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- Call 800-753-2160 (M-F, 8 AM-8 PM ET)
- Email customerservice@AudiologyOnline.com

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COMPLEX PEDIATRIC AUDIOLOGY CASES

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LEARNING OUTCOMES

As a result of this course, participants will be able to:

1. select appropriate assessment measures for patients with complex histories and/or needs.
2. evaluate multiple performance measures in order to plan and validate treatment.
3. explain the value of both objective and subjective measures in working with pediatric patients.

CONTINUED

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DISCLOSURES

- WE HAVE NOTHING TO DISCLOSE

CONTINUED

Pediatric Audiology is Complex By Definition

- Children are less cooperative than adults
  - We need to figure out what is interesting and will get them to cooperate
- Hearing loss in children can be a surprise
  - Adults usually come in knowing that something is wrong
    - Hearing has been deteriorating for years
  - Families do not expect something to be wrong
- Managing hearing loss in children is complex
  - Helping families understand the need for developing the auditory brain
  - Be sure technology is providing sufficient benefit
  - Helping families accept and use technology
  - Helping arrange therapy
  - Counseling

MAIN IDEAS

- We establish type and degree of hearing loss, not for its own sake, but to assist in selecting technology, planning therapeutic management, and advocating for positive audiologic outcomes for the child.
  - Validity and reliability measures are critically important when evaluating applicability of any test protocol.
  - Audiologic test results need to be presented to other team members, including parents, in a functional format.

MAIN IDEAS

- While verification is a critical part of evaluation with technology, validation of the technology fitting is essential if we want to know what a child is truly hearing – that is – what sounds are actually reaching the child's brain, and if the signal is clear or distorted.
- The whole point of technology (e.g. hearing aids, cochlear implants, bone anchored systems, and FM systems) is to get sound/spoken communication to the child's brain.

MAIN IDEAS

- Children speak what and how they hear – if they speak "distorted", likely the brain is receiving distorted sounds and deficient auditory information.
- Interpreting audiologic results includes using test information to estimate the child's performance outside of the test situation and making appropriate recommendations.

WHAT ARE THE OUTCOMES OF A SUCCESSFUL TECHNOLOGY FITTING?

- Eliminate auditory neural sensory deprivation
- Access auditory information for the stimulation and development of neural pathways for cognitive growth
- Improve auditory brain access to spoken language
- Provide auditory brain access of information/knowledge, sufficient for auditory learning
- Maximize use of residual hearing
- Lay foundation for academic learning using audition
- Facilitate brain access of information for distance hearing and incidental learning
- Facilitate socialization
- Safety
- Comfort

JRM

THERE ARE ALWAYS QUESTIONS TO ASK

- Was the correct test used?
- Do we have enough audiologic data to make management decisions right now, or do we need additional tests?
  - Do we have a complete picture of auditory performance?
  - Do we have enough information to plan management at this point in time?
- Do the speech perception tests selected provide sufficient information to assess if the child has enough acoustic access to his/her brain?
  - to learn language
  - to learn in a mainstream classroom
- Are we explaining test results clearly to other Team members, including the family?

REAL EAR vs REAL BRAIN

- Real ear, eSRT, and neural response measures are critical, BUT they do not tell us what *meaningful* information is arriving at the auditory brain
  - While real ear may provide good thresholds for some children, everyone's ear is different; the way sound passes through the auditory system is different.
  - HA/CI manufacturer recommended settings are averages. They do not account for the unique characteristics of the individual's auditory system.
  - Only behavioral measures will tell us exactly what the child is hearing.
    - That is, what meaningful information is getting to the brain.

HAs AND CIs ARE *SPEECH* PROCESSORS

- Bottom line -- simply verifying through objective measures that the prescribed response has been obtained is not enough!
- We need to validate the fit by obtaining aided thresholds and performing speech perception testing.
- If aided thresholds are not at the level of the speech string bean,
  - Why? Lack of access or interaction with technology?
  - Do we need to get new earmolds, change HA settings? Get new HA's?
  - Do we need to move to a CI?

TEST PROTOCOL WITH TECHNOLOGY

- To ASSESS AUDITORY FUNCTIONING
- Test speech discrimination at:
  - Normal conversational level (50 dBHL) (R, L, B)
  - Soft conversational level (35 dBHL) (B)
  - Normal conversation in competing noise (+5 SNR) (B)
    - Noise needs to be realistic – e.g. four talker babble
    - Average classroom noise level is +5 dB SNR (the goal is +15 dB or + 20 dB SNR)
- Aided thresholds – Right and left

SPEECH PERCEPTION STANDARD SCORES

			Male				Female			
Condition	**CA**	**List**	**N**	**WR%**	**SD**	**95% CI**	**N**	**WR%**	**SD**	**95% CI**
Quiet 50 dB	3-5	NU-C	14	98	3.7	96-100	12	98	3.2	96-100
Quiet 50 dB	6-8	PBK	13	98	3.1	97-100	12	98	3.2	96-100
Quiet 50 dB	9+	W-22	13	99	1.9	98-100	6	96	5.1	92-100
Quiet 35 dB	3-5	NU-C	19	95	5.2	92-97	13	96	4.8	93-98
Quiet 35 dB	6-8	PBK	23	97	3.7	95-98	24	98	3.1	97-99
Quiet 35 dB	9+	W-22	17	98	2.8	97-100	9	96	4.2	93-98
50 @ +5 SNR	3-5	NU-C	28	93	4.6	91-95	16	94	4.1	92-96
50 @ +5 SNR	6-8	PBK	13	94	4.5	92-96	25	95	5.1	93-97
50 @ +5 SNR	9+	W-22	17	97	4.1	95-99	7	93	3.8	90-96
50 @ 0 SNR	3-5	NU-C	23	91	6.9	88-94	17	92	6.5	89-95
50 @ 0 SNR	6-8	PBK	18	91	5.4	89-93	28	93	6.0	90-95
50 @ 0 SNR	9+	W-22	19	95	4.7	93-97	11	93	4.8	91-96
35 @ 0 SNR	3-5	NU-C	23	90	6.1	87-93	16	92	6.0	89-94
35 @ 0 SNR	6-8	PBK	28	91	6.2	88-93	28	90	6.1	87-92
35 @ 0 SNR	9+	W-22	18	91	6.2	88-94	11	90	7.0	86-94

HOW DO WE KNOW AUDITORY BRAIN ACCESS IS SUFFICIENT?

- Speech perception scores are good to excellent:
  - At normal conversational levels
  - At soft conversational levels
  - In quiet and in noise
- Aided thresholds at 20-25 dBHL throughout the frequency range
  - With understanding of technology interactions

SUGGESTED SCORING - SPEECH PERCEPTION

Madell et al 2010

- Excellent 90-100%
- Good 80-89%
- Fair 70-79%
- Poor < 70%

IF THE CHILD IS NOT PROGRESSING AS EXPECTED

- Suspect technology first
  - Is the child hearing well enough with the technology? That is, is the child's brain receiving enough, high fidelity auditory information?
  - Is the child hearing high frequencies?
- Is the child wearing technology consistently?
  - If a child is using technology 4 hrs/day it will take 6 years for the child to hear what a typically hearing child hears in one year.
- Does the family have appropriate expectations?
  - Are they requiring full time use of technology?
  - Are they providing auditory stimulation?
  - Do they expect the child to listen and talk?
- Do the practitioners working with the child have appropriate auditory expectations?

CASE NUMBER ONE: MILD HEARING LOSS

MILD HEARING LOSS

- Jamie is referred for evaluation by his school. He has been struggling with some aspects of academics in both kindergarten and first grade
- Pregnancy, birth and developmental history is uneventful
- Parents are not observing any hearing problems at home.

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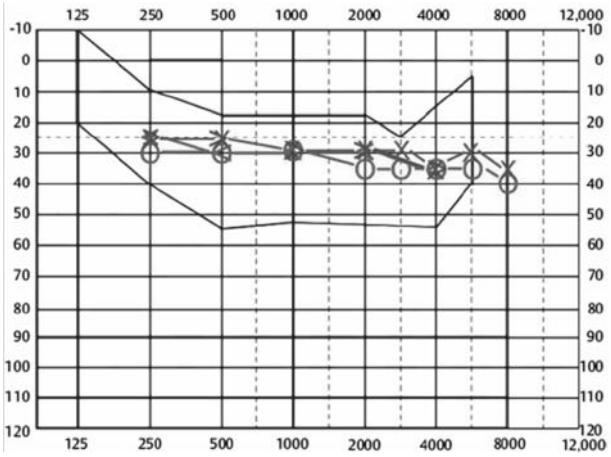
MILD HEARING LOSS



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MILD HEARING LOSS

- The audiologist reported to parents
  - testing indicated thresholds at minimal/mild HL levels,
  - Normal middle ear functioning
  - Return in one year
- Questions
  - Has enough testing been completed?
  - Is the recommendation appropriate?
  - Does the fact that Jamie is having academic problems affect the recommendation?

CONTINUED

	Right ear	Left ear
Speech recognition threshold	30 dB HL	30 dB HL
Speech perception: 40 dB SL (70 dB HL)	84%	88%

	Sound field (%)
50 dB HL (average conversational-level speech)	76
35 dB HL (soft conversational-level speech)	46
50 dB HL + 5[4] SNR (four-talker speech babble)	54

RECOMMENDATIONS

- Educate school staff about difficulties Jamie can expect in learning from soft speech and in competing noise
- Counsel family about keeping the home quiet and monitoring middle ear disease which could make the mild HL worse
- Use of remote microphone system in all academic settings
- Psycho-educational evaluation to identify areas of difficult which require management

CASE NUMBER TWO: MATTHEW BILATERAL COCHLEAR IMPLANTS

MATTHEW

- Profound HL identified at birth
- Pregnancy, birth and developmental history not significant
- Bilateral cochlear implants at 9 months
- Successfully mainstreamed
- At IEP meeting prior to 3rd grade, the school reviewed recent test results from the CI center and determined that Matthew's hearing loss was no longer significantly interfering with his development and that he no longer needed any special services at school

MATTHEW, 9 YRS MAINSTREAMED 3RD GRADE

- Profound hearing loss
- Bilateral cochlear implants

	Right CI	Left CI	Binaural	FM
PBK 50 dBHL	98%	98%	98%	DNT

MATTHEW, 9 YRS MAINSTREAMED 3RD GRADE

- Profound hearing loss
- Bilateral cochlear implants

	Right CI	Left CI	Binaural	FM
PBK 50 dBHL	98%	98%	98%	DNT
CNC 50 dBHL	68%	72%	76%	86%
CNC 35 dBHL			54%	
CNC 50 dB +5SNR			46%	

Matthew, 9 yrs Speech-Language Evaluation

Test	Standard score	% rank	Age Equiv.
Antonyms	121	92	10-6
Syntax Construction	107	68	8-8
Paragraph comp.	111	77	9-4
Nonliteral language	120	91	10-6
Pragmatic language	96	39	7-8
CORE Composite	113	81	
Sentence completion	92	30	7-4
Grammatical judgment	95	37	6-9
Inference	92	30	7-0

Matthew, 9 yrs Educational Evaluation

	SCORE	% RANK	DESCRIPTION
Verbal comprehension	110	75	High average
Perceptual reasoning	96	39	Average
Working Memory	104	61	Average
Processing speed	94	34	Average
Full Scale IQ	103	58	Average
Copying (visual motor) (Bender)	99	47.34	Average
Recall	94	34.46	Average

What Should We Recommend for Matthew?

- Appropriate audiological evaluation
- Use of FM in all academic classes with use of pass mic
- TODHH services to include Preview/Review
- Classroom Acoustic Modifications
- Test accommodations

CASE NUMBER THREE: RIVER MILD TO MODERATE?

RIVER

- Did not pass newborn hearing screening
- Pregnancy, birth and developmental history not significant
- ABR indicated mild to moderate bilateral sensorineural hearing loss

	500Hz	1000Hz	2000Hz	4000Hz
Right	30dBnHL	40dBnHL	40dBnHL	50dBnHL
Left	25dBnHL	35dBnHL	40dBnHL	45dBnHL

- Fitted with binaural hearing aids at 3 months
- Per ENT, no additional referrals needed for mild HL
- Return at 12 months of age

RIVER

- Returns at 12, 18, and 24 months of age for VRA testing
- At each visit, mother expresses concern that "language does not appear to be developing"
- "Patient will not condition" to VRA
- At 24 months, ABR recommended

RIVER

- Questions:
  - What concerns are evident?
  - What could have been done differently?
  - What should be done at this point?

RIVER

- At age 2, parents decide to seek 2nd opinion for child
- 2nd opinion center suggests use of CPA
  - Testing every 6 months
  - One ear at a time

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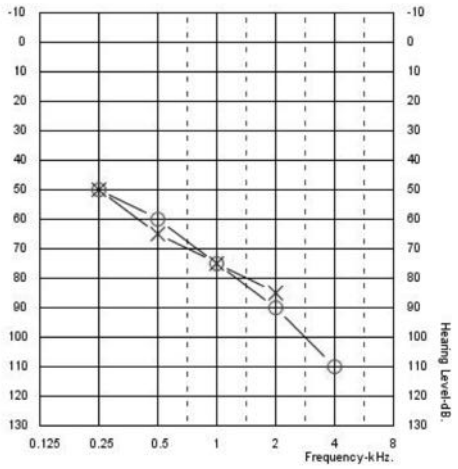
RIVER Age 3.2 (compilation of 3 audiograms)



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RIVER

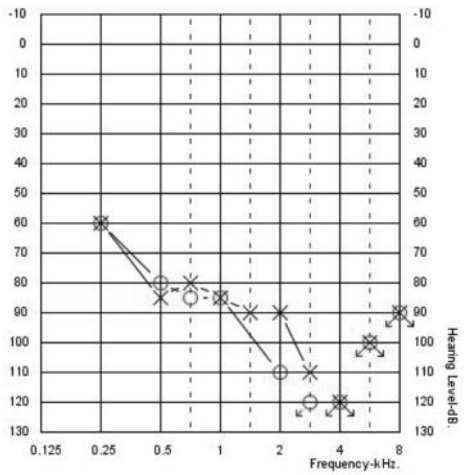
- At age 3.2, based upon results, center increases gain on hearing aids
- Questions:
  - What additional information would be important?
  - What are appropriate next steps?

RIVER

- Mother requests retest in 3 months
- At age 3. 6, results consistent with compilation audiogram
- Center provides loaner power hearing aids
- Refers to ENT who recommends imaging
- Parent decides to seek 3rd opinion

RIVER

3rd opinion at age 3.6



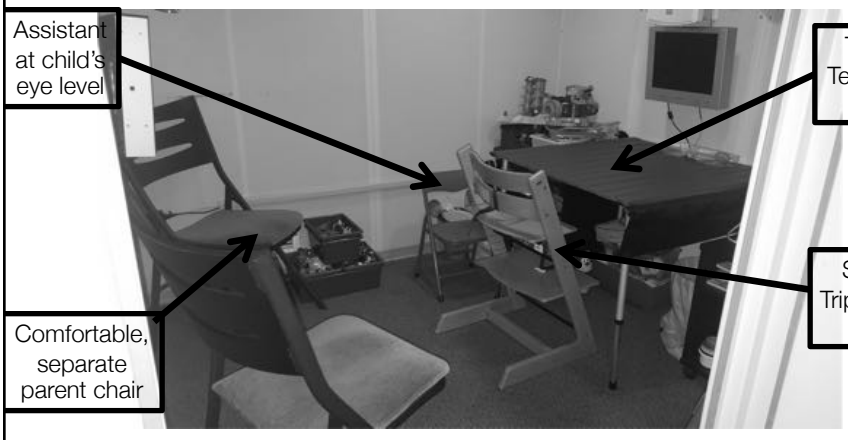
RIVER 3rd opinion at age 3.6

	Unaided SRT (open set)	Unaided NU-Chips at 105dBHL (open set)	Aided SRT (open set)	Aided NU-Chips at 50dBHL (open set)
Right	105dB	24%	CNT at 65dB	CNT
Left	105dB	48%	50dB	0%

RIVER

"A comfortable testing environment sets the stage for a successful assessment, especially for young children."

Bracken, Bruce A., and Richard J. Nagle. *Psychoeducational Assessment of Preschool Children*. Routledge, 2017.



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RIVER

CONTINUED

RIVER

- Questions:
  - What additional information do we need to know?
  - What recommendations should be made?
- Mom received results of imaging indicating bilateral EVA

RIVER

- At 3.9 years, patient simultaneously bilaterally implanted
  - 1st 6 weeks were difficult
- Speech perception 6 months post CI

	Aided SRT (open set)	Aided NU-Chips at 50dBHL (open set)	Aided NU-Chips at 35dBHL (open set)	HINT-C at 50dB in quiet
Right CI	30dB	64%		
Left CI	35dB	76%		
Bilateral CI			48%	51%

RIVER

- Language progress
  - By 3 months post implant, child had made 6 months' language growth from preimplant levels
  - By 6 months post implant, child had made 1 year's language growth
  - By 12 months post implant, child had made 2 years' language growth

CASE NUMBER FOUR: CONNOR AUTISM SPECTRUM DISORDER

CONNOR

- Passed newborn hearing screening ABR
- At 1 year of age, mother expressed concern about lack of language development
- Pediatrician administered:
  - OAEs = passed
  - Autism screening = referred
- Neurologist diagnoses child as having:
  - Autism Spectrum Disorder (ASD)
  - Significant communication disorder
  - Excellent social interaction

CONNOR

- Child receives:
  - ABA therapy at age 1
  - Enrollment in autism class at age 3
  - AAC device at age 3
  - Yearly hearing screening through school district nurses

CONNOR

- At age 5:
  - Child using AAC device to communicate in sentences
  - Teacher administers ASD screening and finds NO traits of autism
  - School nurse administers hearing screening after inservice training from audiologist
    - Learned CPA
    - Stopped using Music 2 My Ears

CONNOR

- Child referred for audiological testing
  - DPOAEs:
    - Right = Absent 1000 to 6000Hz
    - Left = Absent 1000 to 4000Hz / Present 6000Hz
  - ABR:
    - Right = Present wave V to 80dBnHL with reversing polarity
    - Left = Absent wave V to 85dBnHL with reversing polarity

CONNOR

- Child referred for audiological testing
  - ASSR:

	500Hz	1000Hz	2000Hz	4000Hz
Right	75dBcorHL	90dBcorHL	80dBcorHL	70dBcorHL
Left	85dBcorHL	90dBcorHL	80dBcorHL	70dBcorHL

  - Diagnosis of ANSD
- Questions:
  - What additional information is important?

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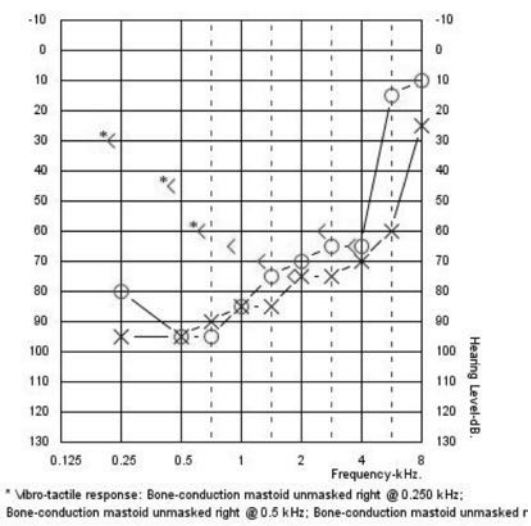
CONNOR



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CONNOR

- What type of hearing loss is this?
- Questions:
  - What is the diagnosis?
  - What are the recommendations for intervention now?

CASE NUMBER FIVE: ROSIE MULTIPLE SENSORY IMPAIRMENTS

ROSIE

- Patient diagnosed with significant visual impairment and moderate hearing loss shortly after birth secondary to CMV
- Received hearing aids at 3 months
- Patient enrolled in ASL program through state school for the deaf. The clinicians recommended that all children learn ASL even if they were learning to speak.
- When parents expressed concern that Rosie could not participate in dinner table discussion with the family of 7,EI clinicians recommended that one parent or sibling be assigned to sit next to child in high chair and sign 9-12 inches from child's face during all meals

Rosie

Questions

- Is assigning someone to sit within 9-12 inches of a child's face at all times to sign to the child a reasonable recommendation?
- If a child with both vision and auditory loss has usable hearing, is it a reasonable recommendation that emphasis be placed on vision?
- For a child with hearing and vision loss, would you emphasize building auditory skills?

KEY POINTS

- Be absolutely certain that children are receiving enough auditory information for auditory brain development and development of language and literacy
- Be specific in what the child needs to hear
  - Are aided thresholds at sufficiently soft levels?
  - Is the child hearing well with both ears/two neural tracts?
- Speech perception with technology
  - Is speech perception good in each ear?
    - Normal conversational levels
    - Soft conversational levels
    - In competing noise
- Be absolutely certain that the family understands what is necessary for a child with hearing loss to succeed
- Audiologists have a responsibility to monitor therapy to be sure a child is receiving everything she needs to succeed.
- Never assume – **everything** needs to be tested

AUDIOLOGISTS

- Until Audiologists do their job of getting auditory information to the child's brain, no one else can to their job.
- Unfortunately, not all audiologists have an auditory-verbal approach when fitting technology on children.
- In fact, most audiologists rely on hearing aid or cochlear implant manufacturers to suggest basic programming of technologies.
- Therefore, responsibility for assuring that technology is providing sufficient auditory brain access, optimal aided performance, good to excellent speech perception, and sufficient information to plan intervention, often falls to families, SLP's, and LSLS practitioners.
- Audiologists must work collaboratively with other professionals and *provide evidence of auditory brain access and technology function for language and literacy development.*

THANK YOU FOR LISTENING

QUESTIONS?