 5.5 hours/day





Presented in partnership with

CONTINUED

Case Study #2

- 31-year-old female
- Enlarged vestibular aqueducts (EVA)
- Spoken English and American Sign Language

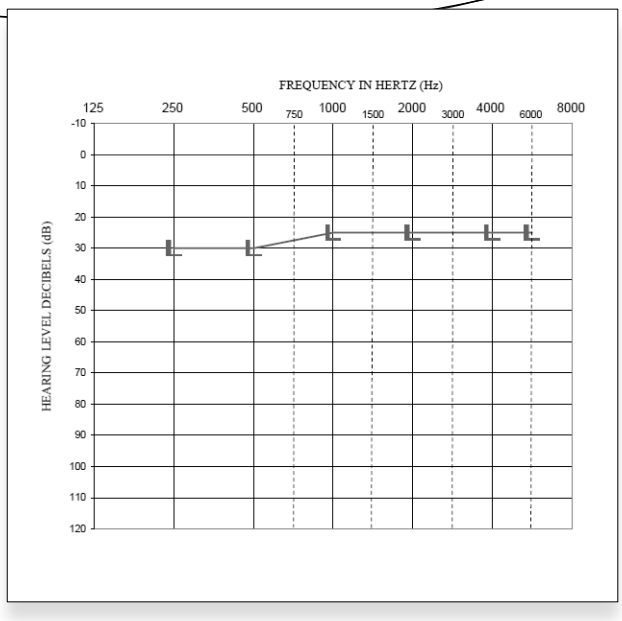
- Between 2-3 years: Diagnosed with bilateral hearing loss
- 3 years old: Fit with bilateral HAs
- 7 years old: Discontinued right HA due to limited benefit

- 25 years old: Received a left MED-EL CONCERT FLEX28 internal electrode

Case Study #2

- Pre-ESRT based map
- Consistent CI User

- CNC = 74%
- BKB-SIN = 9 dB SNR



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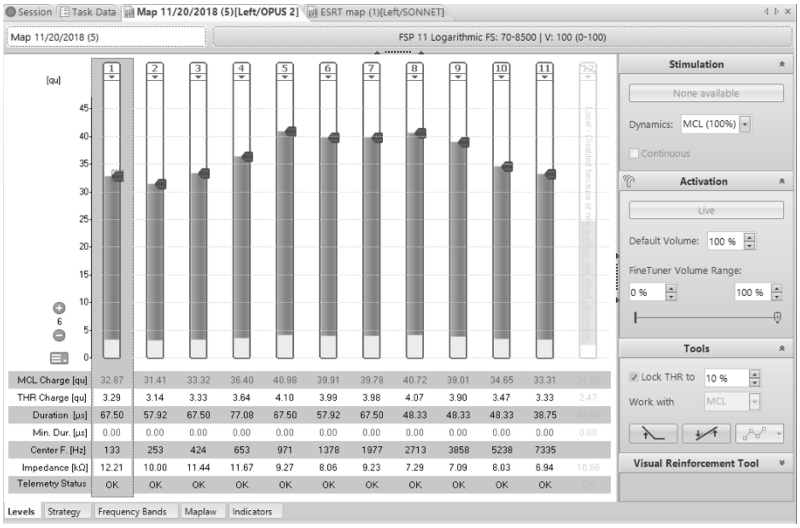
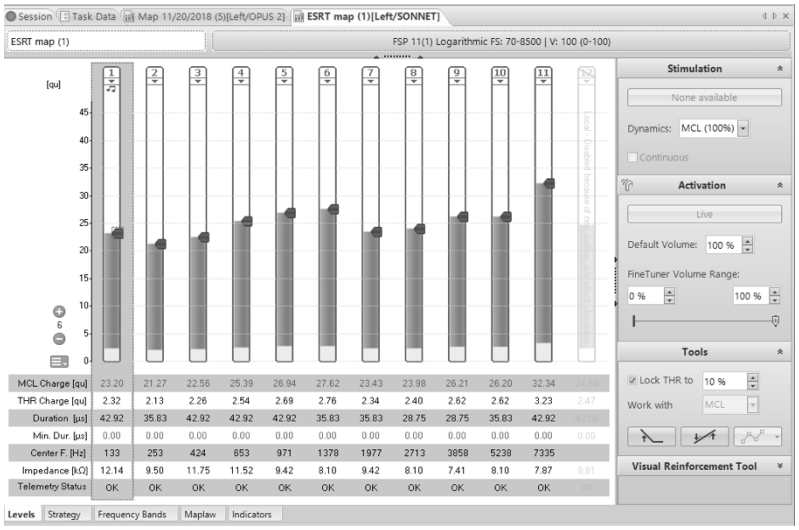
Case #2

- Pre-ESRT map



Case #2

- ESRT map
  - Did NOT like
  - Facial stimulation noted on high frequency channels



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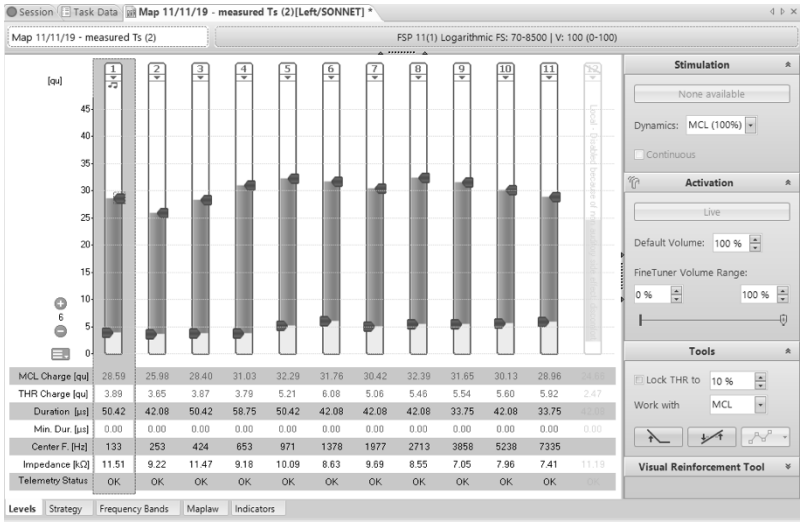
CONTINUED

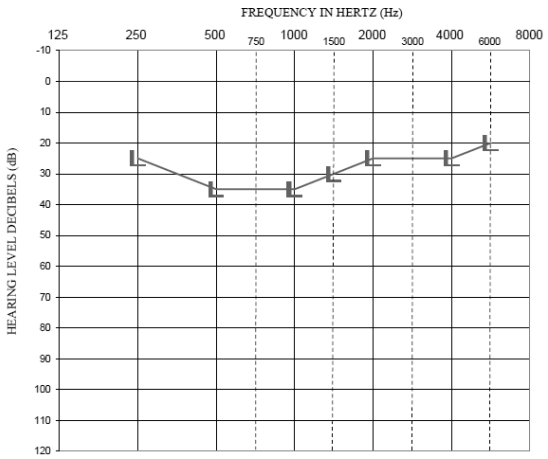
Case #2

- ESRT-based map
  - Able to bring down MCL levels, but still higher than ESRT
  - Measured Ts and decreased/swept to ensure inaudibility
- Recommendation:
  - Sound Diet



Case Study #2

- In a live mode, patient thought it was too soft and felt like everyone was whispering but gradually adjusted.
- After the appointment, patient reported much more comfort with the sound of running water.
- CNC = 72%



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CONTINUED

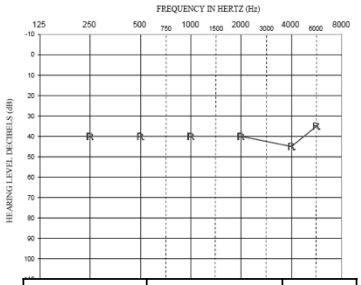
Case Study #3

- 4-year-old female (currently)
- Enlarged Vestibular Aqueducts (EVA)
- Asymmetric, progressive hearing loss

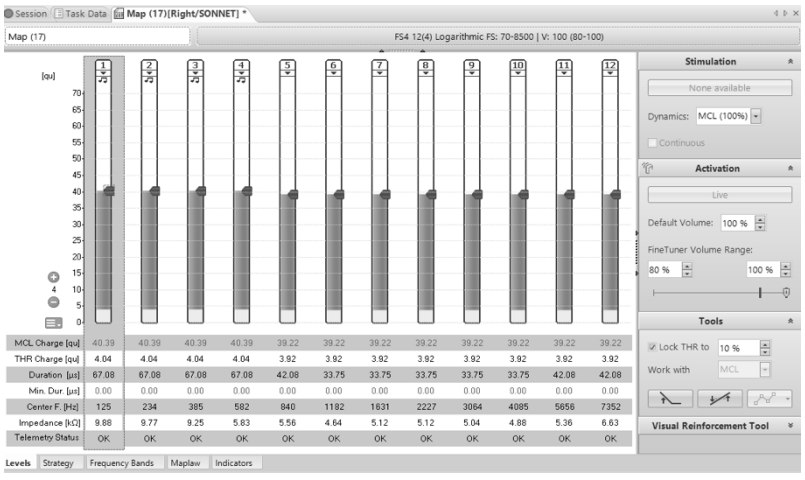
- 7 mos: Right hearing aid
- 23 mos: Left hearing aid
- 27 mos: Received a right MED-EL FLEX28 internal electrode

Case #3

- Pre-ESRT



Right CI	NUCHIPS	80%
Bimodal	NUCHIPS MLNT	88% 50%



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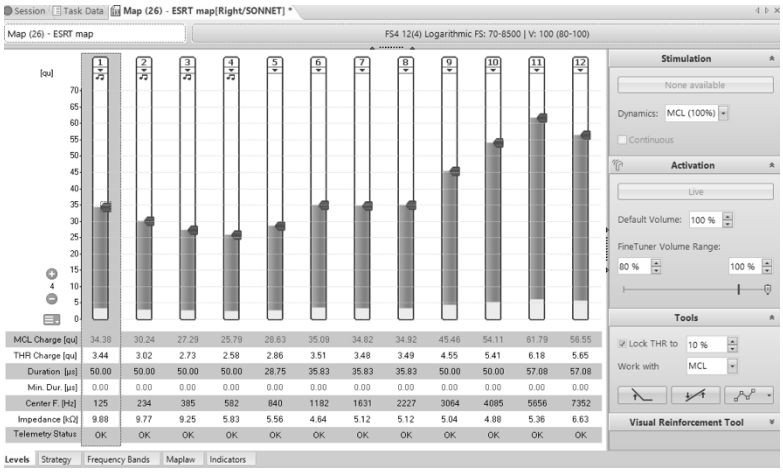
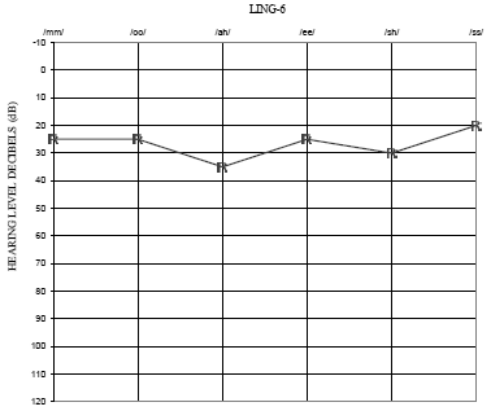
Case #3

- ESRT levels
- Note:
  - Higher stimulation levels in the high frequencies than a typical map. ESRT is "typically" flat across the array.



Case #3



Right CI	NUCHIPS MLNT	80% 79%
Bimodal	LNT	74%

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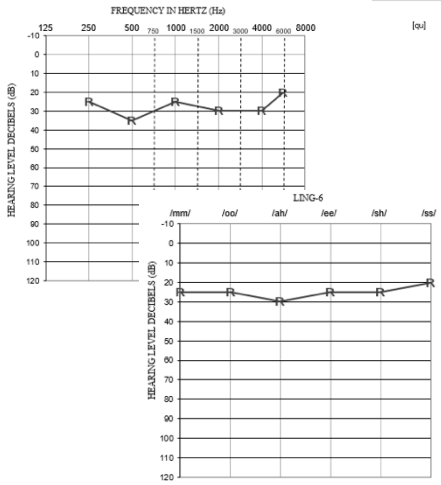
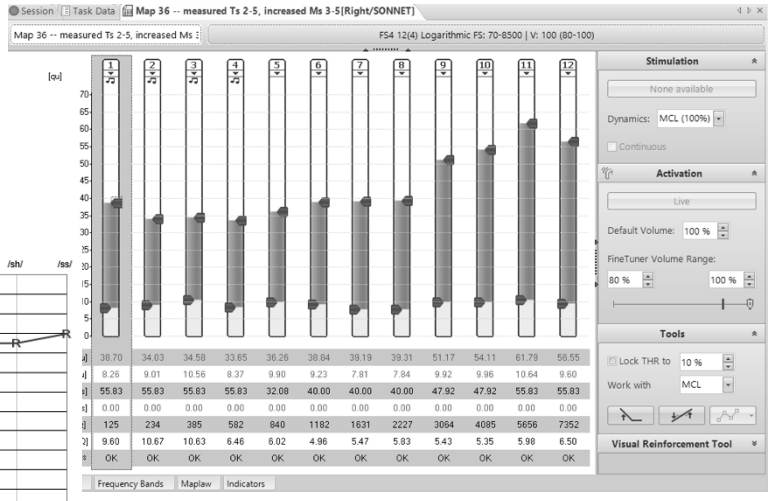
Case #3

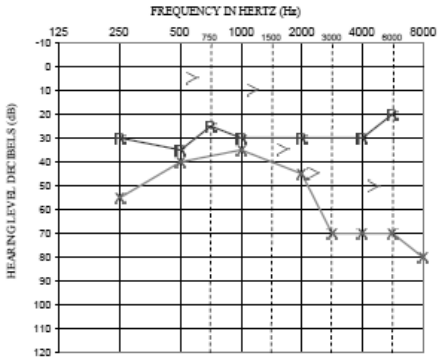


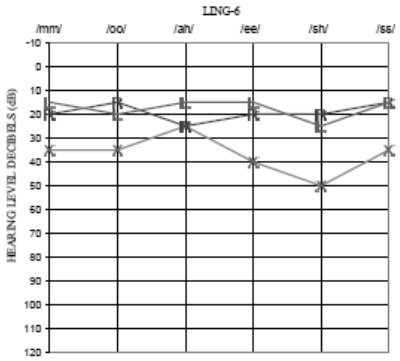


Case Study #3

- Pediatric AzBio
  - Quiet = 96%; Noise +5 SNR = 64%

Right CI	PBK	76%
Left HA	PBK	84%
Bimodal	PBK BKB-SIN	80% 3.5 SNR





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Case Study #3

CASL-2 Subtest	Standard Score	Percentile Rank	Test-age Equivalent
Receptive Vocabulary	119	90	4;9-4;11
Expressive Vocabulary	110	75	4;6-4;8
Sentence Expression	119	90	5;3-5;5
Grammatical Morphemes	114	82	5;0-5;2
Sentence Comprehension	124	95	6;0-6;2
Inference	108	70	4;3-4;5
Pragmatic Language	108	70	5;0-5;2

CASL-2 Indexes	Standard Score	Percentile Rank
General Language Ability	112	79
Receptive Language Index	119	90
Expressive Language Index	109	73
Lexical Semantic Index	113	81
Syntactic Index	119	90

Conclusion

- Great objective measure
  - To verify where you've set your MCL levels
  - When patients aren't reliable at loudness scaling
  - When patients are loudness junkies
- ESRT can be completed on children
- Better patient outcomes and comfort
- Validation and verification of programming is essential

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Thank you!

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