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Grand Rounds, in partnership with The Ohio State University

Gail Whitelaw, PhD
Jack Korsgard, BS
Madison Pollock, BA
Christina Martin-Smith, MGS
Aryn Robinson, BS
Liam Smyth, BA

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Gail Whitelaw, PhD

Gail M. Whitelaw, Ph.D., is a clinical associate professor in the AuD program and the director of the Speech-Language-Hearing Clinic at The Ohio State University in Columbus, OH. Her areas of clinical interest are tinnitus, auditory perception in children and adults, educational audiology, and working with people with HD (hearing deficits-- those with functional auditory complaints). She has consulted to many school districts throughout the county. Dr. Whitelaw has also worked with children and their families in developing educational plans and goals for children with auditory processing disorders.

Jack Korsgard, BS

Jack Korsgard is a third-year student AuD student at The Ohio State University. He graduated with his B.S. In Psychology from OSU in 2022, discovering a passion for speech science and ultimately audiology in his fourth year while working as a research assistant. Before starting graduate school in 2023, Jack worked full-time in the field of psychiatry as a medical technician. As a graduate student, Jack has worked as a graduate research assistant in the Speech Recognition and Aging laboratory, and as a teaching assistant for Ohio State's introductory vestibular course. His clinical and academic interests include vestibular diagnostics, ototoxicity and delivering healthcare that considers patient quality of life and individual needs.

Christina Martin-Smith, MGS

Christina Martin-Smith, MGS is a fourth-year student. She accepted a 4th year externship at the Pittsburgh VA Health Center. Christina's passion in audiology encompasses tinnitus, vestibular, and older adults. However, she currently has interest in educational audiology after volunteering for hearing screenings during the three academic years of the OSU audiology program. Outside of the profession, Christina enjoys exploring Pittsburgh with her family and taking walks along one of the three famous Pittsburgh rivers.

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Madison Pollock, BA

Madison Pollock is a third-year Doctor of Audiology student at The Ohio State University, where her Bachelor of Arts in speech and hearing science was also completed. Madison has a strong interest in complex and unique medical pediatric cases. She is a LEND trainee in audiology at the Nisonger Center at Ohio State for the 2025-2026 school year.

continued

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Aryn Robinson, BS

Aryn Robinson is a third-year student in Ohio State's Doctorate of Audiology Program. She is an active member of her program, department, and university. Miss Robinson serves as the president of Ohio State's chapter of the Student Academy of Audiology (SAA). She is also one of the department's delegates to the university's Council of Graduate Students. Her favorite activities with the department are those that deal with community outreach.

Liam Smyth, BA

Liam Smyth is a 4th year doctor of audiology student at the Ohio State University, currently completing his externship at the Iowa City VA Medical Center. He graduated from Ohio State in 2022 with a BA in Speech and Hearing Science and a minor in Public Policy. His interests include auditory scene analysis, tinnitus, interdisciplinary care, and advocacy.

Disclosures

- **Presenter Disclosure**: Financial: Gail Whitelaw is an employee of the Ohio State University. Non-financial: Gail Whitelaw sits on the Board of Directors, Accreditation Commission for Audiology Education (ACAE), Honors and Awards Committee, and American Academy of Audiology. Financial: Jack Korsgard has no relevant financial relationships to disclose. Non-financial: Jack Korsgard has no relevant non-financial relationships to disclose. Financial: Christina Martin-Smith has no relevant financial relationships to disclose. Non-financial: Christina Martin-Smith has no relevant non-financial relationships to disclose. Financial: Madison Pollock has no relevant financial relationships to disclose. Non-financial: Madison Pollock has no relevant non-financial relationships to disclose. Financial: Aryn Robinson has no relevant financial relationships to disclose. Non-financial: Aryn Robinson has no relevant non-financial relationships to disclose. Financial: Liam Smyth has no relevant financial relationships to disclose. Non-financial: Liam Smyth has no relevant non-financial relationships to disclose.
  - AudiologyOnline has made a donation to the audiology program at The Ohio State University Student Academy of Audiology for this presentation.
- **Content Disclosure**: This learning event describes the use of CROS/biCROS hearing aids in unique clinical populations.
- **Sponsor Disclosure**: This course is presented by the Ohio State University in partnership with AudiologyOnline.

Limitations/Risks

- The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.
- As healthcare is rapidly evolving, new findings may change the validity of the information presented in this course. Providers should always consult the latest research and guidelines from professional associations.
- The interventions discussed in this course may be limited in generalizability, requiring practitioners to consider specific individual and population factors.
- The course may not cover all possible risk factors, diagnostic methods, or treatment options, and complex cases may require additional considerations.
- Healthcare providers should apply cultural competence and sensitivity to ensure effective and respectful care based on their patients' diverse needs.
- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Learning Outcomes

After this course, participants will be able to:

- Describe use of CROS/biCROS hearing aids in unique clinical populations.
- Discuss cochlear implant use and concerns in genetic and medical conditions.
- Outline the role of the audiologist in working with TBI/stroke patients.

continued

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Bilateral Implantation but Only One Functional Cochlear Implant

Christina Martin-Smith, MGS

Agenda

- Brief Overview of Wegener's Granulomatosis
  - What is it?
  - How does it relate to the ears?
  - How is it treated?
- Meet Mrs. L
- Year of Surgeries
- Spring 2025

Wegener's Granulomatosis

- Described in 1897 by McBride but fully presented by Fredrich Wegener (Nemade & Shinde, 2021)

- Now called Granulomatosis with polyangiitis (GPA)

Scientific Definition

- “a systemic autoimmune disease of unknown etiology characterized by necrotizing granulomatous inflammation and vasculitis affecting mainly small blood vessels” (p. 3 Nemade & Shinde, 2021)

Broken Down Definition

- [a]Granulomatous:
  - Inflamed cells trying to eliminate a foreign body
- [b]Necrotizing (necrosis):
  - Body tissue dying
- Vasculitis:
  - Inflamed blood vessels

- Putting them together:
  - Dying inflamed cells and inflamed blood cells
  - Predominantly affecting the upper/lower respiratory tracts and kidneys.

[a]https://my.clevelandclinic.org/departments/respiratory/depts/infectious-disease/granuloma
[b]https://my.clevelandclinic.org/health/diseases/23959-necrosis

[a] Impact on Hearing/Balance

- Sensorineural hearing loss/Balance
  - Vasculitis of the inner ear blood vessels
  - Clustered cells on the VIII cranial nerve
- Conductive hearing loss
  - Blood cells of the eardrum cluster together and necrotize causing perforations and chronic drainage
- Mixed Hearing loss
  - [b]Often causes the highest thresholds

[a] Nemade & Shinde 2021
[b] Vainutiene et. al. 2024

Treatment of Wegener's

Induce Remission:

Immunosuppressants

- [a]Rituximab
  - Cyclophosphamides alternative
  - Used for autoimmune inner ear disease (AIED) to help resolve hearing loss symptoms
- [b]Methylprednisolone
  - Steroid

Maintain Remission

- [c]Azathioprine
  - Anti-rejection, antimetabolite drug
  - Not much is known on side effects

[a] Arya et al., 2025
[b]Nemade & Shinde, 2021
[c]Franz et al., 2022

Meet Mrs. L

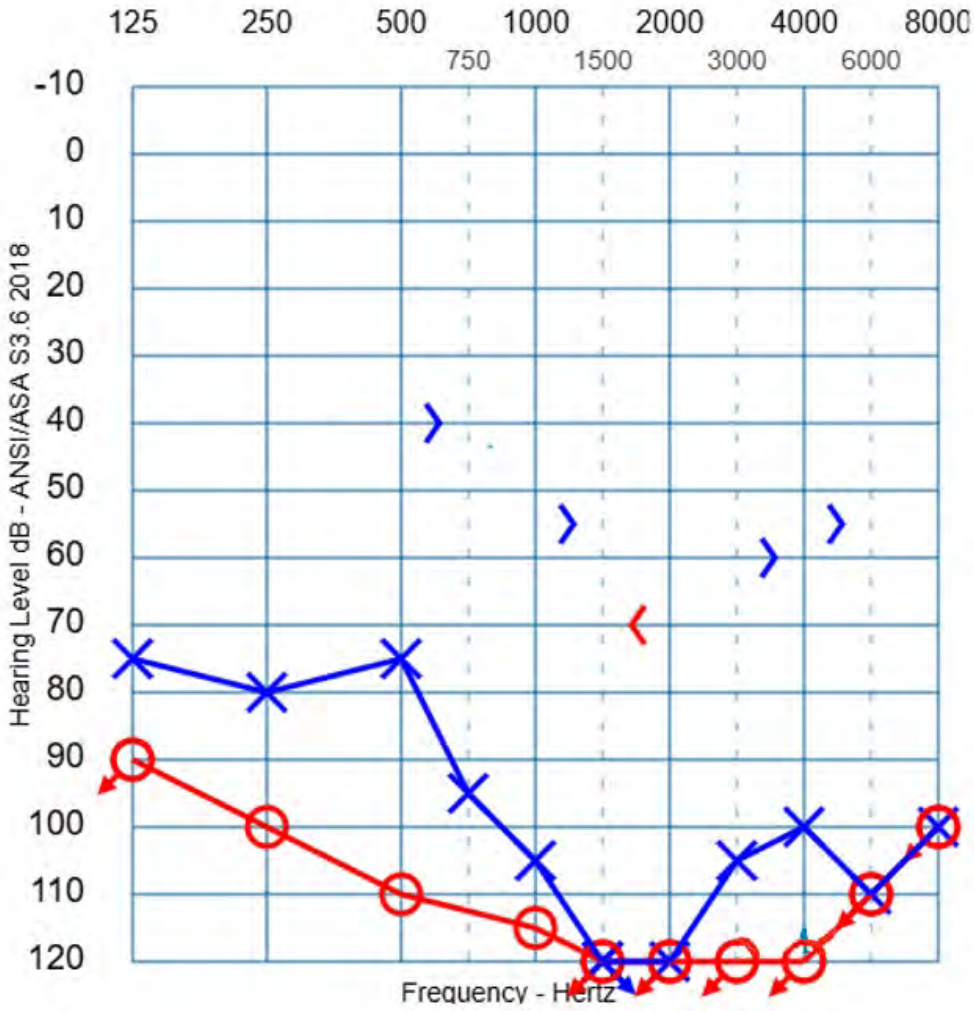
April 15, 2024

- 75-year-old female
- Uses Live Caption App on her smartphone
- She reported her hearing loss was caused by Wegener's Granulomatosis. She expressed having normal hearing until 2017.
- History of ear surgery: 2018 mastoidectomy for 'suspected' cholesteatoma.
- History of drainage and pain in the left ear

Audiogram: 4/15/2024

	Right	Left
SRT	105dB	85dB
WRS	12% at 110dB	52% at 105dB

SRT= Speech Recognition Threshold
WRS= Word Recognition Score



Cochlear Implant Evaluation

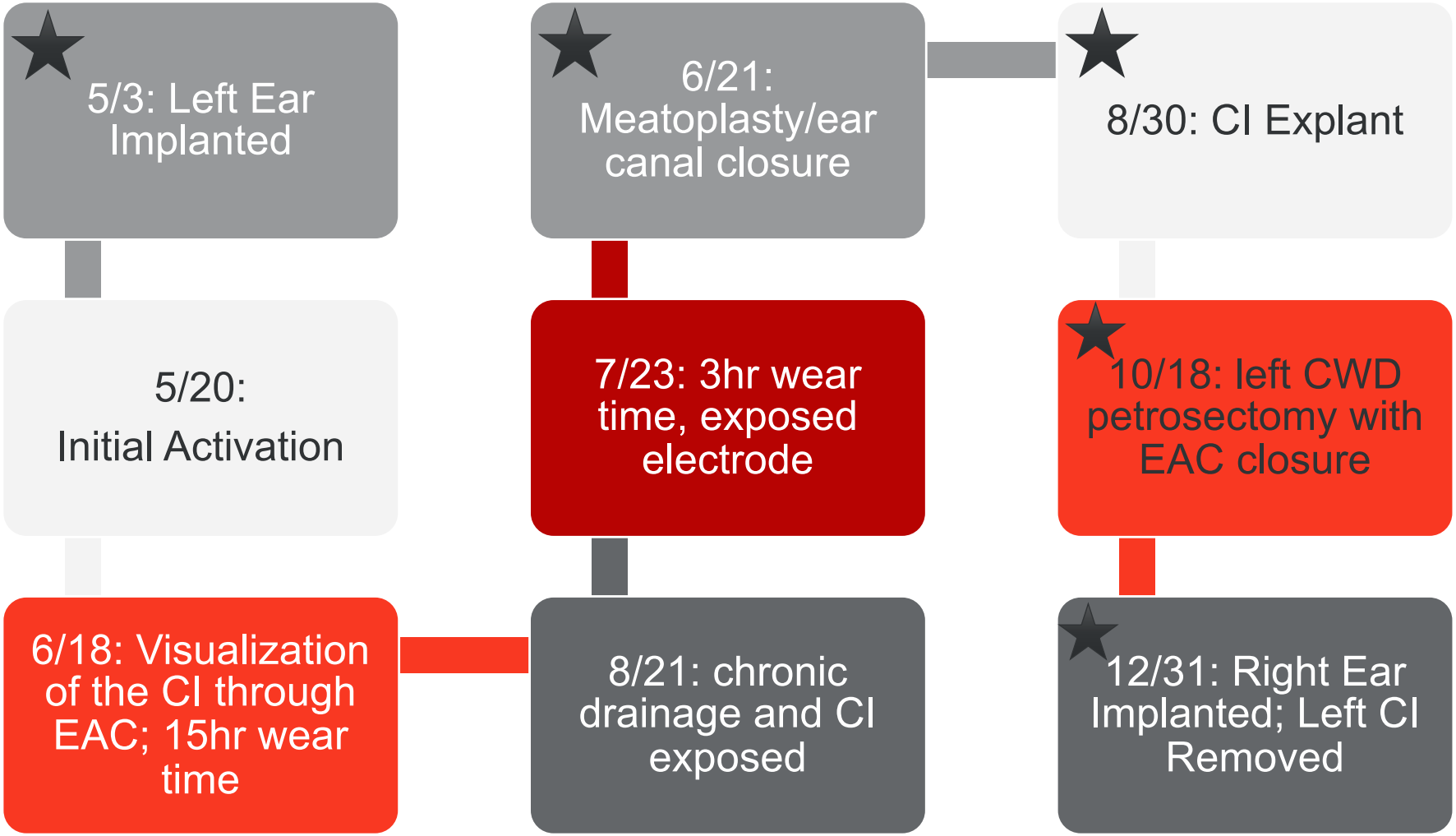
- Fit with Phonak Naida P90 hearing aids with foam molds
  - Unable to complete Real Ear Measure on the left ear due to drainage

	AzBio (quiet)	CNC, words, Phonemes
Binaural	53%	18%,42%
Right	0%	DNT
Left	44%	DNT

Year of Surgery

May 2024- December 2024

★ Denotes Surgery



Hearing Ability

Results from Left ear:

- Air Conduction Threshold
- *AzBio (sentences in quiet)
- *CNC (words, phonemes)

*Phonak Naida P90 UP were programmed

	4/15/2024*	12/4/2025
250Hz	60	40
500Hz	50	40
1000Hz	45	30
2000Hz	60	35
3000Hz	65	40
4000Hz	70	30
6000Hz	DNT	25
AzBio	44%	77%
CNC	DNT	40%, 60%

How is she doing?

Spring 2025

January 22, 2025

- Initial Activation of Right Cochlear N8 Processor
- Medical History: reports of balance difficulties since surgery
- Programming
  - Population mean for initial start then balanced for loudness to ensure audibility and comfortability.
  - Paired processor to iPhone, iPad, phone clip and mini-microphone

1-month and 3-month post-activation

February 12, 2025

- Reports doing well
- Recently completed another round of treatment and felt lethargic
- Perceives sound coming from her left side

April 23, 2025

- Continues to do well
- No longer perceives sound from the left side

Hearing Ability

Results from Right Ear:

- Air Conduction Threshold
- AzBio (sentences in quiet)
- CNC (words, phonemes)

	4/15/2024	2/12/2025	4/23/2025
250Hz	50	25	30
500Hz	60	30	35
1000Hz	80	30	30
2000Hz	NR@80	35	40
3000Hz	NR@80	40	45
4000Hz	NR@80	30	40
6000Hz	DNT	20	20
AzBio	0%	61%	67%
CNC	DNT	34%, 57%	48%, 70%

Summary

- Wegener's Granulomatosis: an autoimmune disease affecting small blood vessels
  - Can cause SNHL, CHL, or MHL
- Mrs. L was first implanted on the left side before it was removed and the right side was implanted
  - Underwent two additional surgeries on the left side while the right side has only had the one implantation surgery to date.
- The months following the right-side activation have been going well with no further complications.

TBI & Auditory Processing

Liam Smyth, B.A.

Agenda

- What is mTBI?
- A Review of the Research
- Patient Case Report
- How Does This Case Relate Back to The Research?
- Stream Segregation
- Some Closing Thoughts

Mild Traumatic brain Injury

- Traumatic Brain Injury is classified along a continuum, divided into mild, moderate, and severe categories (Katz, et al (2015)).
- Mild Traumatic Brain Injury (mTBI) is generally defined as:
  - Loss of consciousness lasting 0-30 minutes.
  - Post traumatic amnesia lasting less than 24 hours.
  - Focal neurological deficits that may or not be transient.
  - Any sort of mental alteration at the time of the incident.

Harris, et al (2024)

- Most studies investigating acoustic trauma have focused on blast injuries.
- The authors sought to review the effects of mTBI on the structures and pathways of the auditory and vestibular systems.
- Literature review - PubMed, Scopus, and Web of Science were searched.
  - Reference search did not yield any additional studies.

Harris, et al (2024)

- Hidden hearing loss occurs by synaptopathy, followed by neural axonal loss and neural degeneration in the Prescence of full recovery of cochlear thresholds.
  - Noise-exposed rats had significantly fewer synoptic ribbons.
- Damage to the central auditory pathway could occur via overt damage to CN VIII, endolymphatic duct, labyrinthine fluid shock pulses that damage the sensory epithelium of the vestibulocochlear apparatus.
- Histological changes may include hair cell damage, organ of Corti degeneration, BM shearing, and auditory nerve avulsion.

Harris, et al 2024

- Authors estimate that 34-50% of mTBI patients have tinnitus, SNHL, or vertigo.
- There was not always a correlation between the severity of the induced blow, degree of hearing loss, and degree of histological changes.
- Hearing loss from mTBI does tend to skew toward the high frequencies.

Knoll, et al (2019)

- The authors aimed to study the auditory symptoms of mTBI and its impact on QOL.
- They were administered the HHIA, THI, and HQ
- Subjective hearing loss, tinnitus, and hyperacusis were associated with a significant handicap in patients with a history of mTBI.

Patient Case Study

Initial Background

- 53 years old at the time of his traumatic brain injury in 2021 (now 57)
- Former lawyer; no longer practicing.
- Previously lived with a friend who helped with finances, medical care management, transportation.
- Living independently as of May 2025.

Traumatic Brain Injury – September 2021

- Cutting branches with a chainsaw and fell forward.
- Hit left side of his head and right side of his body.
- Does not remember the accident.
- He does remember waking up and hearing paramedics but not being able to form words.

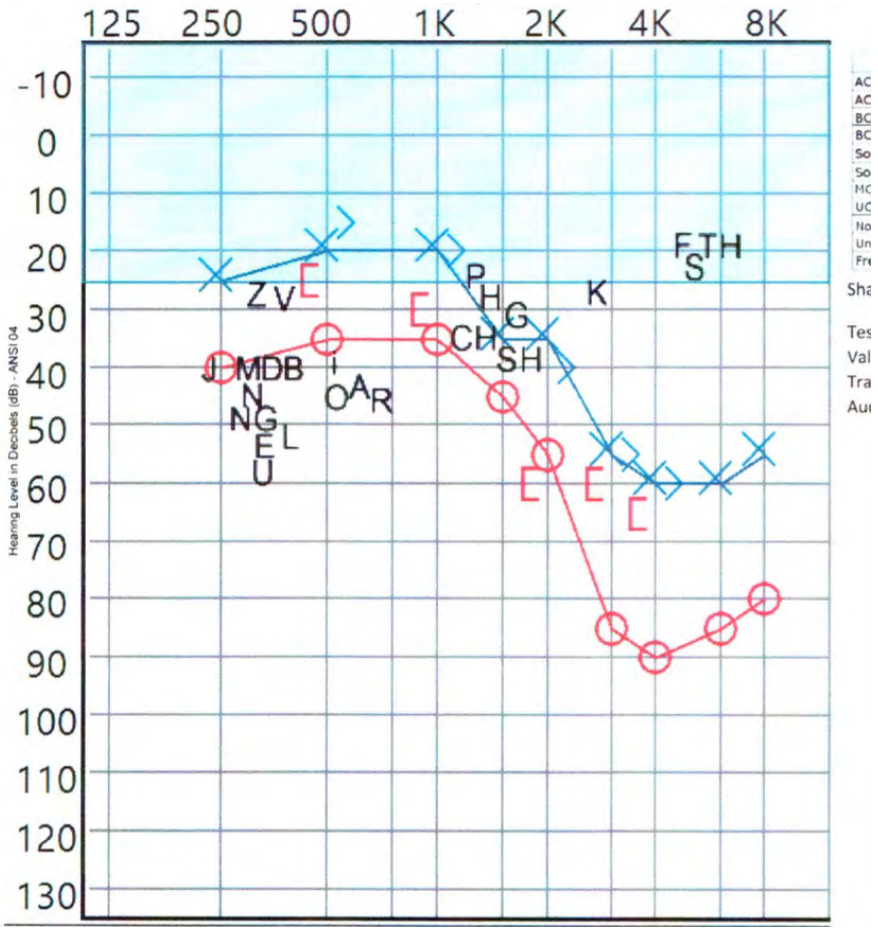
Photo courtesy of OSU. Used with permission.

Initial Diagnosis & Treatment

- Taken to hospital and underwent brain surgery.
- Part of his skull was removed and then replaced in December 2021.
- Left focal damage resulting in aphasia.
- Could not walk at first and had difficult understanding speech.
- Reported consistent bleeding out of the right ear and swelling in the left ear.
- He then spent three weeks in a rehab center, receiving PT, OT, and Speech therapy.

First Audiogram – May 2022

- His physical therapist recognized that he heard better out of his left ear and referred him for an audiogram.



Aphasia Initiative Eval – September 2022

- Appears to have functional auditory comprehension.
- Appears to have mildly impaired receptive language.
- Independent with ADLs, simple homemaking, and medication management.
- Short-term goal: return to driving
- Long-term goal: return to work

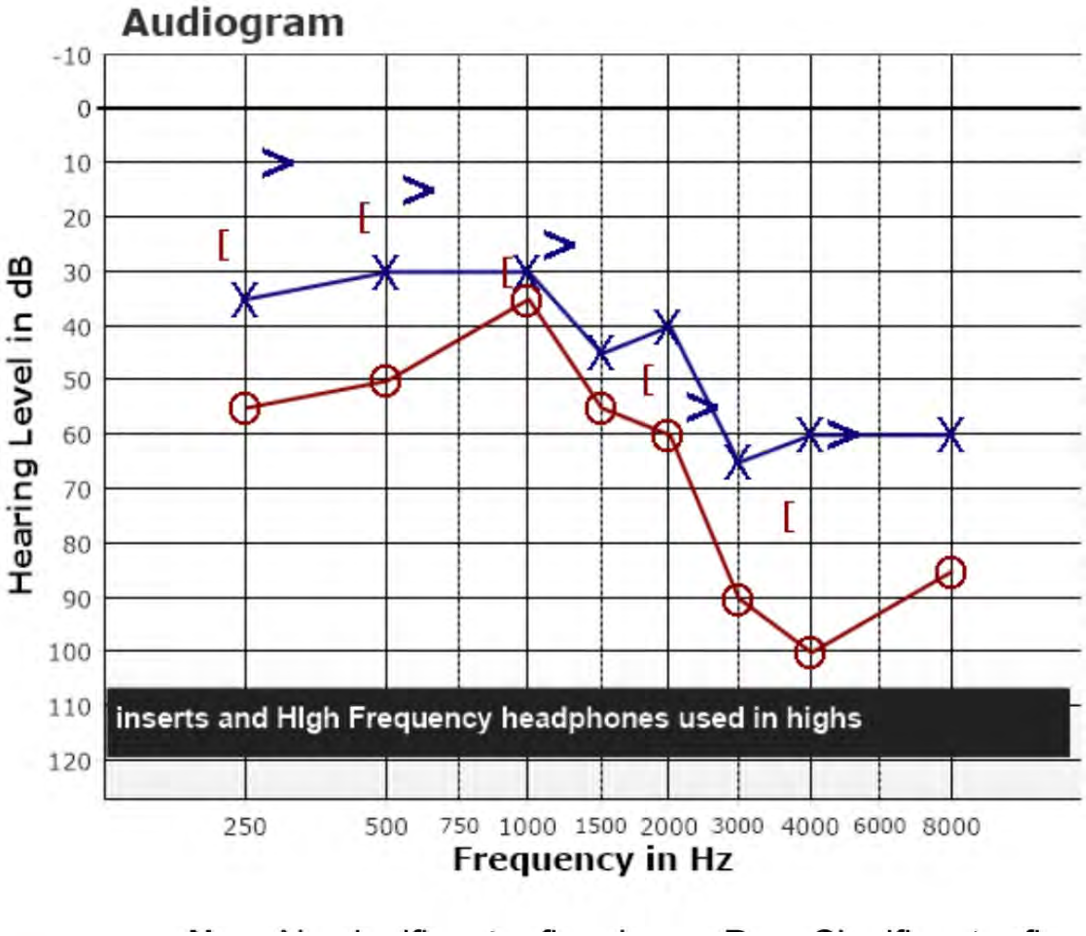
Auditory comprehension

- Answers Yes/No Questions
- Follows Verbal Commands
- Conversational
- Reported on 10/26/2022 that he feels he hears better out of his right ear and struggles with speech in background noise.
- Adult Auditory Performance Scale
  - Global Score: 3.06 - Abnormal

Initial Hearing evaluation – 11/29/2022

- Communication limitations described by the Aphasia Initiative notes were apparent and case history information was limited.
- The purpose of this evaluation was to address current hearing and to develop a plan to improve listening and hearing to contribute positively to the quality of his life.
- Denied ear pain, pressure, or drainage.
- Reported tinnitus in his right ear.
- Reported that he felt he heard better out of his left ear and that his right ear sounded muffled.

Audiogram - 11/29/2022



- Word recognition under headphones was 96% for the right ear and 88% for the left ear.
- It was noted that his responses were somewhat delayed.
- Q-SIN: SNR Loss of 22.5 dB
- APD testing not performed due to hearing loss.

Initial Hearing Aid Fitting – April 2023

- Oticon OPN S 1 miniRITE
- He reported his goals for the HAs were to equalize hearing between ears and improve hearing overall.
- At a follow-up, he initiated a conversation about his communication difficulties. He stated that he found most people to be impatient with him and communication frustrating.
- He complimented his audiologist on being a "patient communication partner" and some strategies were discussed. He stated that he wants people to know that he's "still in there".

Interim

- After the HA fitting, the Aphasia Initiative only saw him sporadically during the rest of 2023 and audiology did not see him at all.
- As he later reported in his July 2024 hearing eval, he underwent four surgeries during this time, the last of which installed an implant in his back to assist with balance.
- He underwent a total of 11 surgeries since the accident.

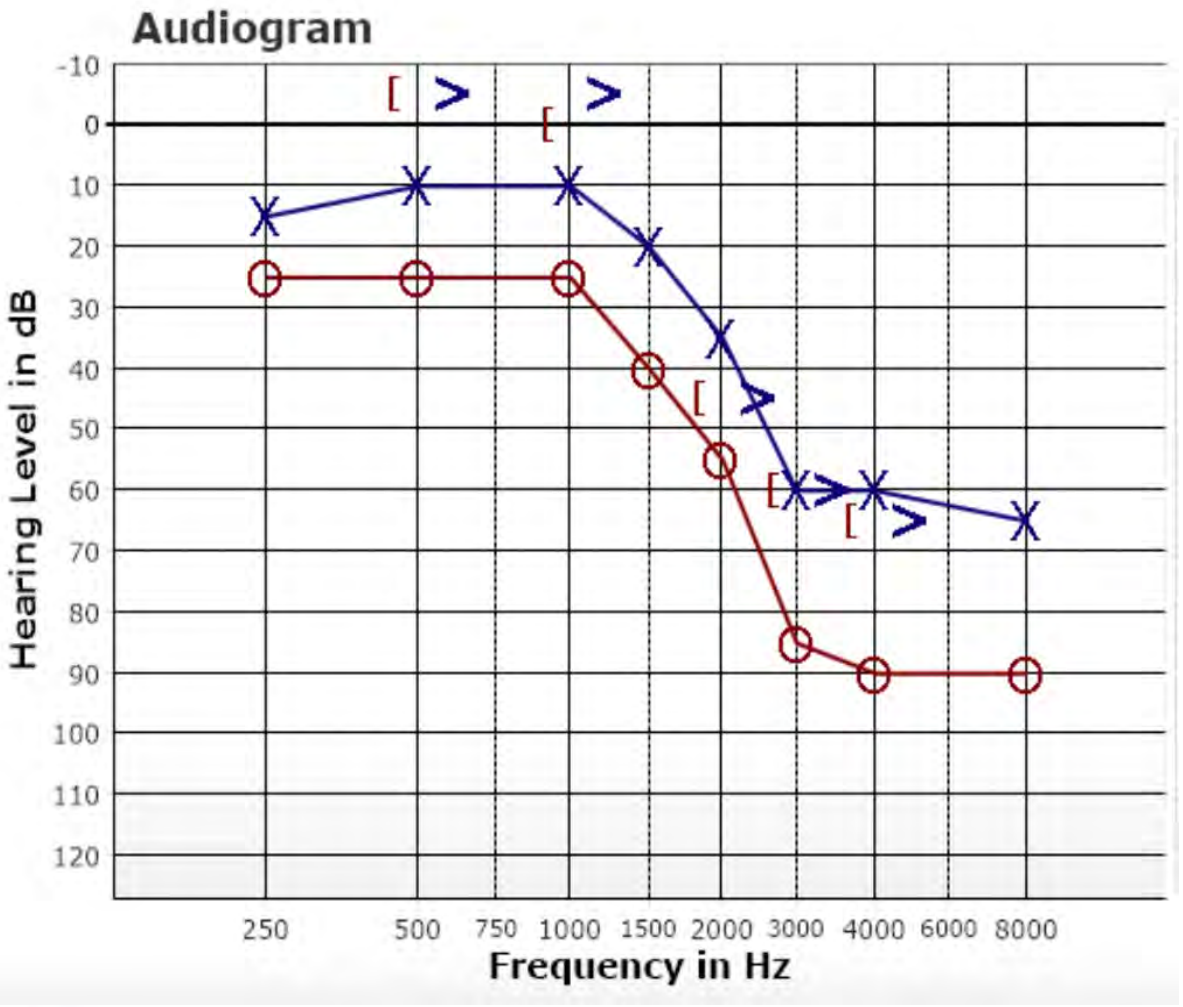
May 2024 Aphasia Initiative Report

- He displayed a greater deficit in auditory comprehension than written comprehension.
- Given his hearing loss, his communication was most successful when the message was not fully dependent on a moment in time (i.e. listening to a signal).
- Having the option of referencing information on his own time gave him the time and space that he needed to fully process messages.
- It was after this report that he was referred back to audiology for an annual hearing evaluation.

July 2024 Hearing Evaluation

- He reported that he has made significant progress in his recovery, including the four surgeries and the back implant.
- However, he still reported significant difficulties with balance. He reported when walking, he lists slightly to the right and forward.
- He reported that he felt his hearing was worse in his right ear, consistent with previous reports.
- He reported that he experiences intermittent, non-bothersome tinnitus in his right ear.
- He reported that he had trouble understanding music, particularly lyrics.

July 2024 Evaluation



- Mild, sloping to severe mixed hearing loss in the right ear and normal hearing through 1500 Hz sloping to a severe mixed hearing loss in the left ear.
- R-SPIN: 75% for high predictability and 38% for low predictability
- An informal observation of his walking confirmed his reported balance difficulties.
- Was fit with Oticon Intent 1 mRITE R HAs in October 2024

Patient Status Today

- Living independently.
- Reported numerous changes to routine.
- Has resumed hobbies such as hiking and photography.
- Focused on understanding his accident and having a positive attitude about moving forward.
- Continues to embrace the differences that come with his injuries.
- Is currently undergoing treatment for lung cancer.

How Does this Case Relate to the Research?

- Harris, et al (2024) reported that these mTBI patients often have vestibular symptoms caused by errant blood or debris in the semicircular canals.
  - This patient had these symptoms.
- The authors of that study estimate that 34-50% of mTBI patients have tinnitus, SNHL, or vertigo.
  - This patient had all these symptoms
- Electrophysiological testing was not done on this patient.
- Hearing loss from mTBI does tend to skew toward the high frequencies.
  - His hearing loss fit that description.

How Does this Case Relate to the Research?

- This patient's hearing difficulties put a damper on his QOL.
- We gave him the Vanderbilt Fatigue Scale, which is similar to the HHIA given by Knoll, et al (2019).
- We did not him a THI or HQ. Perhaps we should have if we wanted to do a retrospective study down the road.
- Clearly the subjective hearing loss was at play here.
- Little research into psychoacoustic tasks such as stream segregation.

continued

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Auditory Stream Segregation

Stream Segregation – June 2025

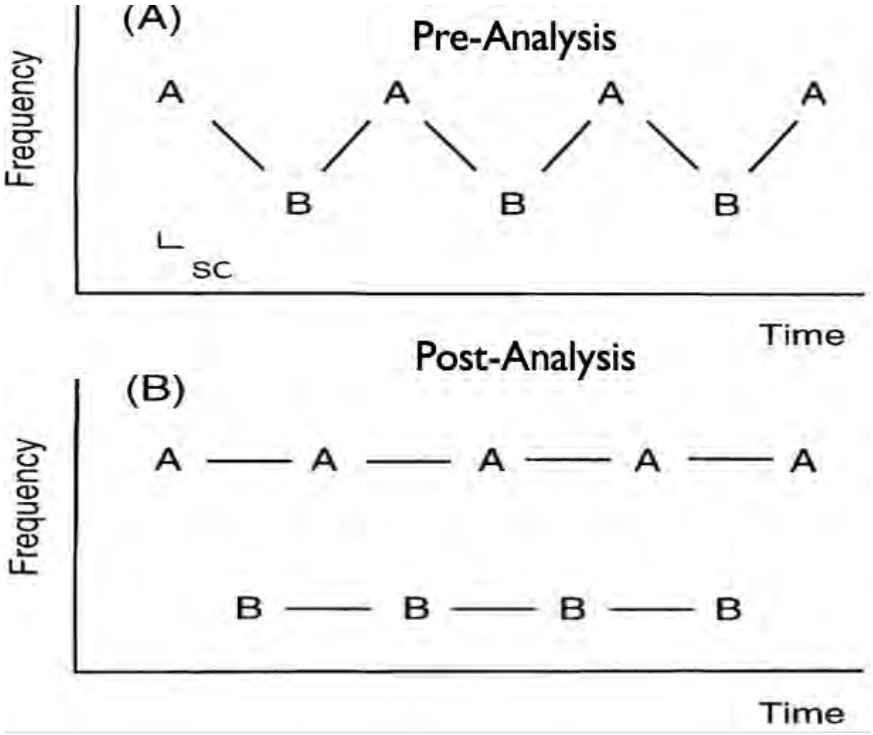
- The patient's reported difficulty parsing lyrics in a song, makes me wonder how he would perform on a stream segregation task.
- Patient was seen in June 2025 and presented demos of stream segregation task, reporting his subjective experience for each demo.

Auditory Scene Analysis

- Auditory Scene Analysis (ASA) is a framework proposed by Albert Bregman, relying on the auditory system's ability to separate components of a complex signal into distinct streams.
- With ASA, listeners can process the complex multitude sounds found in the everyday world and make sense of it.
- Bregman's framework was first published in a book in 1990, providing a comprehensive explanation of the processes underpinning auditory scene analysis.
- A subsequent CD in 1996 provided auditory demos of the concepts Bregman explored.

Auditory Stream Segregation

- The graph shows perception of a signal before and after ASA has been carried out. Before the analysis, the signal is perceived as one connected, continuous stream. After the analysis, the signal is perceived as two separate streams.

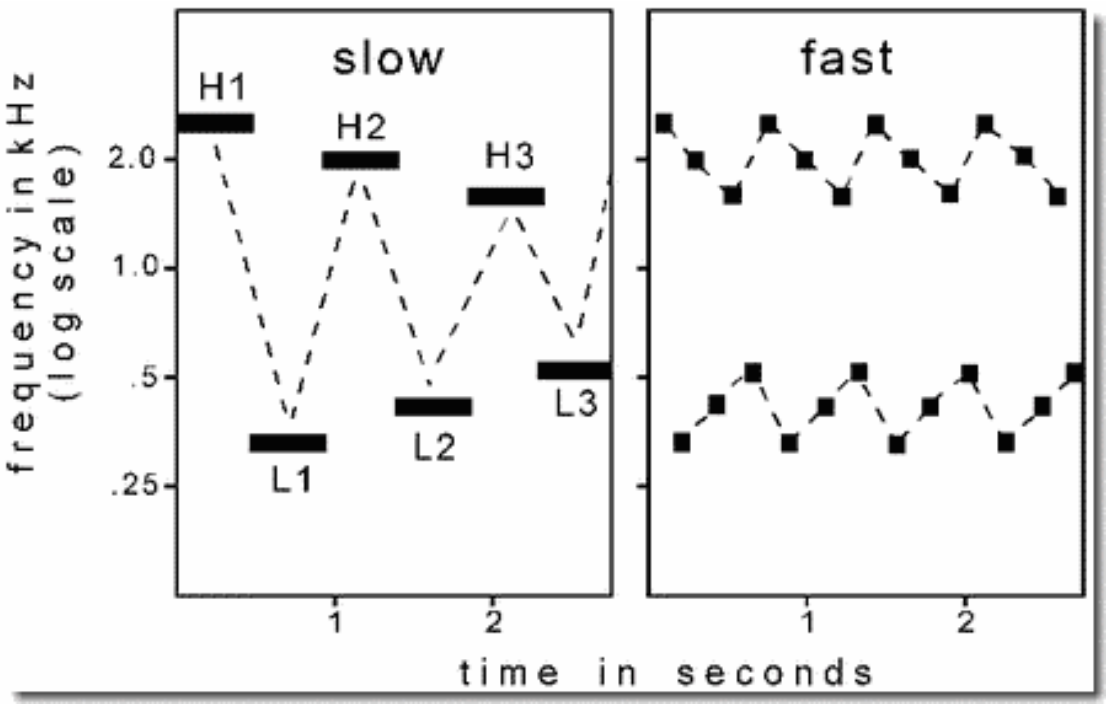


Adapted from Helenius, et al (1999)
Edited by Liam Smyth (2025)
Audio by Bregman (1971, 1996)

Stream Segregation Demos

Stream Segregation In a Cycle of Six tones

- Bregman & Campbell (1971)
- A sequence of three high tones and three low tones is played slowly, and then quickly.
- A listener should perceive two streams at the faster speed.
- Patient perceived two streams.



Pattern recognition, Within and Across Perceptual Streams

- Bregman & Campbell (1971)
- The brain naturally groups acoustic components likely to form patterns.
- The expectation can be defeated in the lab by arranging a sequence of tones so that it doesn't align with what the listener is expecting to hear.
- This is auditory camouflage.
- The patient heard a standard sequence of three tones, followed by a six-tone cycle.
- The patient was to determine the pattern.

Pattern recognition, Within and Across Perceptual Streams

- Finding the pattern is easy when the three tone stone standard is embedded within the stream.
- When some tones cross into another stream, this is much harder.
- Within Stream – Patient could easily determine the pattern.
- Across Stream – Patient struggled to determine the pattern.

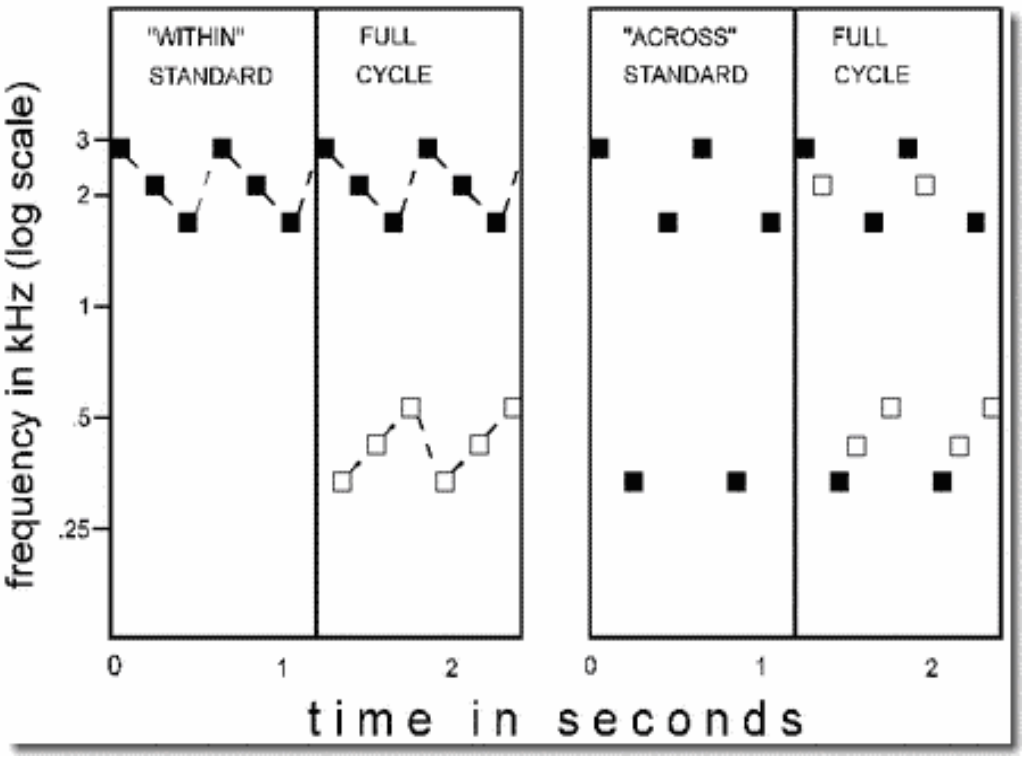
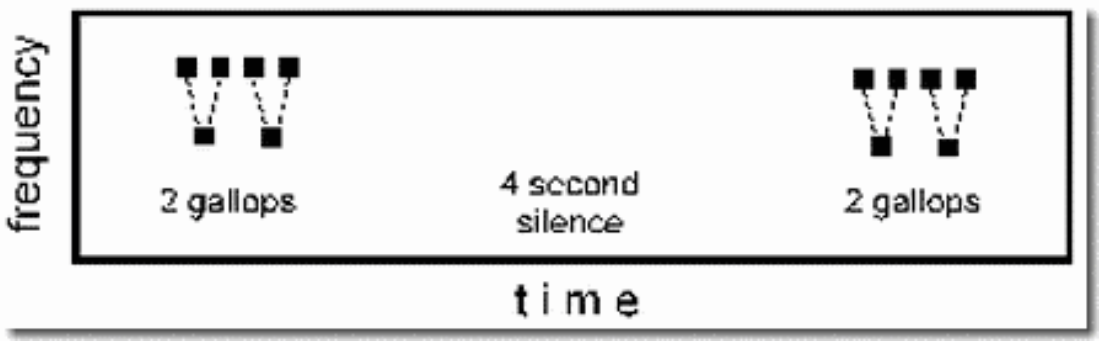


Image used with permission; https://www.themusiclab.org/bregman

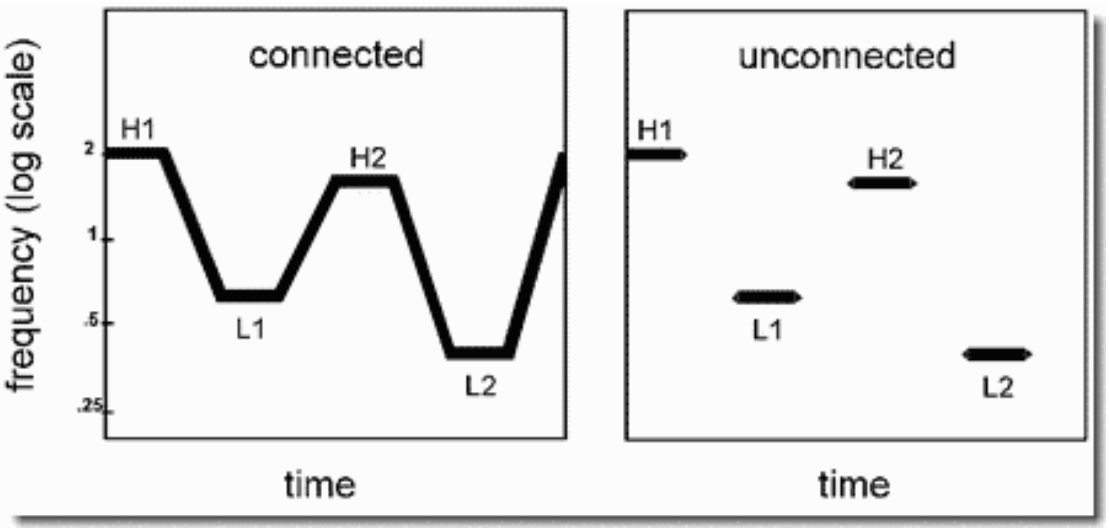
Cumulative Effects of Repetition on Streaming

- Bregman (1978) found that the auditory system takes several seconds to gather information on a signal before inducing streaming.
- In this demonstration, progressively longer repetitions of a three-tone sequence were presented, with the expectation that they would be progressively easier.
- The patient found streaming to get progressively easier with repetition.



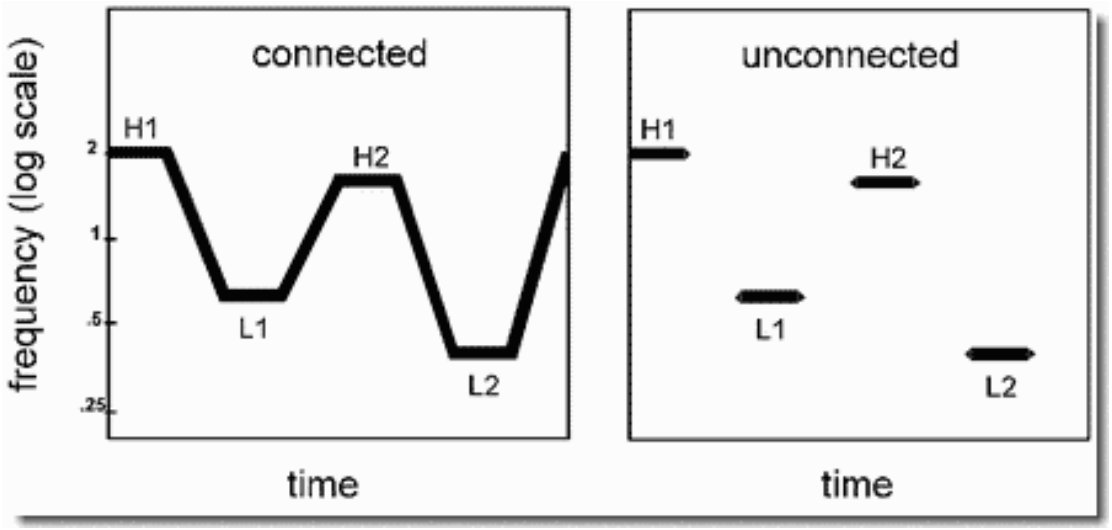
Effects of Connectedness on Segregation

- Based on Bregman and Dannenbring (1973)
- A smooth transition between differing tones is expected to inhibit streaming and promote integration.
- The patient was presented a sequence of tones connected by a frequency transition and a sequence with no connection.



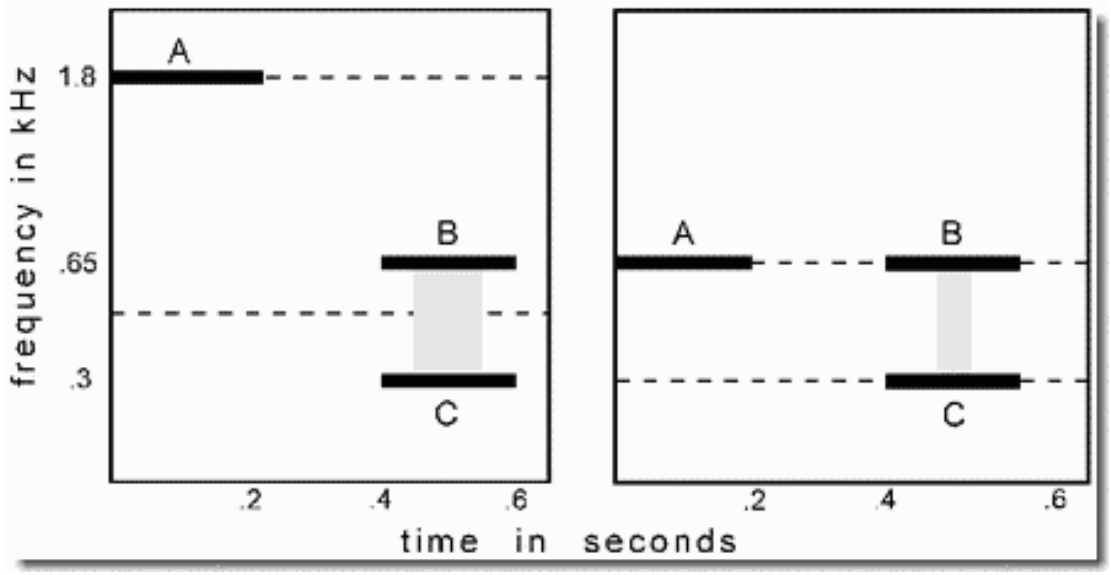
Effects of Connectedness on Segregation

- Patient reported that in the connected sequence, it was easy to follow the transition between tones.
- In the unconnected sequence, the differences between tones was much more jarring and pronounced.
- In other words, the unconnected sequence was easier to segregate.



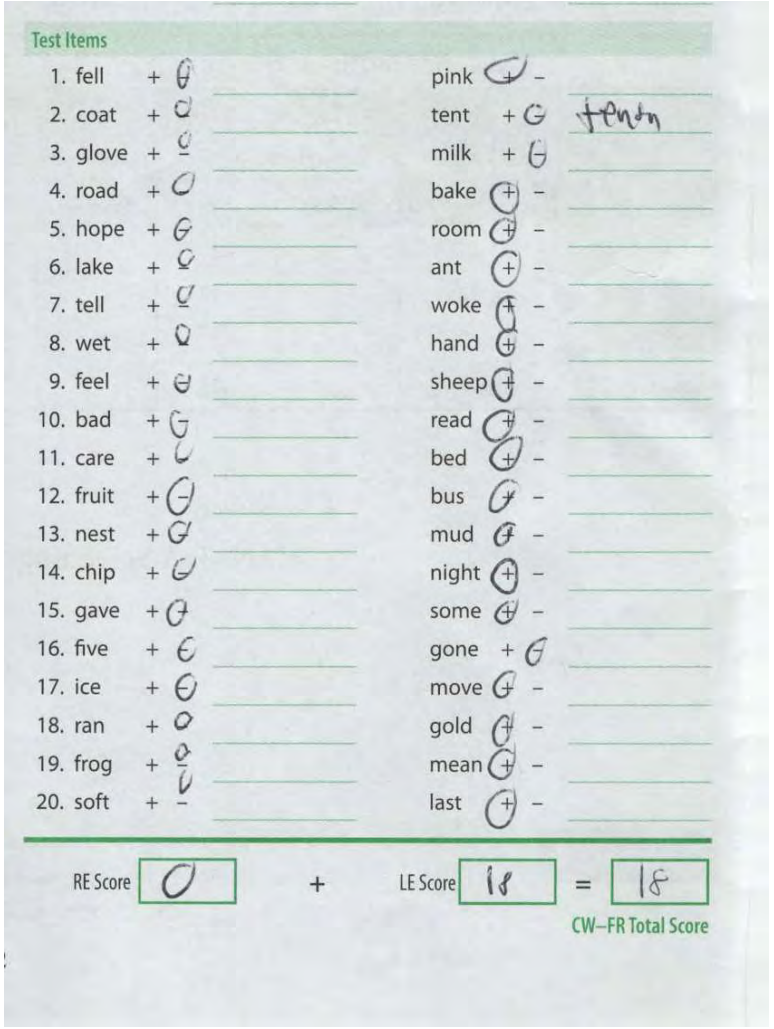
Capturing a Tonal Component Out of a Mixture

- Up to now, we have been talking about sequential stream segregation.
- We now turn to simultaneous stream segregation.
- The patient heard an alternating sequence of two tones with a third tone interleaved.
- The patient struggled with the task, and ultimately could not discern the interleaved tone.



Simultaneous Integration

- Based on the results of the last stream segregation task, processing of simultaneous components in an auditory signal is significantly more difficult than processing sequential components.
- The Competing Words-Free Recall test of the SCAN-3A was administered.
- The patient was unable to complete the task.



Test Items

1. fell	+		pink	+	–
2. coat	+		tent	+	–
3. glove	+		milk	+	–
4. road	+		bake	+	–
5. hope	+		room	+	–
6. lake	+		ant	+	–
7. tell	+		woke	+	–
8. wet	+		hand	+	–
9. feel	+		sheep	+	–
10. bad	+		read	+	–
11. care	+		bed	+	–
12. fruit	+		bus	+	–
13. nest	+		mud	+	–
14. chip	+		night	+	–
15. gave	+		some	+	–
16. five	+		gone	+	–
17. ice	+		move	+	–
18. ran	+		gold	+	–
19. frog	+		mean	+	–
20. soft	+	–	last	+	–

RE Score 0 + LE Score 18 = 18

CW–FR Total Score

Concluding Thoughts

- The auditory component in this patient's case history is a relatively small component but is one that we can have a significant impact on quality of life.
- To that end, audiologists occupy a unique vantage point in the realm of interdisciplinary clinical care.
- The application of basic psychoacoustic research to clinical practice deserves further exploration.

Acknowledgements

- Jennifer Brello, Larry Feth, Arin Sheeler and Gail Whitelaw are thanked for their guidance and support throughout this project.

continued

THE OHIO STATE UNIVERSITY

At a CROSroads

Jack Korsgard, B.S.

Aryn Robinson, B.S.

Outline

- Dean and Sudden Sensorineural Hearing Loss
- Jane and Squamous Cell Carcinoma
- Management Options
- Contralateral Routing of Signal Devices
  - Verification and Validation
  - Considerations
- Key Takeaways

Meet Dean

- History of high frequency sensorineural hearing loss (SNHL)
  - Used hearing aids but did not like them
- October 2024
  - Experienced sudden hearing loss in his left ear while on a trip

Sudden Hearing Loss

- Estimated annual incidence 27 per 100,000
  - Commonly co-occurs with:
    - Tinnitus (more common)
    - Dizziness (less common)

- Always rule out conductive HL

Chandrasekhar et al., 2019; Alexander & Harris, 2013

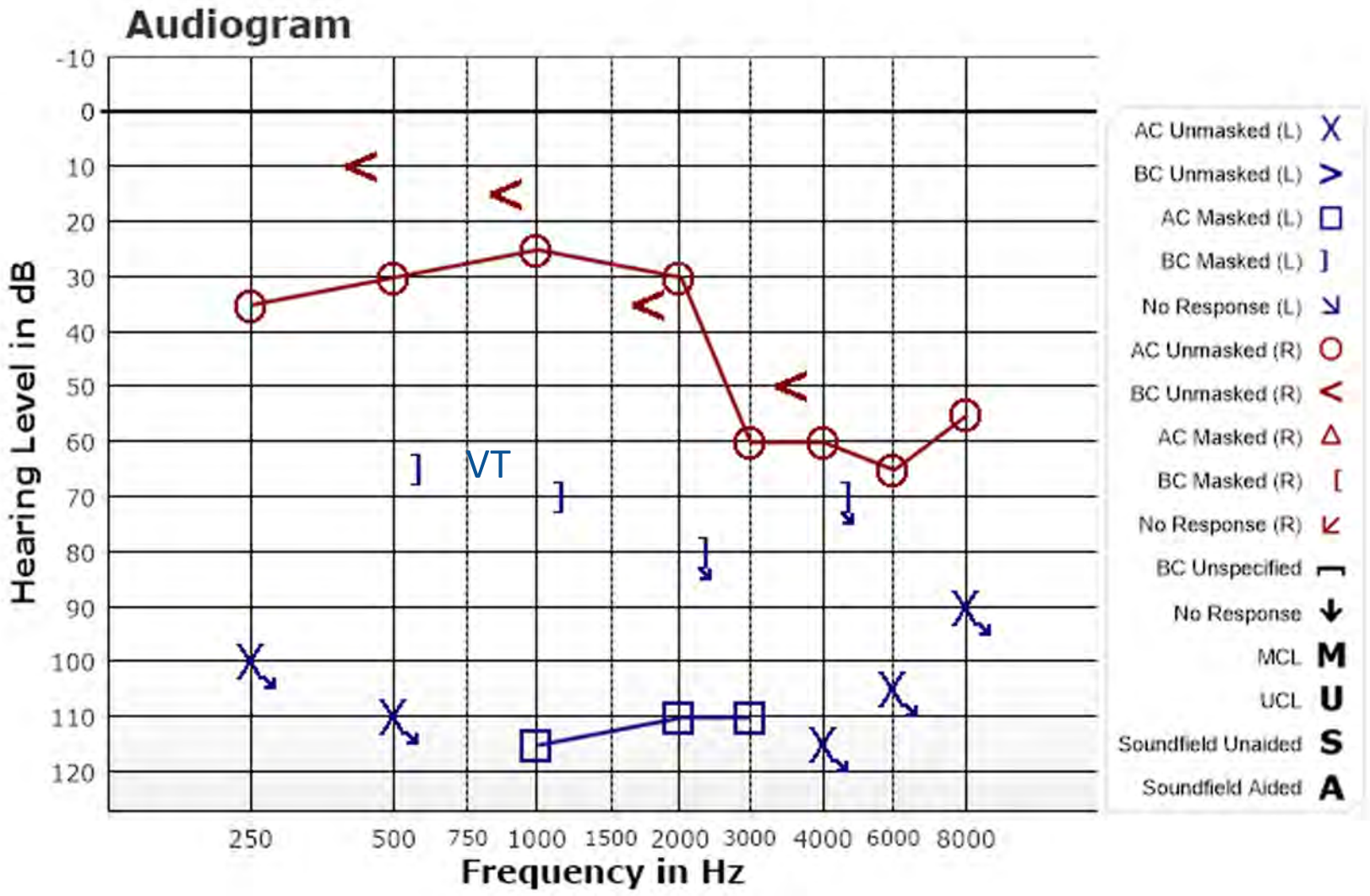
Sudden Hearing Loss Recovery

- Research indicates 32% to 65% recover spontaneously

- Degree of hearing loss is one factor related to likelihood and extent of recovery

Chandrasekhar et al., 2019; Mattox & Simmons, 1977; Fetterman et al., 1996

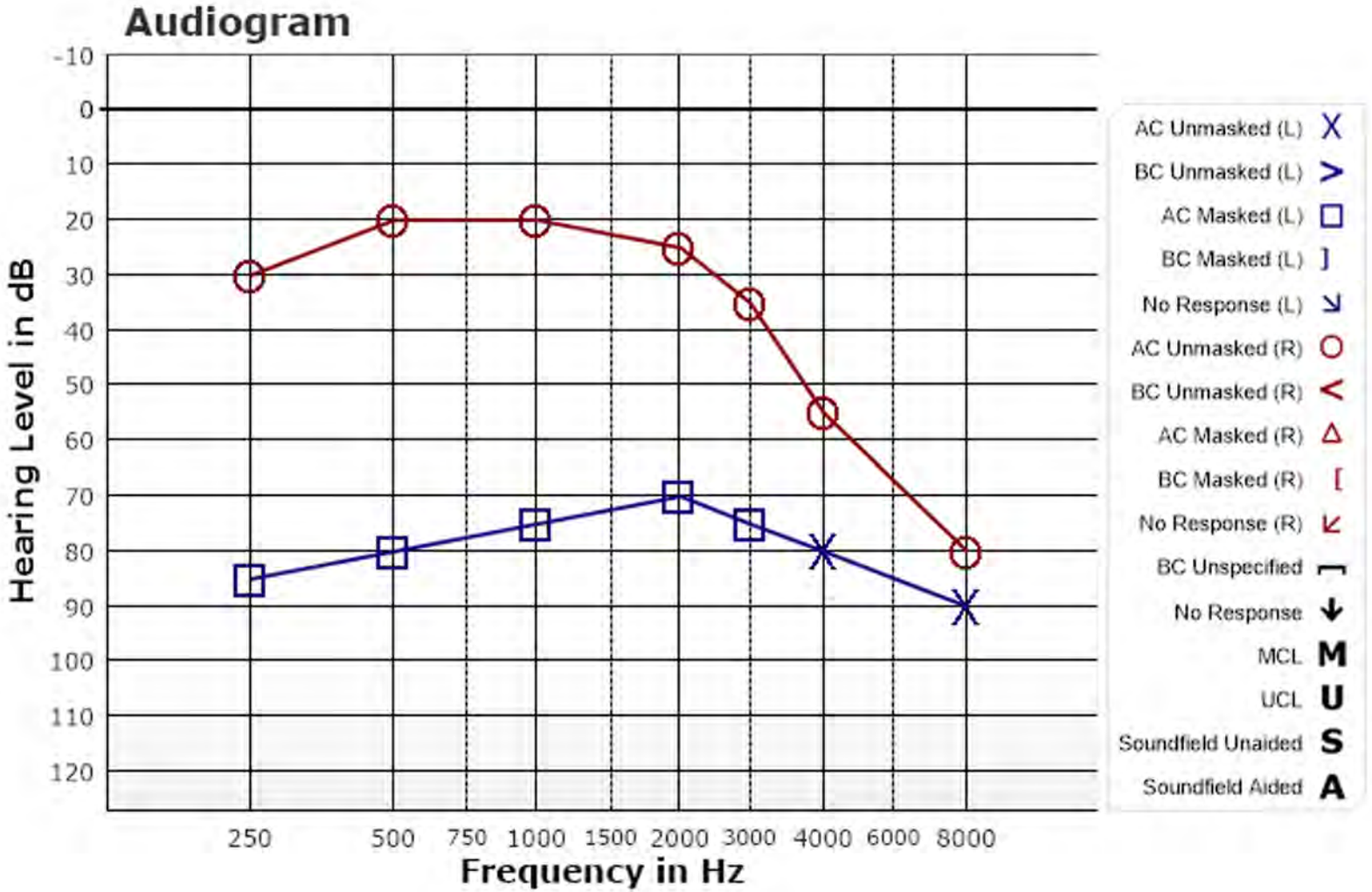
October 2024 Audiogram



Dean Seeks Help

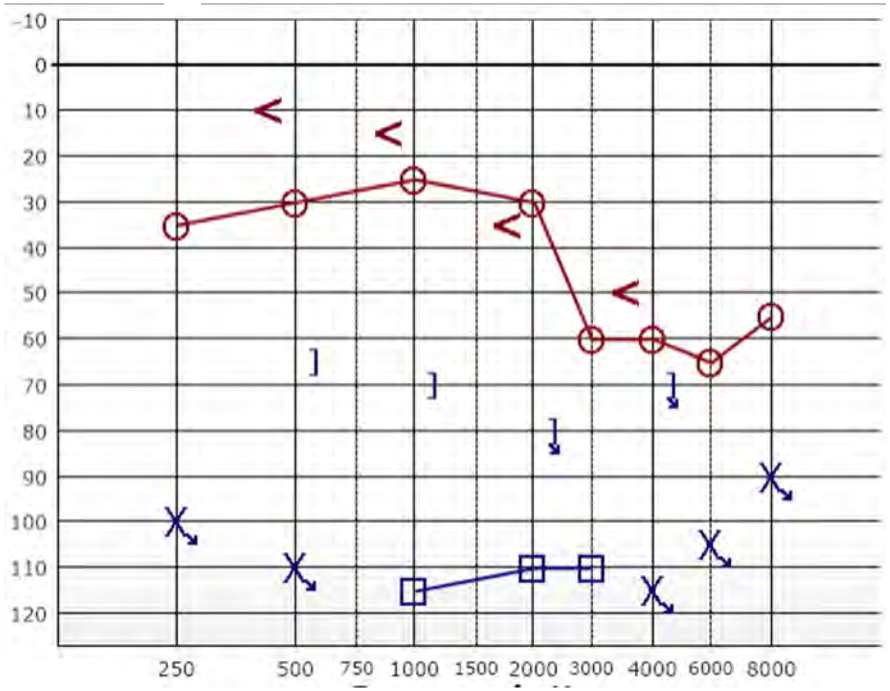
- Otologic evaluation and treatment
  - Treated with a round of oral steroids
  - Physician discussed hyperbaric chamber treatment
    - Dean ultimately does not pursue within the window for treatment

December 2024 Audiogram

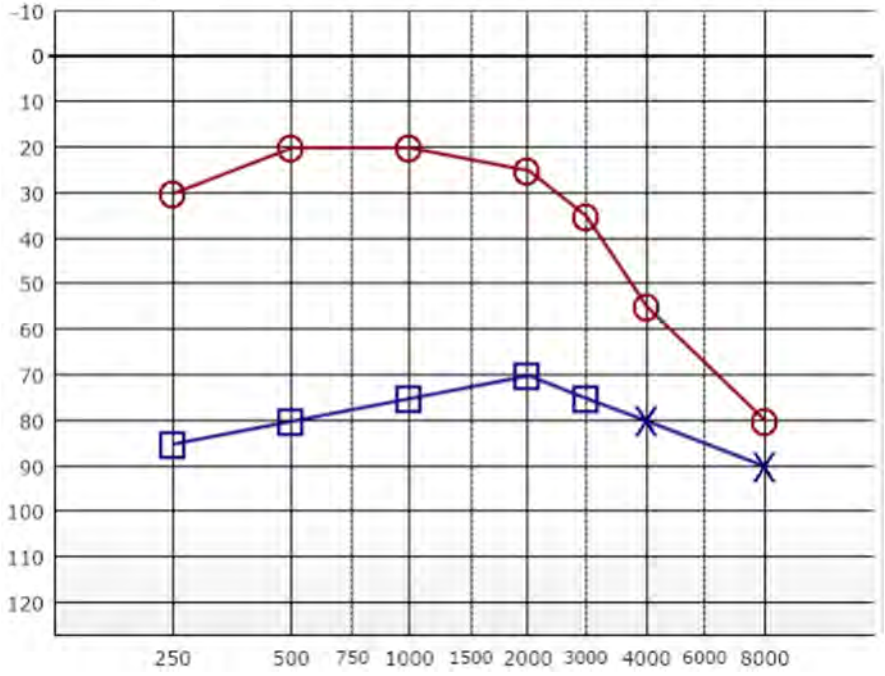


October vs December Audiograms

10/15/2024



12/09/2024



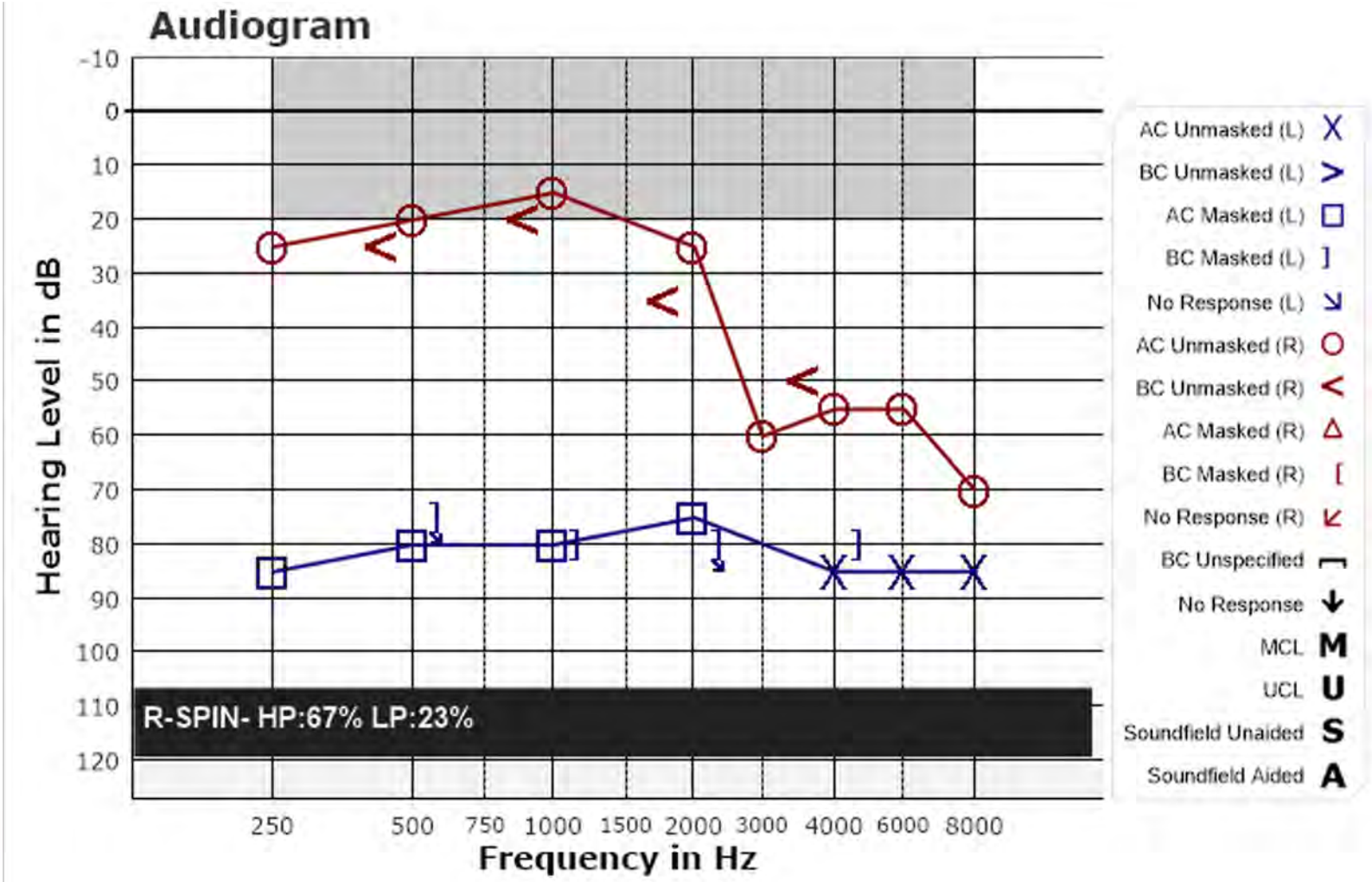
Dean comes to Ohio State

- First meeting Dean states: “I’m looking for a cure.”
- Describes immense communicative difficulties, safety concerns
  - Cannot localize sound
  - Reports great frustration in noise
  - Has affected his social life
  - Bothersome tinnitus
  - No dizziness

Dean describes his HL

- Cannot understand anything through his left ear
- Dean can hear *something* above a certain level, but states it is distorted
  - At best, does nothing to help
  - At worst, distortion actively interferes with his listening ability
  - Hmm…

February 2025 Audiogram



Meet Jane

- Female, 80s
- Tinnitus for 20+ years
- 2021
  - Squamous Cell Carcinoma in her left ear canal

Squamous Cell Carcinoma (SCC)

- Definition: Benign or malignant tumors that form in squamous cells
  - Squamous cells: thin, flat cells found in the tissue that forms the surface of the skin
    - Ex. The lining of the hollow organs, respiratory and digestive tracts
- Incidence: Rare

NCI Dictionary of Cancer Terms; Allanson et al., 2018; Lassig et al., 2013

SCC Continued

- Risk Factors: Fair skin, solar ultraviolet light exposure, and immunosuppression
- Presentation: Chronic discharge, bleeding, otalgia, hearing loss, facial palsy, otitis externa or otitis media
  - SCC is often treated as a persistent infection before a neoplasm (tumor) is suspected and a diagnostic biopsy is performed

Allanson et al., 2018

SCC Outcomes

- Extent of surgery depends on affected structures
  - Typically results in some amount of the temporal bone and middle ear structures being removed
  - Followed by reconstruction of the ear canal
- Jane
  - Temporal bone resection
  - Removal of malleus and incus
  - Surgically closed ear canal

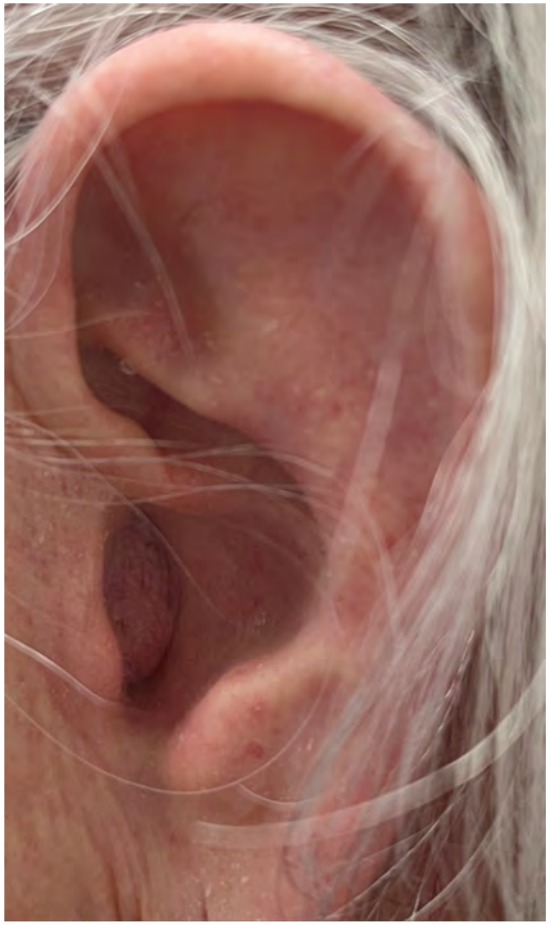
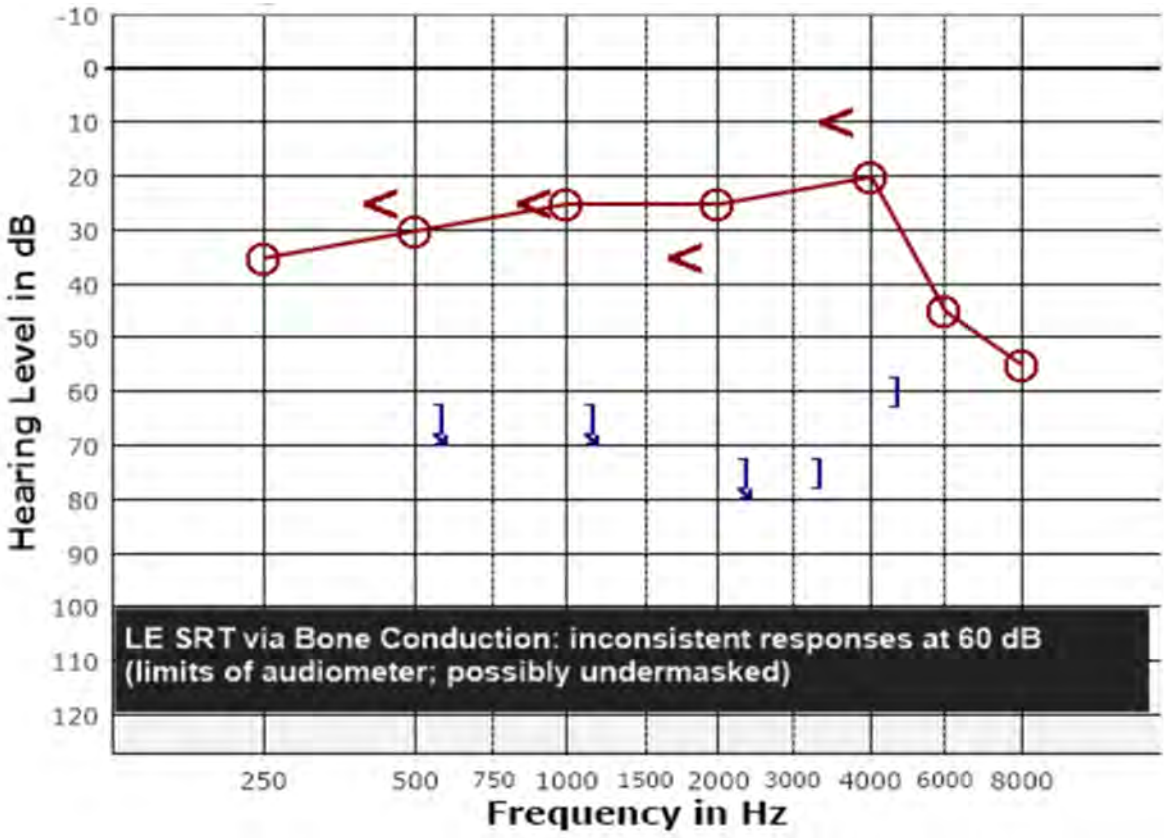


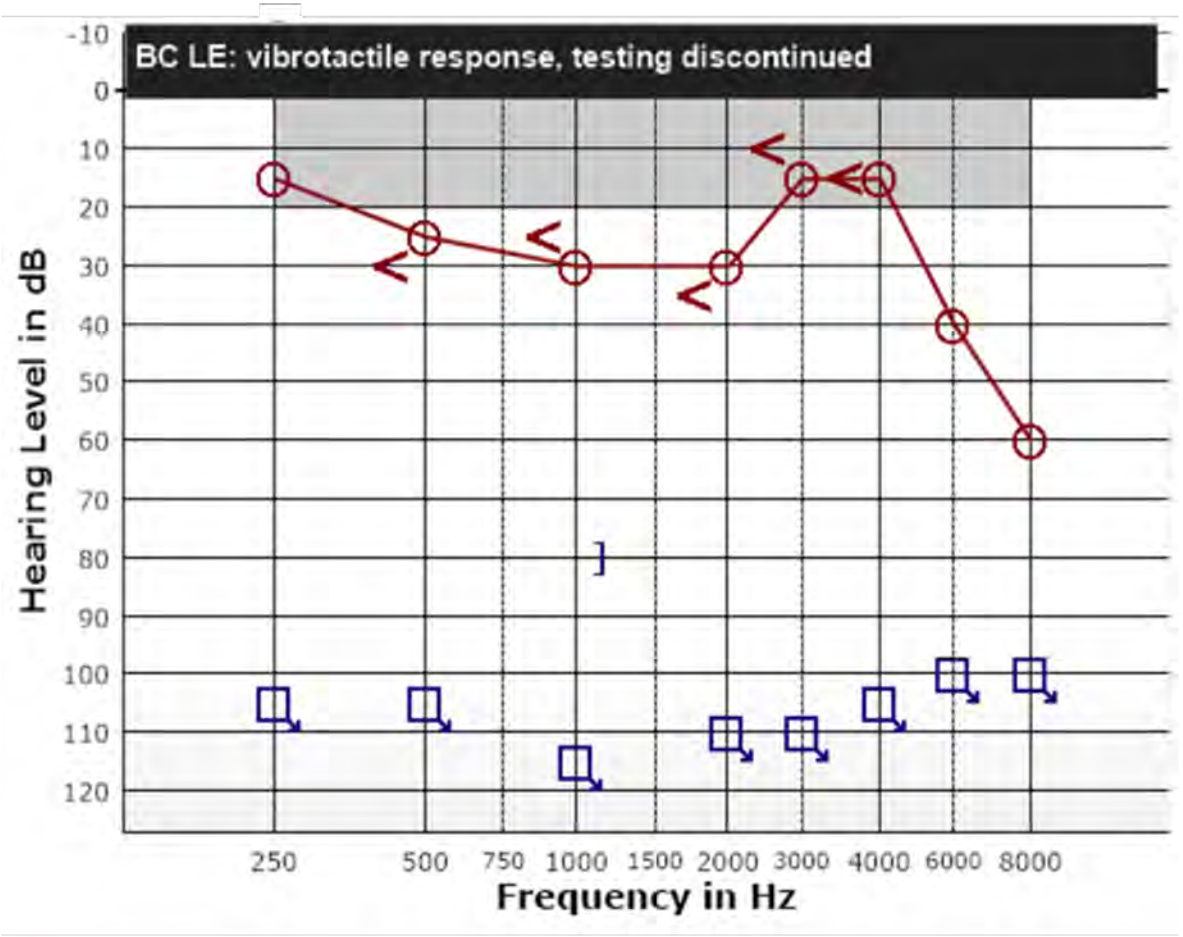
Photo by OSU. Used with permission.

2022 Audiogram



	Right
PTA	27 dB
SRT	25 dB

2025 Audiogram



	Right
PTA	28 dB
WRS	100% @ 65 dB

Situations with an Unaidable Ear

Management Options

- Sensorineural Hearing Loss
  - Hearing Aid
  - CROS/Bi-CROS
  - Cochlear Implant
- Mixed/Conductive Hearing Loss
  - Hearing Aid
  - CROS/Bi-CROS
  - Bone-Anchored Hearing Aid
  - Cochlear Implant

Hearing Aids

Monaural Fit

- Advantages
  - Non-invasive
  - Cheapest option
- Disadvantages
  - No access to sound on unaided side

Bone-Anchored Hearing Aid

- Advantages
  - Stimulate residual bone conduction hearing
  - Localization
- Disadvantages
  - Cost
  - Surgery

Cochlear Implant

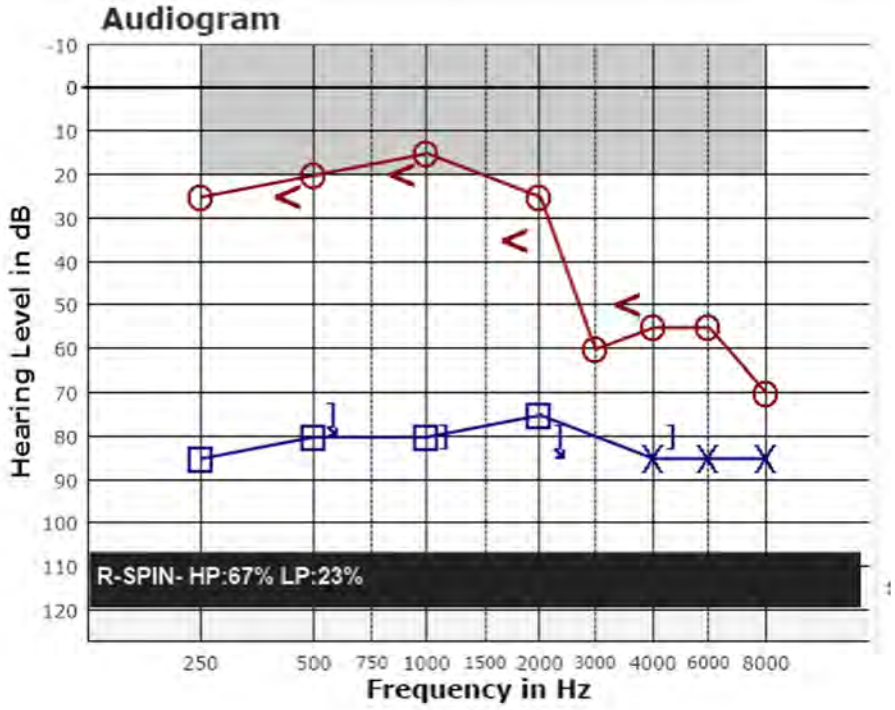
- Advantages
  - Direct stimulation of the auditory nerve
  - Localization
- Disadvantages
  - Cost
  - Surgery/Recovery
  - Learning to listen in a new way

Contralateral Routing of Signal (CROS)

- Advantages
  - Non-invasive
  - Relatively cheap
- Disadvantages
  - No localization
- Special consideration for Jane
  - Need a place for the receiver to sit

Dean's Intervention

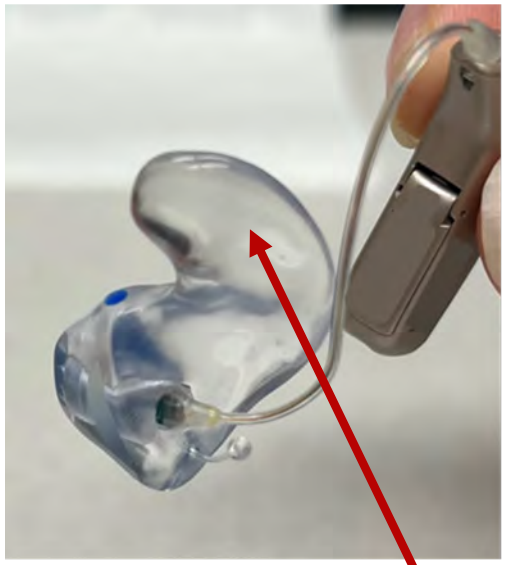
- Initially hesitant about hearing aids - previous negative experience
- Decided to trial a Bi-CROS
- To occlude or not to occlude?
  - Dean's left ear is not helpful, and sometimes actively interferes with listening…



Jane's Intervention

- Not interested in more surgery
- Trialed a bone conduction device with a soft headband
  - Very happy, really liked it
  - Told that an adult could not wear one
- Trialed multiple CROS devices
  - Unhappy because devices would not stay in the left ear

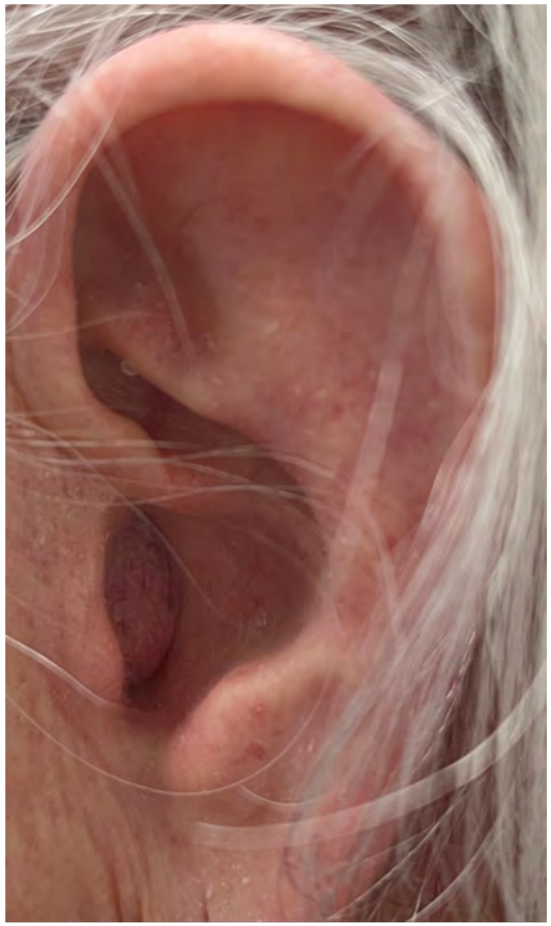
Custom Earmold



Photos by OSU. Used with permission.

with a helix lock

CROS for Jane



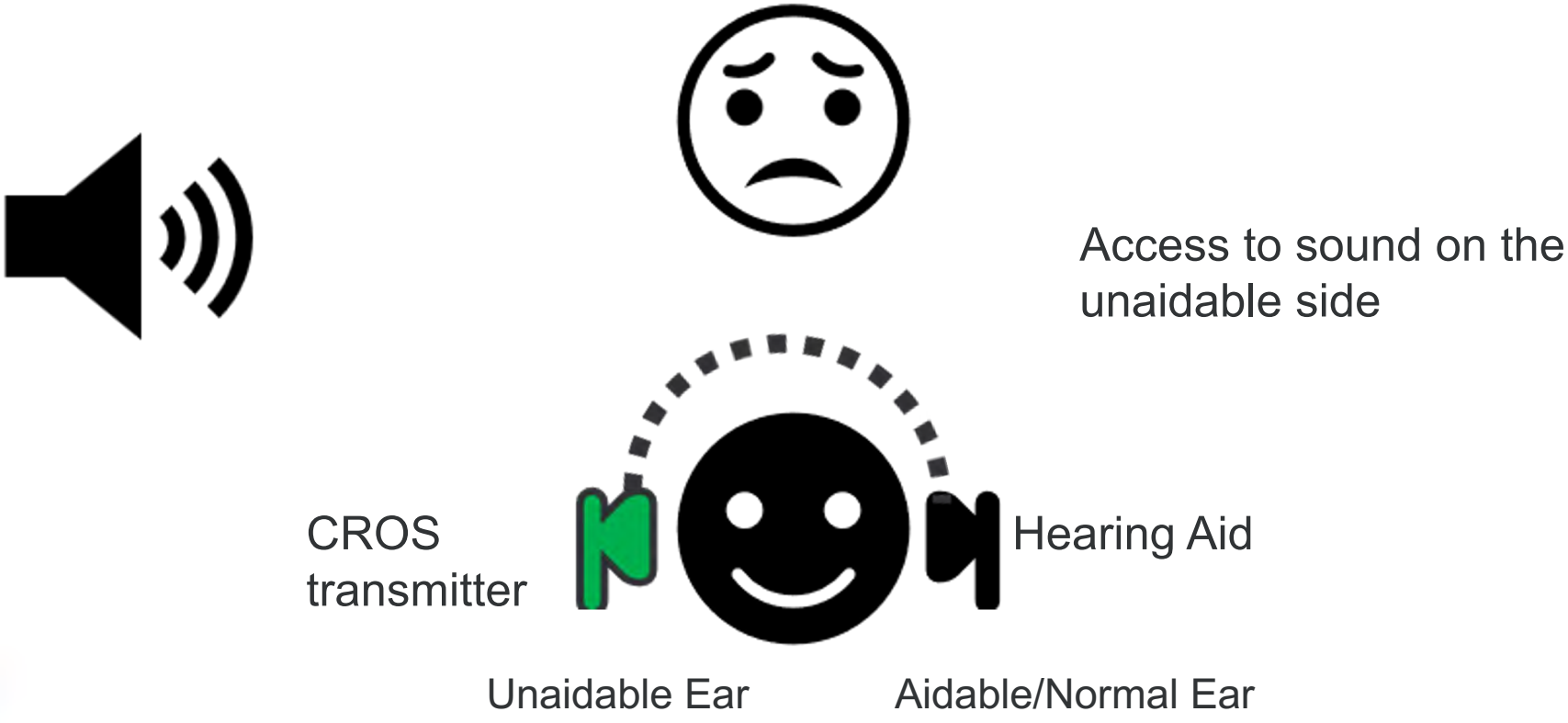
Patient Concerns: What can we address?

1. “I can’t understand people in noise”
2. “I can’t hear people on my left”
3. “I can’t hear where things are coming from”

- First two can be addressed to some degree
- Third cannot
  - Localization inherently relies on binaural cues

CROS Setup

- Scenario: Two people with no hearing in their right ear



CROS Outcomes: Speech-in-Noise

- Can it help in noise? It depends.
  - If…
    - Speech: Side of unaidable ear
    - Noise: Side of aidable ear
    - Then yes!
  - If…
    - Speech: Front/Back
    - Noise: Front/Back
    - Then maybe…
  - If…
    - Speech: Side of aidable ear
    - Noise: Side of unaidable ear
    - Then NO - turn it off!

Kitterick et al., 2018

CROS Outcomes: Localization

- CROS cannot generally help with localization
- May improve *lateralization* to some degree

Kuk et al., 2015

Verification and Validation

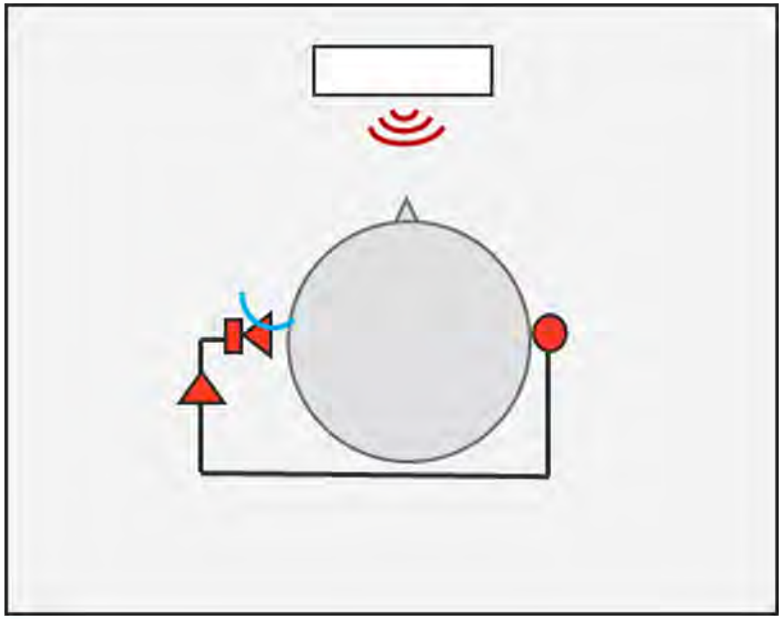
- Verification
  - Objective measure that ensures the device is functioning as intended
- Validation
  - Subjective measures that assess the user's perceived benefit
    - Including satisfaction and handicap reduction

- Important for any device fitting
- Can be used to assist with CROS counseling and establishing realistic expectations

CROS Verification - REM

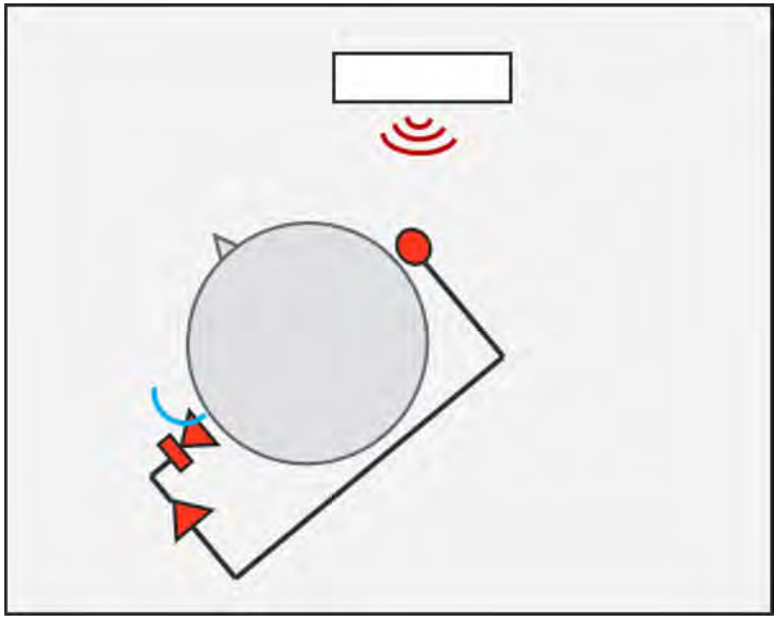
Complete REM as normal

- **Patient sits facing REM speaker with both devices on**

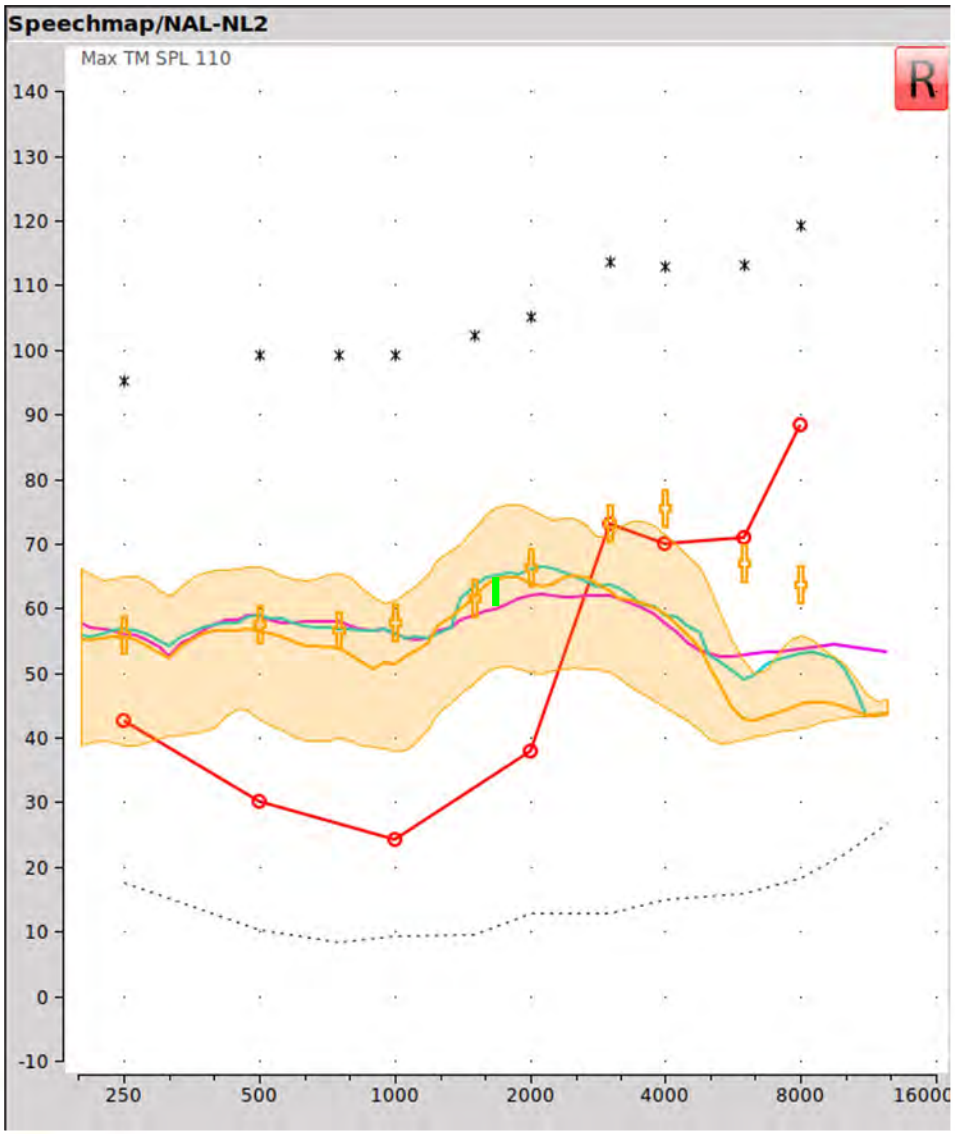


Turn patient 45-90 degrees

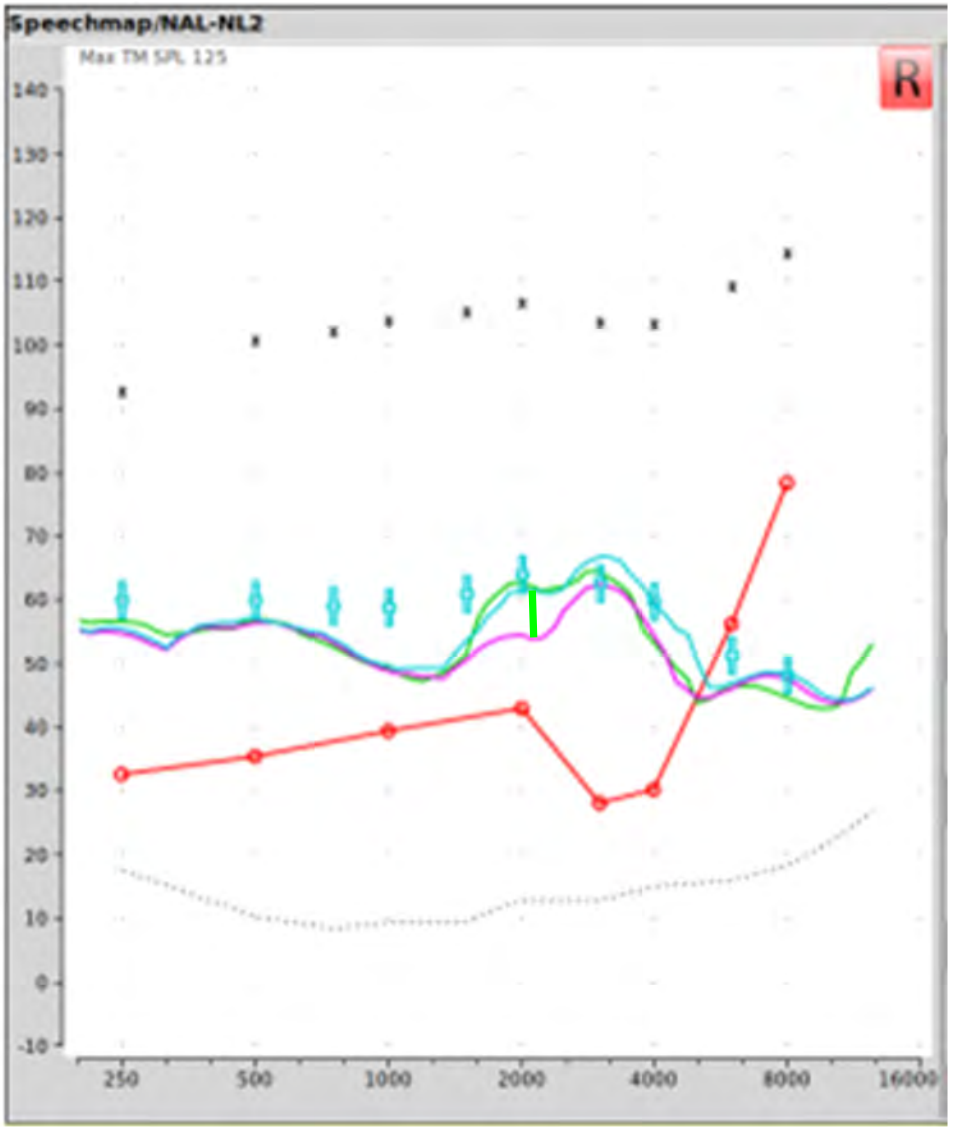
- REM should match previous run



Dean's REM



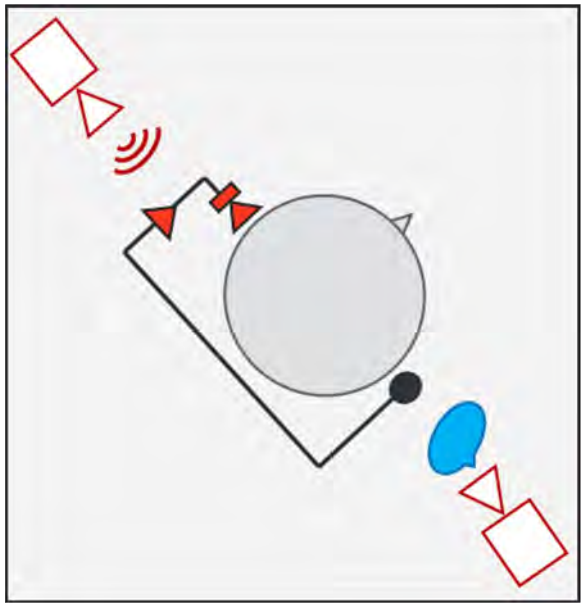
Jane's REM

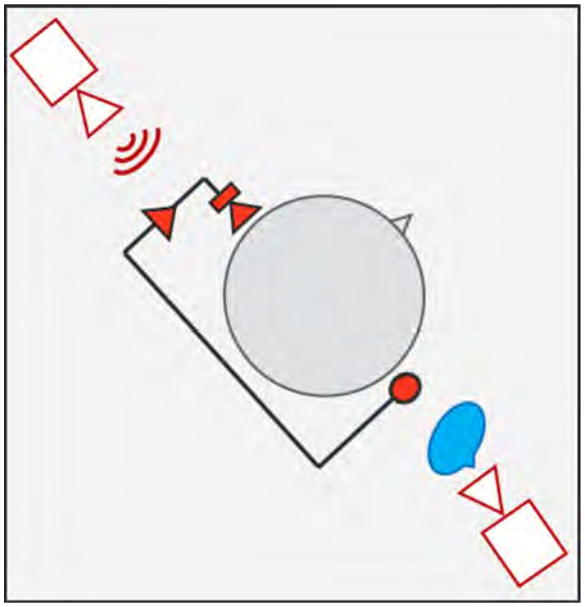


CROS Verification - SIN

Orient patient so that CROS is toward the speech and HA is toward the noise

- **Complete SIN with the CROS off**
- Run the test again with the CROS **on**





CROS SIN Verification

Sentence Test: RSPIN (+8 SNR)				
Patient	CROS	High Probability	Low Probability	Overall*
Dean	Before	67%	23%	56%
	On	100%	77%	88%
Jane	Off	92%	23%	56%
	On	100%	69%	84%

*Overall score difference is significantly different per Carney and Schlauch (2007)

Dean's CROS Validation

- Easier time in noise
- Less stress in social situations
- Ability to localize has not improved, but more aware of his environment

- Decided to purchase his own devices

Jane's CROS Validation

Client Oriented Scale of Improvement (COSI)		
Goal	**Degree of Change**	**Final Ability**
Be aware of sounds on the left side	Much Better	Most of the Time
Decrease perception of tinnitus	Better	Most of the Time

CROS Considerations

- Talking about the CROS:
  - Clarity
  - Redundancy
  - Written materials
- Limitations of device
  - Will not improve localization
  - Ceiling for improvement in noise is uncertain
  - Best to turn CROS transmitter off when noise is on the side of the CROS - counseling!

Kitterick et al., 2016; Kuk et al., 2015

Key Takeaways/What I Learned

- Think outside of the box
- Listen to your patient
- Importance of Verification and Validation
- Counseling
  - Realistic expectations with a CROS

continued

THE OHIO STATE UNIVERSITY

A Case-Based Approach to Conductive Hearing Loss in a Medically Complex Child

Madison Pollock, B.A.

Who is Our Patient?

- 10-year-old boy
- History of Witteveen-Kolk Syndrome
- History of Cell B Lymphoblastic Leukemia (excess B-lymphoblasts created by bone marrow)

Medical History

- Diagnosed with Cell B Lymphoblastic Leukemia at age 5 –
- Finished treatment in June 2022
- Chemo was administered via intrathecal – currently watching for long-term side effects
  - We are aware that there have been cases reported in adults of fluctuations in hearing due to CSF changes
- Unsure what type of chemotherapy medication was used
- We can acknowledge that there was potential for
- Ototoxicity, but do not have any data on this

What is Witteveen-Kolk Syndrome

- Mutation of gene SIN3A
- Prevalence: <1/1,000,000
- Autosomal Dominant
- 40 reported cases by December 2020

Characteristics of Witteveen-Kolk

- Small head circumference
- Brain anomalies
- Seizures
- Eye anomaly
- Hearing
- Intellectual development and learning
- Speech and language

Initial Appointment

- Referred by Craniofacial Clinic
- Seen at OSU SLH Clinic for Auditory Processing Evaluation
- Reason for the appointment was to find out whether the symptoms Patient was showing was separated from his genetic condition, and if it could be improved

Developmental and Hearing History

- Patient meets developmental milestones 3-6 months later than his peers
- Did not pass first newborn hearing screening
- Passed NBHS after being retested
- Hearing test done at 9 years old at NCH - reported to be within normal limits

Learning History

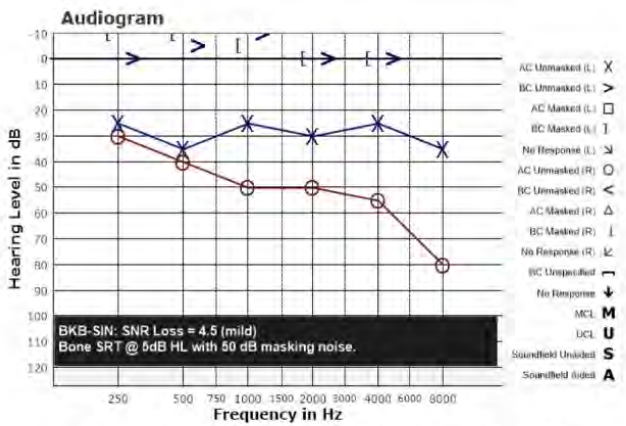
- Report low IQ
- Patient waits at least 30 seconds before responding
- Struggles with expressing himself, articulation, and following directions
- In the classroom, Patient struggles with reading, spelling, comprehension, and writing sentences

Current Interventions

- Speech-Language Therapy
- School based Special Education
- Reading Intervention Tutoring
- Psychological Testing
- Physical Therapy
- Occupational Therapy
- IEP at school

Audiometric Findings

- Flat Tympanograms
- Mild sloping severe conductive hearing loss in right ear
- Mild flat conductive hearing loss in left ear



CONFIGURATION	
Audiometer	GSI-AudioStar Pro
Calibration	06/14/2024
Reliability	Excellent
Test Method	Conventional
Transducer	High Frequency Headphones

PTA (.5, 1, 2kHz)	
Right	Left
46.67	30

Neg: No significant reflex decay **Pos:** Significant reflex decay **Abs:** Absent **Pres:** Present **WNL:** Within Normal Limits **Red:** Reduced
NR: No Response **CNS:** Could Not Seal **CNT/DNT:** Could/Did Not Test **WR:** Word Recognition **SF:**Soundfield **EP:** Earphones

WORD RECOGNITION (Presentation: Recorded / Word List: PBK)						
	dBHL	%	Mask	dBHL	%	Mask
Right	75	92	45			
Left	55	80				

SPEECH AUDIOMETRY (Word List: Spondees)					
	SAT	SRT	Mask	MCL	UCL
Right		45			
Left		25			

Referral

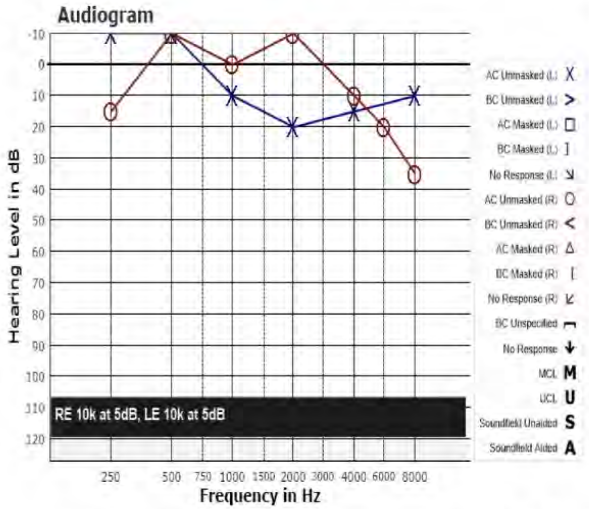
- Patient was referred to an Otologist
- It was determined Patient needed PE tubes
- Patient received PE tubes within a month of initial appointment

Follow-up Appointment

- Patient was seen back in the OSU SLH Clinic
- Parents reported significant improvement in hearing since tube placement
- Parents report continued concern of Patient's attention and processing of auditory information, and speech production when not focusing on what he is saying

Follow-up Hearing Status

- Flat tympanograms with large ECV noting open PE tubes
- Note of SRT PTA disagreement
- Scan-C Screening test
  - Gap Detection : WNL
  - Auditory Figure Ground +8 : WNL
  - Competing Words-Free Recall : Disordered with right ear advantage



CONFIGURATION	
Audiometer	Madsen Astera 1
Calibration	03/07/2025
Reliability	Fair
Test Method	Conventional
Transducer	High Frequency Headphones

TYMPANOMETRY [226 Hz]	Right	Left
Type	Flat	Flat
ECV (cc)	4.6	7.2

PTA (.5, 1, 2kHz)	Right	Left
	-6.67	6.67

Neg: No significant reflex decay **Pos:** Significant reflex decay **Abs:** Absent **Pres:** Present **WNL:** Within Normal Limits **Red:** Reduced
NR: No Response **CNS:** Could Not Seal **CNT/DNT:** Could/Did Not Test **WR:** Word Recognition **SF:**Soundfield **EP:** Earphones

WORD RECOGNITION (Presentation: Recorded / Word List: CID W-22)	dBHL	%	Mask	dBHL	%	Mask
Right	55	92				
Left	60	100				

SPEECH AUDIOMETRY (Word List: Spondees)	SAT	SRT	Mask	MCL	UCL
Right		15			
Left		20			

Recommendations

- Repeat testing in 6 months
- Arrange a consultation with online Speech- Language Pathology service based on parental report and auditory processing screening scores

Continuing Unknowns

- What is the biggest factor in this child's case?
  - Contribution of CSF
  - Chemotherapy/Ototoxicity/Immunocompromised
  - Witteveen Kolk Syndrome
  - Chronic OME
- How much of a role do each of these factors play into the concerns brought forth by the parents today

Hearing the Unheard: A case of tinnitus in a child

Gail M. Whitelaw, Ph.D.

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Department of Speech and Hearing Science

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Myths about tinnitus in children

- Children don't experience tinnitus
  - Prevalence of tinnitus not known in children as we don't ask
  - Prevalence is thought to be similar as in the adult population
  - Children can report as consistently as adults
  - Fifty percent of children with hearing loss are thought to have tinnitus
- Children report that audiologists don't listen to their concerns about tinnitus
- Children and parents told the child is a malingerer

The case

- 10 year 10-year-old presented in the clinic with the primary complaint of tinnitus
  - Remarkable child: Excellent reporter along with supportive family
  - Homeschooled as he is a car racer, learning to rebuild car engines, knowledgeable as a driver and mechanic, interviewed on podcasts
  - He reported tinnitus as similar in both ears, described as ringing, sensitive to weather changes (believes hearing decreases and tinnitus increases), family history of tinnitus, keeps him awake at night, and difficulty hearing over his tinnitus (speech is muffled)
  - Difficult to hear in noisy environments: Difficult to hear when “on the stage”
  - Important to note in this case: he has worn custom fit hearing protection since starting to race cars at age three

The case

- Patient believes he has a loss of hearing, but is secondary to tinnitus perception
- Previous hearing evaluations were reported as of “fair reliability” and he was told he was a “malingerer”
- In retrospect, family believe hearing loss and tinnitus were first reported by child at age 3
- Audiologic evaluation a few months prior to this appointment: Hearing results indicated a moderate hearing loss, suspected as being exaggerated, noted in report to wait until loss progressed to address this
- No one addressed his tinnitus concerns

Evaluation

- Otoscopic and tympanometry were unremarkable
- Mild-moderate sensorineural hearing loss bilaterally, with pure tone averages of 43 dB HL for the right ear and 48 dB HL for the left ear: Good reliability
- Speech reception thresholds at 35 dB HL for the right ear and 40 dB HL for the left ear, commensurate with pure tone results
- Word recognition was 96% for the right ear and 100% for the left ear (40 dB re: SRT)
- Word recognition in noise (BKB-SIN) 4 dB signal-to-noise ratio loss (mild SNR loss)

Evaluation

- Extended high frequencies mild loss for the right ear and moderate hearing loss for the left ear
- Tinnitus Handicap Inventory (THI) results: 72 (severe tinnitus disturbance)
- Tinnitus pitch match: 2000 Hz
- Tinnitus loudness match: 6 dB SL

Treatment Plan

- Hearing aids to address both hearing loss and possibly tinnitus
  - WELL FIT (e.g. verification of fit) hearing aids can reduce tinnitus perception
  - Cognitive behavioral therapy based on THI
  - Sleep hygiene--critical:
    - Use of sound pillow with sound therapy (e.g. ReSound Relief app and/or Widex Zen app
    - Consider CBD isolate from Rowdy Wellness pending discussion with pediatrician
  - Pending tinnitus benefit from hearing aids, consider Lenire tinnitus treatment
  - British Society of Audiology materials
  - Examination by Otologist

Treatment

- Child opted to start with hearing aids
- Retested hearing and pure tone results consistent with previous audiologic evaluation
- Fit with Oticon Intent 1 RIC hearing aids with tinnitus support activated
- Real ear verification
- Hearing aid fitting has “changed my life” according to the patient
  - Hearing “great”
  - Tinnitus is nearly imperceptible
  - Speech “cleaned up”

Treatment

- Confidence has increased due to ability to hear over tinnitus
- May pursue other aspects of plan however at this point, hearing aids have addressed both tinnitus and hearing

Consideration

- Listen to child—dropped preconceived notions about "faking" and what the "textbooks say"
- Tinnitus is real in children and must be discussed and explored
  - Pediatric specific tinnitus questionnaire: impact of Tinnitus in Children Questionnaire (iTCQ)
  - Rank order issues: Do not assume hearing is the most important aspect: Rank order: sound tolerance, tinnitus, hearing loss
    - Tinnitus interferes with listening, focusing, executive functioning, activities in the classroom, sleep, can cause anxiety
    - May need to work with school to create 504 plan or IEP
  - CBT and mindfulness can minimize tinnitus (this patient involved in mindfulness training as a "driver"

Thank you!
Questions?

Gail Whitelaw, PhD
Jack Korsgard, BS
Madison Pollock, BA
Christina Martin-Smith, MGS
Aryn Robinson, BS
Liam Smyth, BA

Congratulations!

- You've completed the course and can move on to the exam!
- From your account:
  - Go to pending Courses
  - Choose take exam