

Auditory Neuropathy Spectrum Disorder

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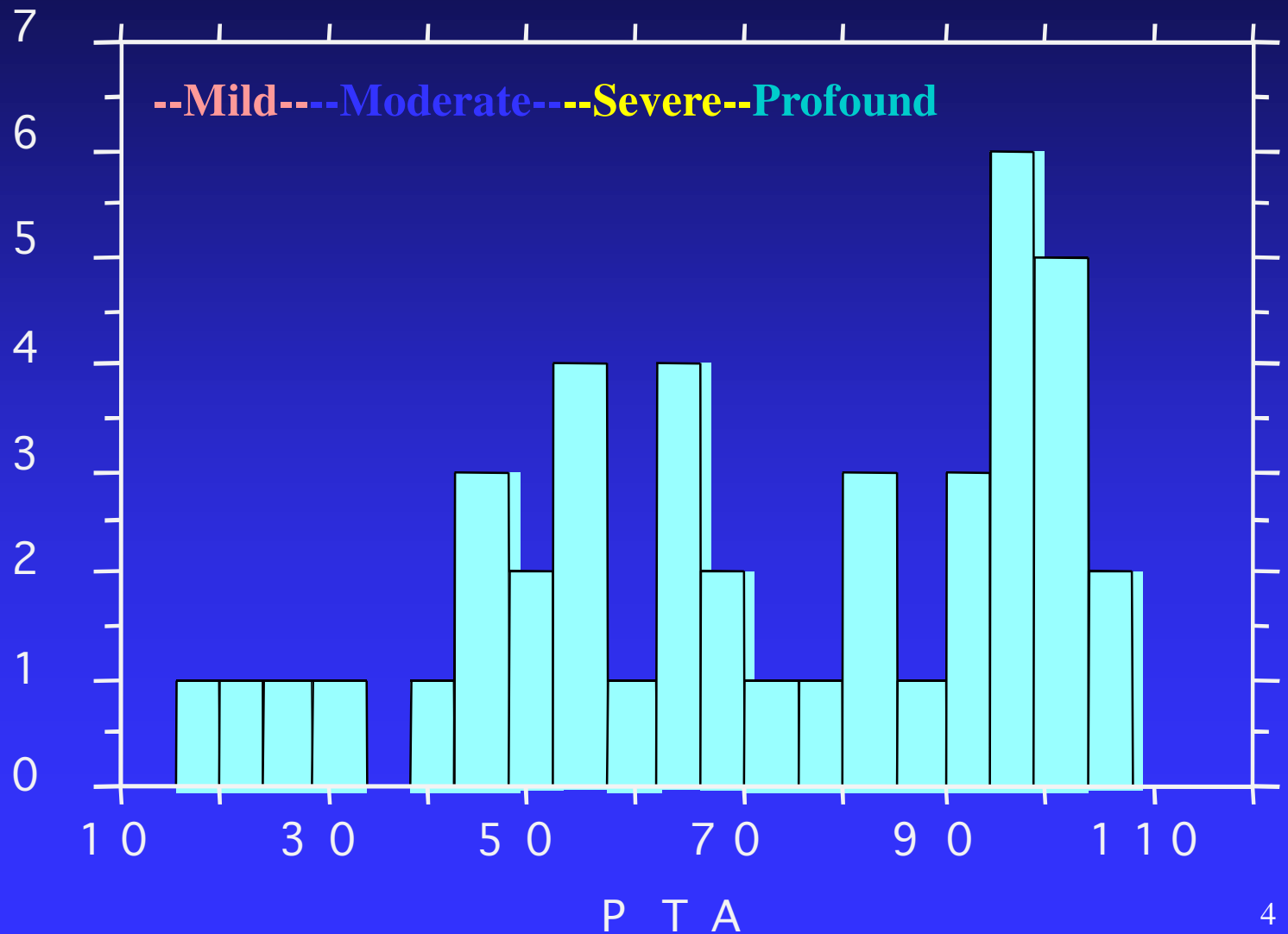
What is it?

Audiologic Signs

- Hearing thresholds from normal to profound deafness
- Auditory Brainstem Response absent or abnormal.
- Present (prominent) Cochlear Microphonic.
- Otoacoustic Emissions usually present.
- Speech perception poorer than predicted by audiogram
- Absent middle ear muscle ear reflexes.

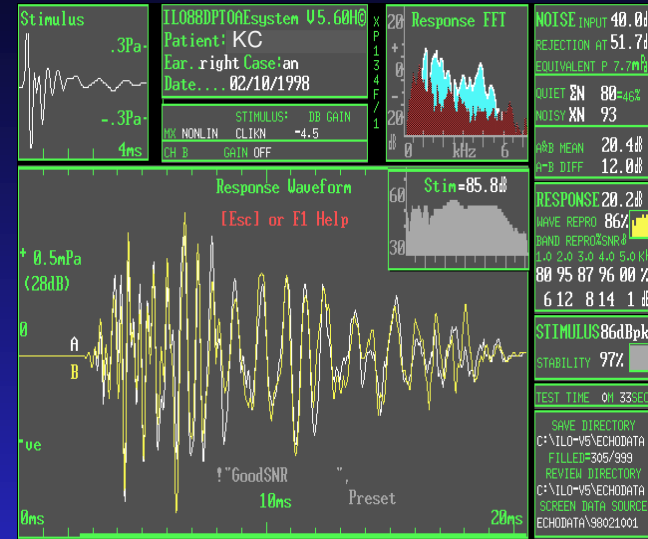
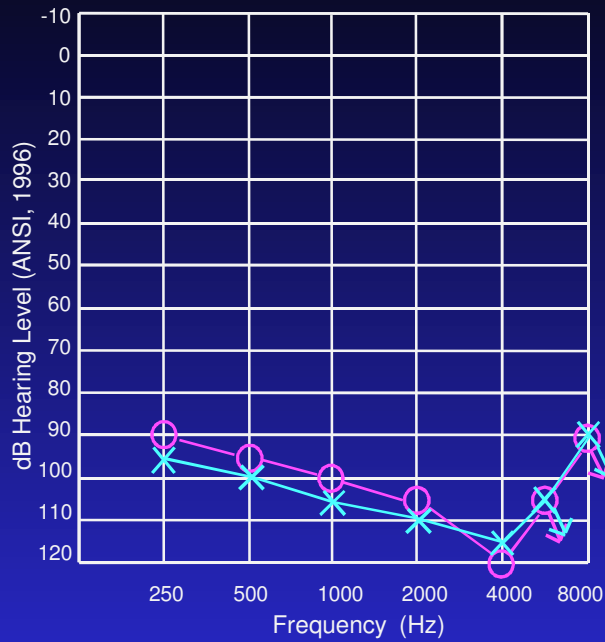
Auditory Neuropathy in Children < 2 Years of Age

Count



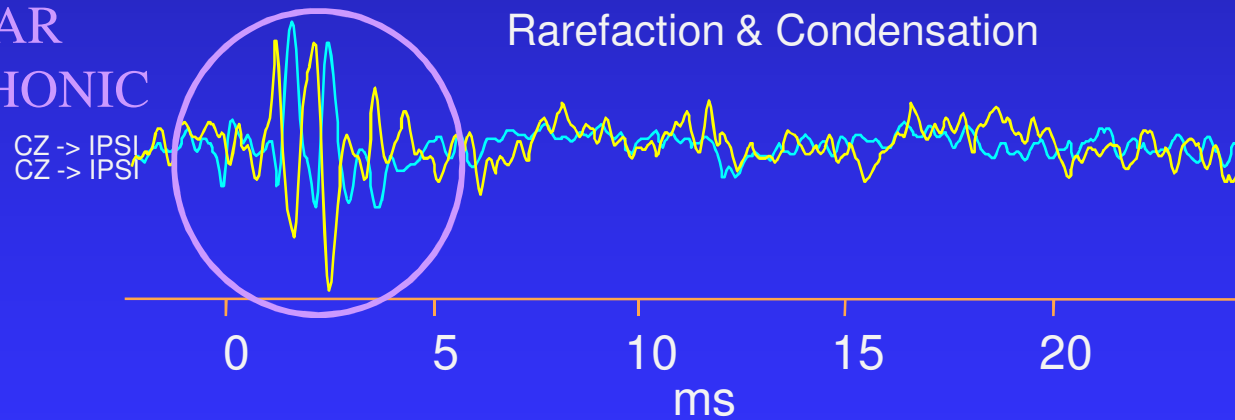
AUDIOGRAM

Female 16 months



COCHLEAR
MICROPHONIC

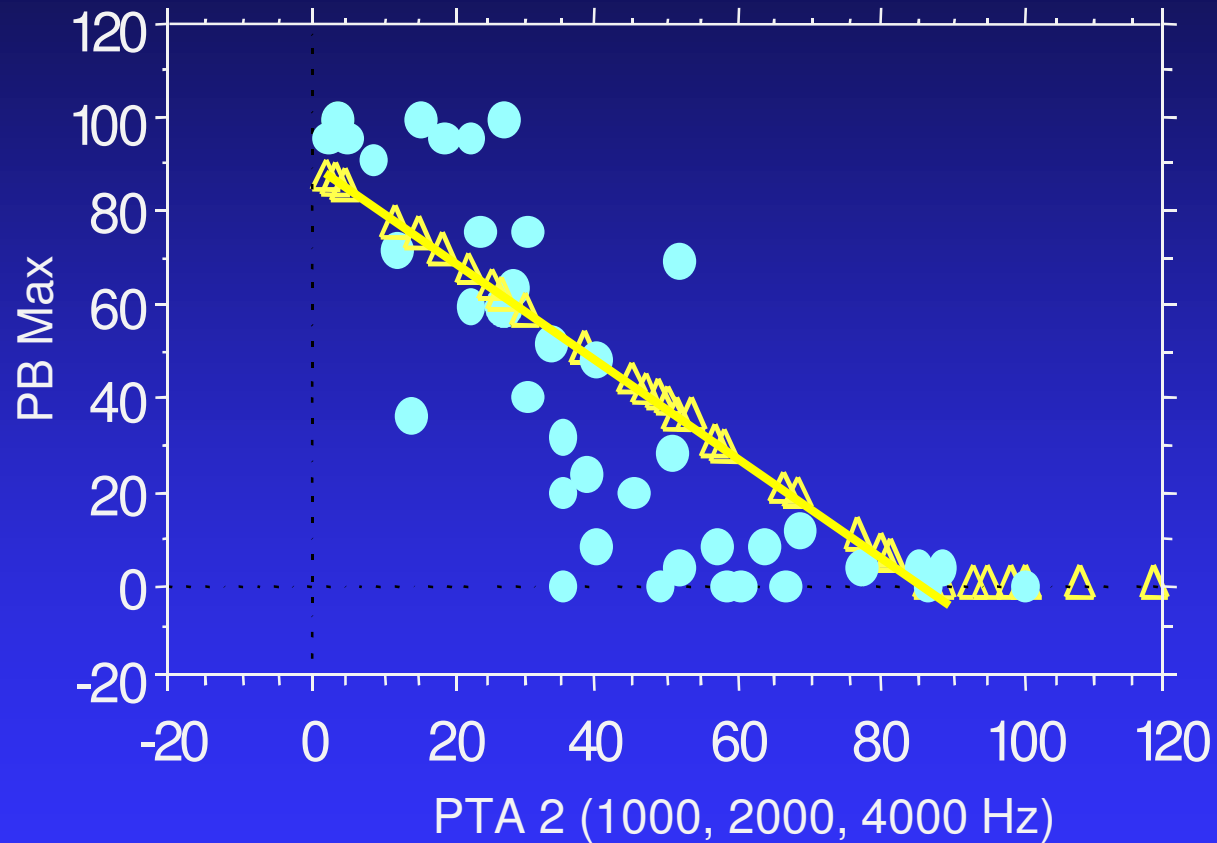
Rarefaction & Condensation



Auditory Brainstem Response

Click 80 dBnHL

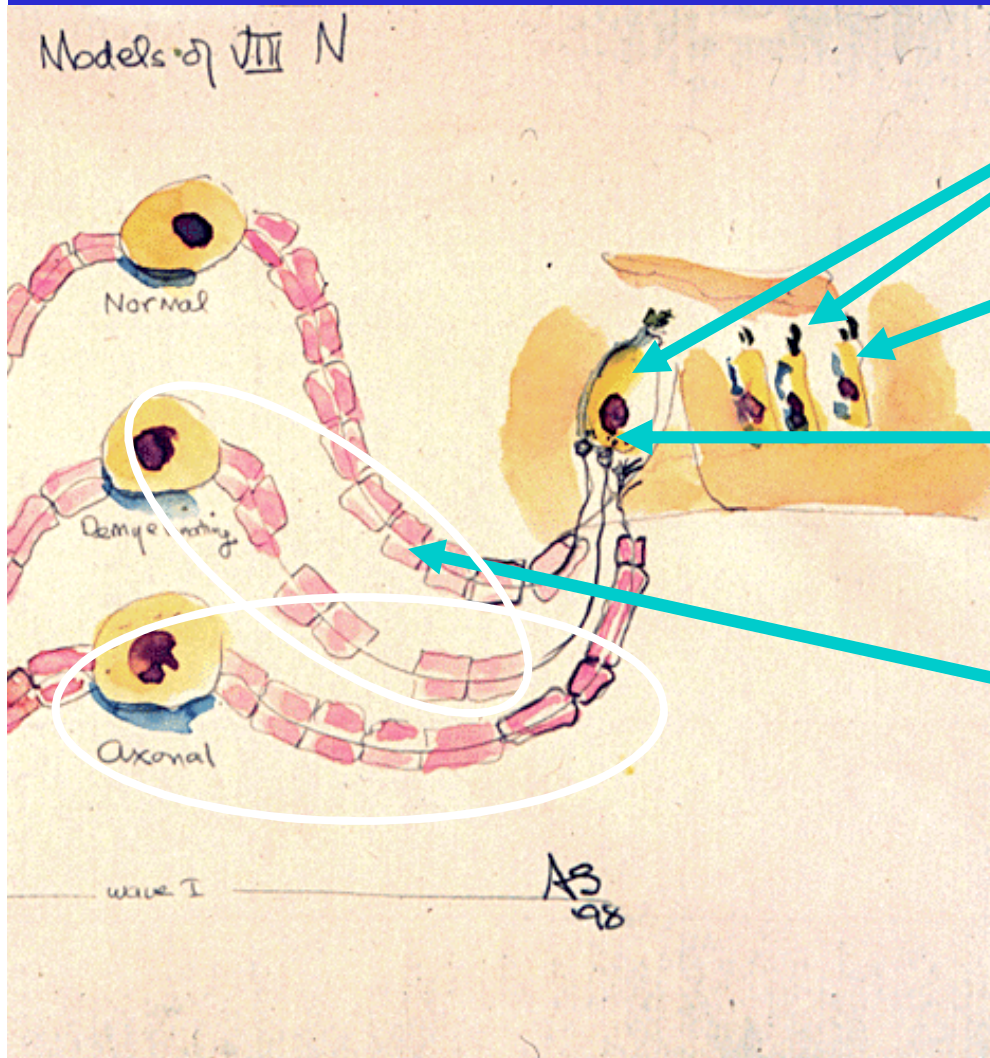
Speech Discrimination re PTA



● Neuropathy Speech Discrimination Score

△ Expected Speech Discrimination Score

Potential Sites of Lesion in AN Based on Symptoms



CM present from either
IHC OHC or both
OAE (outer hair cells)
Functioning

Inner hair cell function
or synapse could be
involved.

ABR Wave I Abnormal-
(Peripheral Auditory
Nerve Involved (?))

Evidence of Auditory Nerve Involvement in Auditory Neuropathy

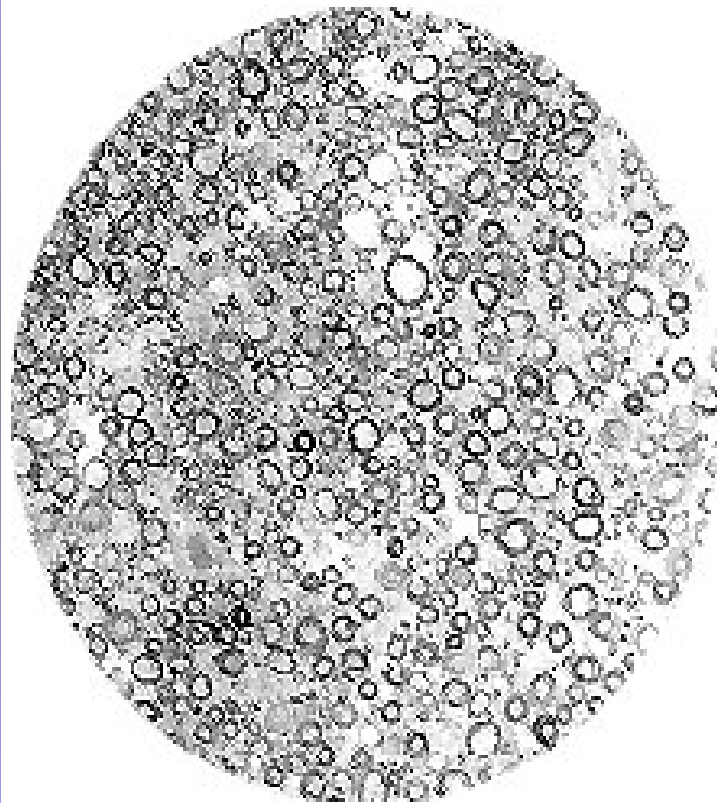
- **Starr et al., found 30-40% of patients have evidence of other peripheral nerves disorders (absent deep tendon reflexes or poor nerve conduction)**
- **As many as 80% of adult AN patients have subtle or pronounced peripheral neuropathy (HSMN, Friedreich's Ataxia).**
- **Sural nerve biopsy on 4 patients with AN shows peripheral nerve disease, primarily axonal.**

Evidence of Auditory Nerve Involvement in Auditory Neuropathy

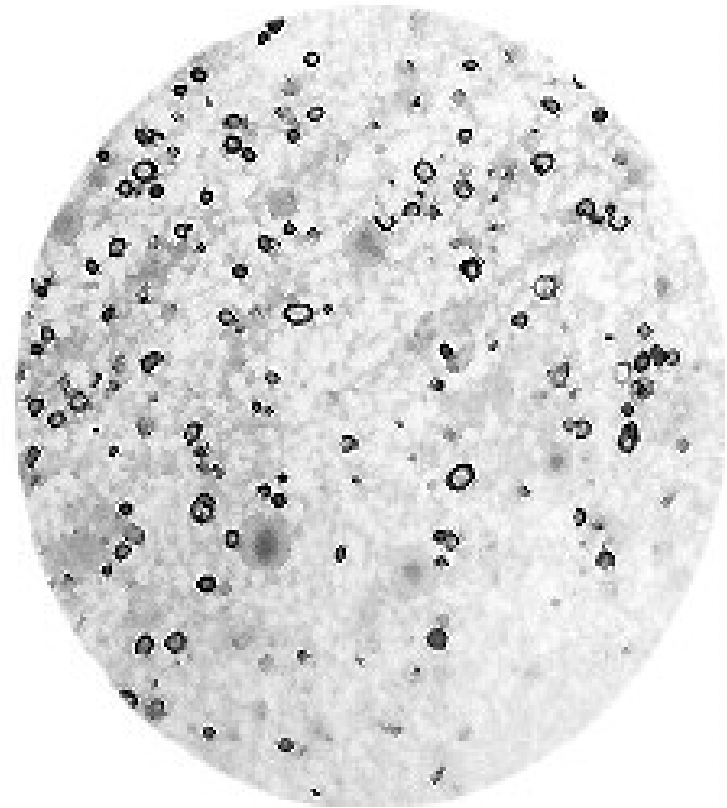
- **Human temporal bone histology showing normal complement of hair cells with poor ganglion cell survival (Spoendlin, Nadol).**
- **Temporal bone histology on patient with documented AN shows axonal degeneration (95% loss of ganglion cells), with a normal complement of hair cells (30% loss of OHC in apical turn). Starr et al., Brain 2003**

Auditory Nerve

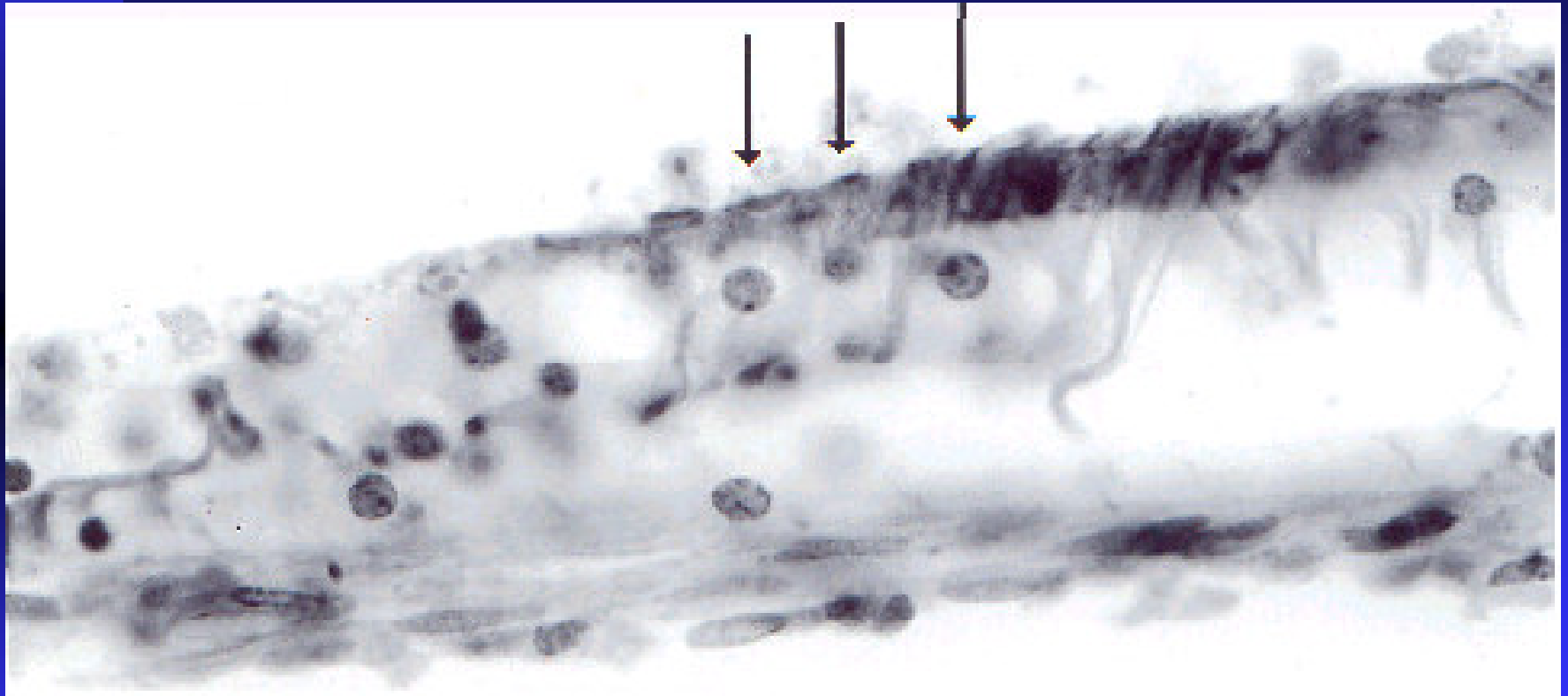
Normal

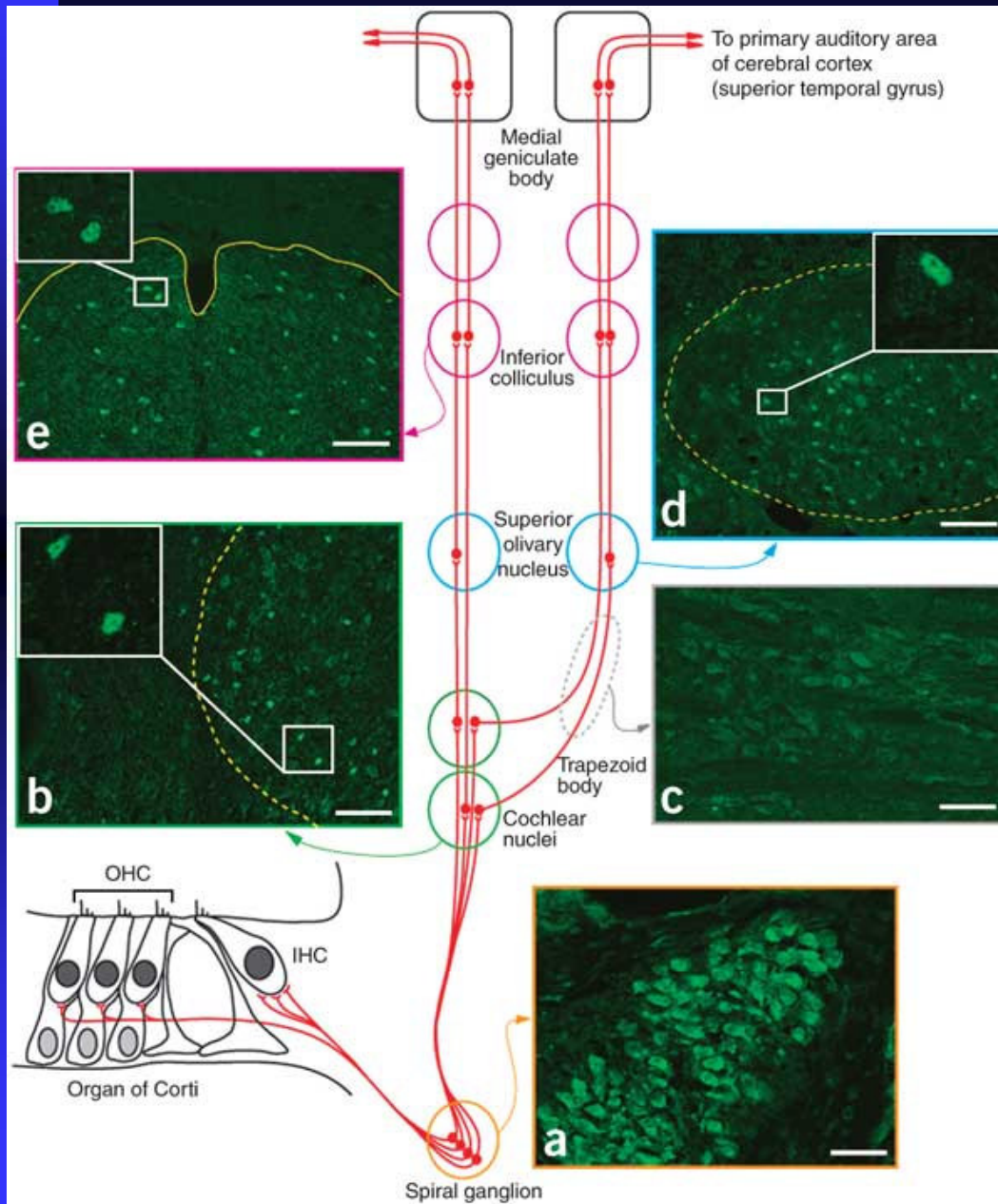


Auditory Neuropathy



Inner Hair Cells from Temporal Bone of Auditory Neuropathy Patient



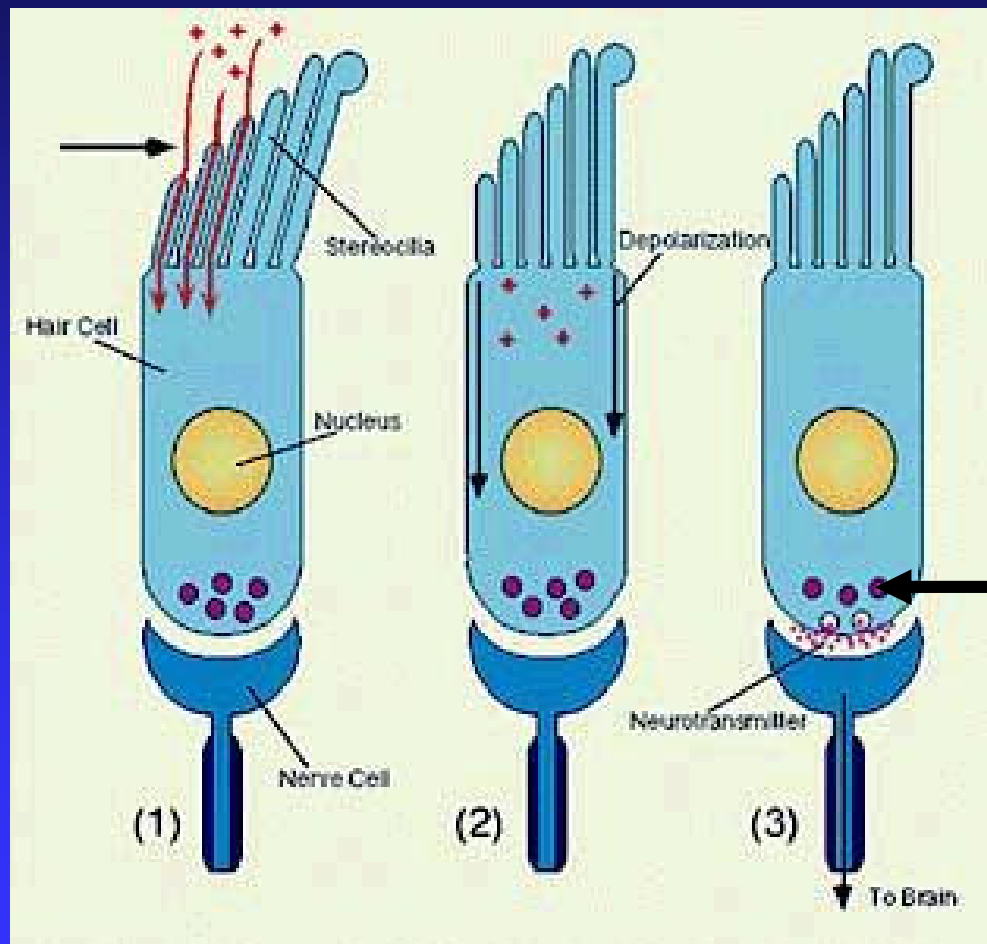


Mutations in the gene encoding pejkavin, a newly identified protein of the afferent auditory pathway, cause DFNB59 auditory neuropathy

**Buchman, CA, Roush, PA, Teagle, HF, et al. (2006).
Auditory neuropathy characteristics in children with
cochlear nerve deficiency. Ear and hearing, 27(4), 399-408.**

Nine (18%) of 51 children with ABR characteristic of AN have been identified as having small (N = 2; 4%) or absent (N = 7; 14%) cochlear nerves on MRI.
RESULTS: Of the nine children with cochlear nerve deficiency, five (56%) were affected unilaterally and four (44%) bilaterally.

Rodriguez-Ballesteros M et al (2003) Auditory Neuropathy in Patients Carrying Mutations in the Otoferlin Gene (OTOF). *Human Mutation* 22:451-456.



OTOF mutations can explain 3.5% of non-syndromic deafness.

Otoferlin involved in vesicle-membrane fusion.

Summary of sites of lesion in ANSD with solid evidence

- **Auditory Nerve
neuropathy or insufficiency**
- **Inner Hair Cell/auditory nerve synapse**



Consequences of Neural Involvement

- ANSD is known for fluctuations in symptoms: remission, true fluctuations, and/or progression.
- Poor and inconsistent encoding of temporal information lead to unusual temporal processing and poor speech perception.
- Noise is even more disruptive to auditory/speech perception than seen in other types of loss.

History Factors in Auditory Neuropathy

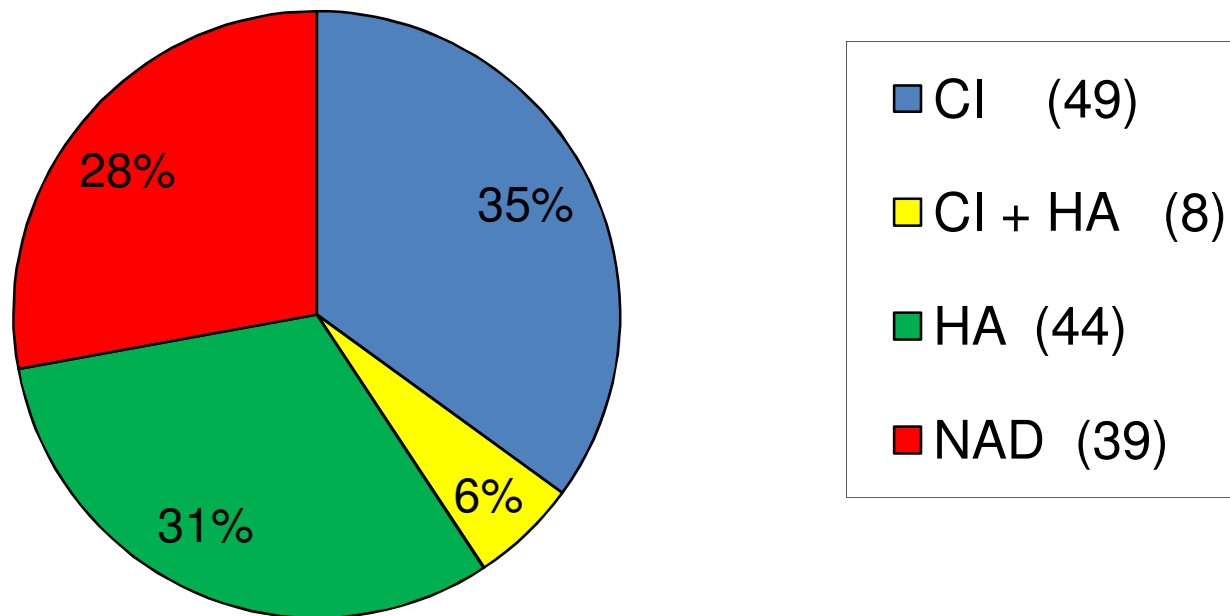
N=59

(Sininger, Starr & Oba)

3	Dominant Family History
7	Multiple Risk Factors
7	Premature Birth
8	Hyperbilirubinemia
17	Recessive Family History
26	No Known Risk Factors

Management of Children with ANSD

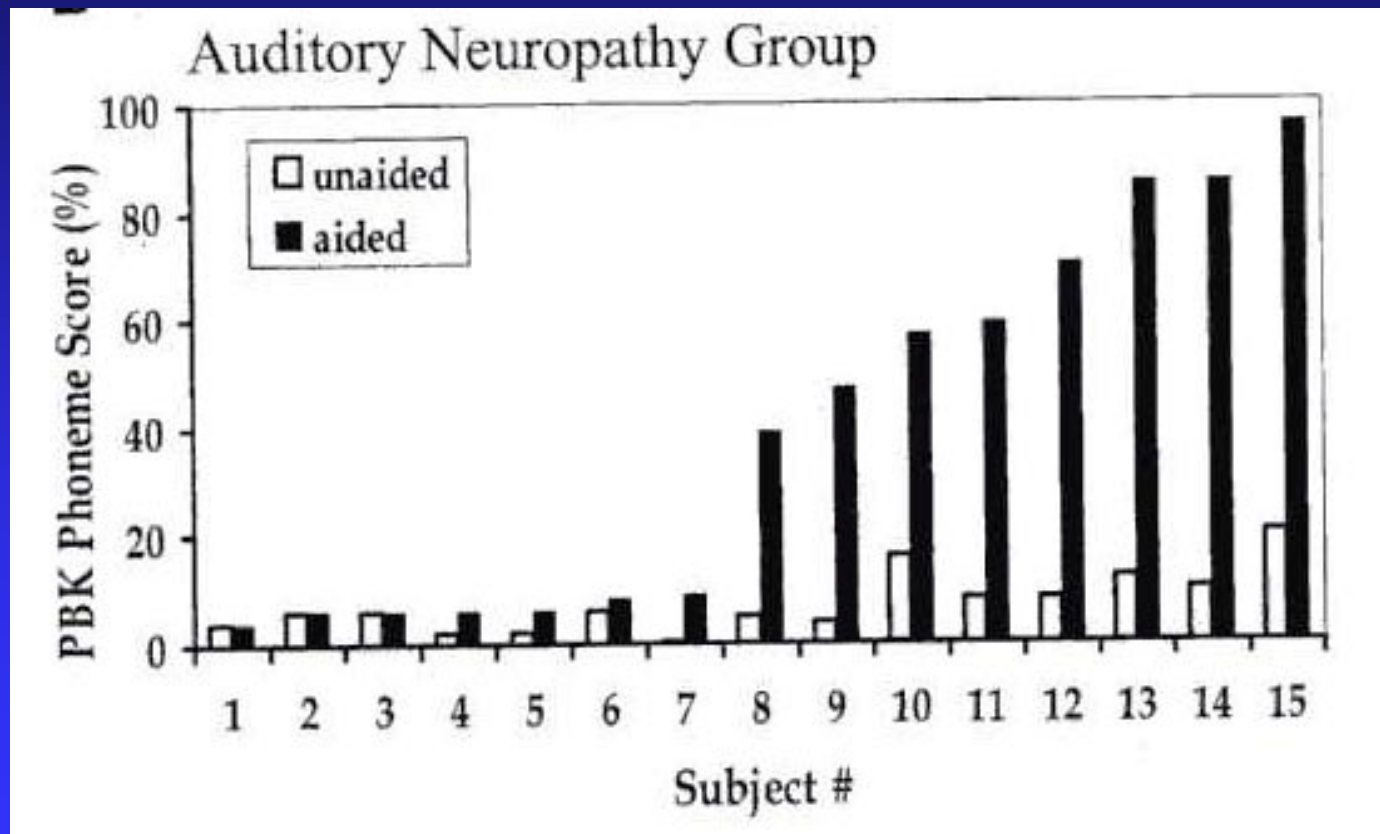
Assistive Listening Devices
N = 140



From Pat Roush U. North Carolina

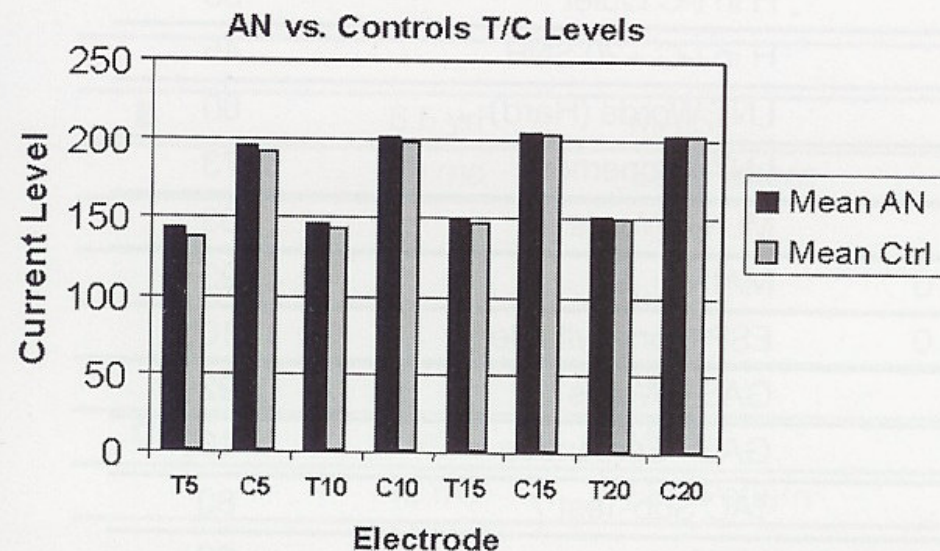
Complicated by difficulty in audiometrics

*Half of Subjects with Hearing Aids
show significant improvement.
Rance et al., E&H 2002*

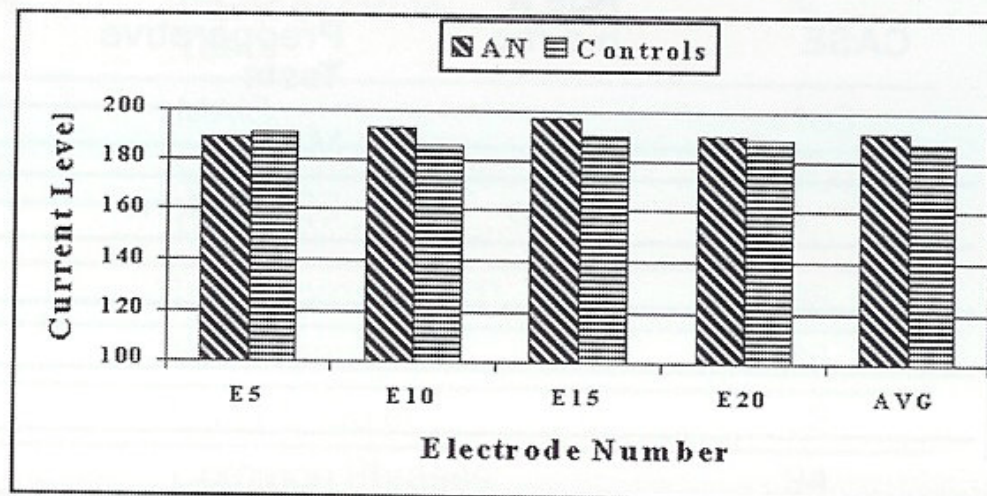


T and C Levels and NRT Thresholds are the Same for AN Patients and Controls

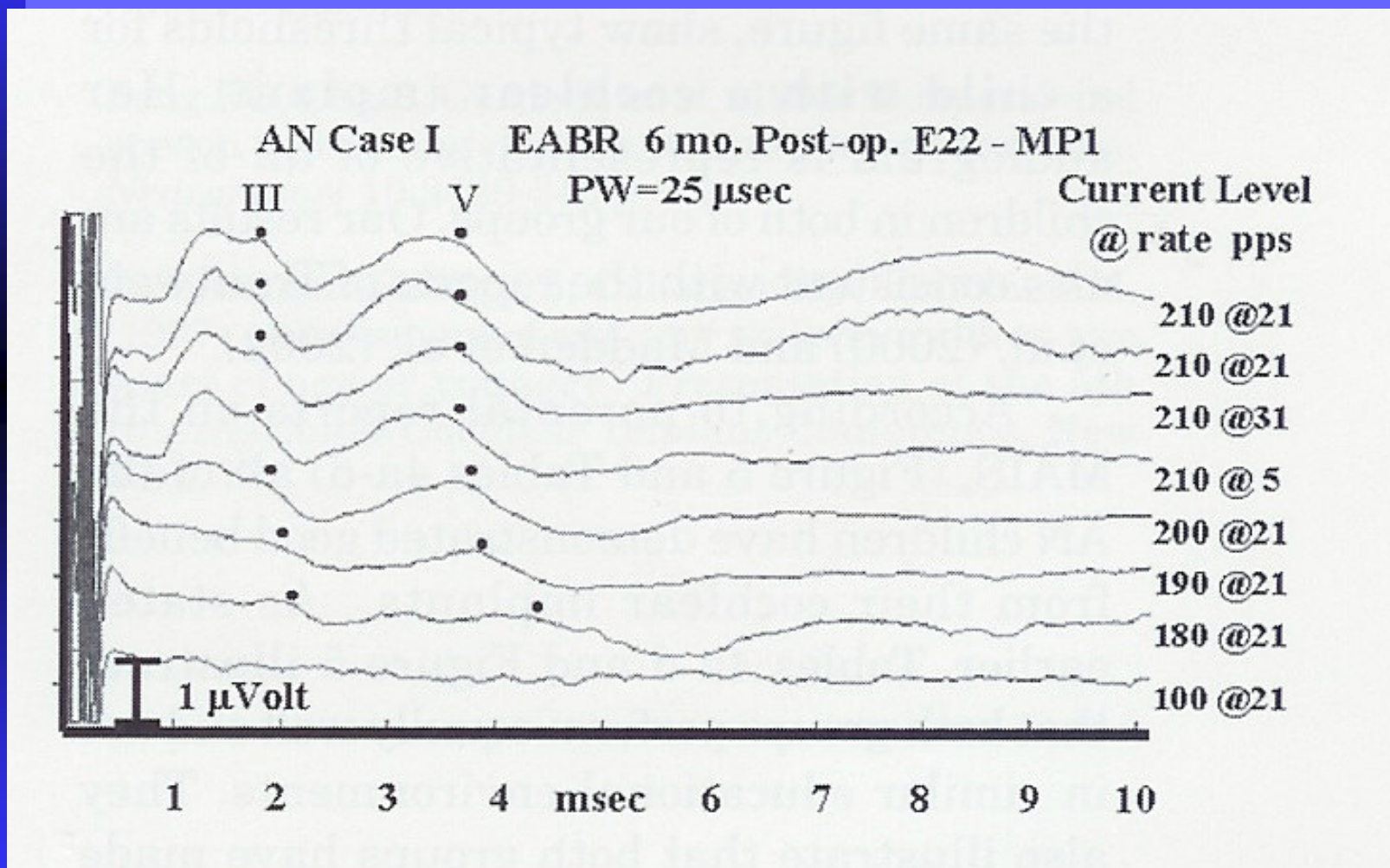
Peterson, Shallop, et al.



Intra-operative Average Predicted NRT Thresholds

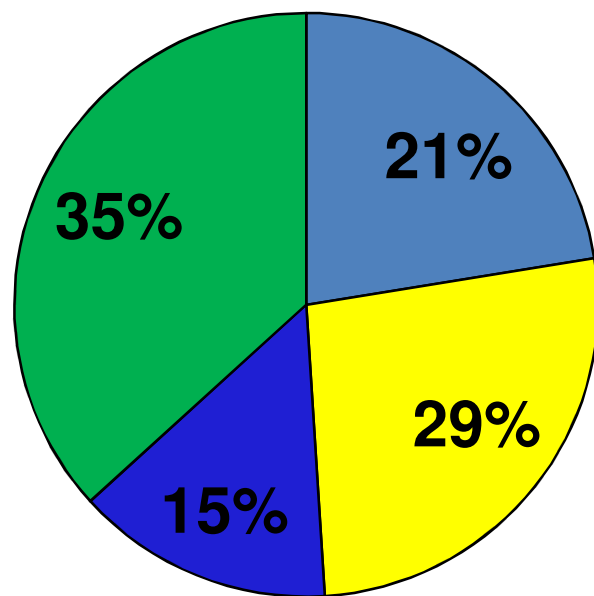


Electrical stimulation “reintroduces” timing precision and synchrony, demonstrated in an electrical ABR



UNC AN Children with CI N=49

CI in AN EAR



- <6 months CI use/CNT
N=11
- Unable to perform open set (>2 yrs of use)
N=13
- Limited Open Set (<30%)
N=7
- Open Set Performers
N=18

From Pat Roush U. North Carolina

Rehabilitation Strategies for Children with ANSD

- **Significant individual variability is seen across patients.**
- **Rehabilitation strategy may need to incorporate and emphasize visual information.**
- **Delays in obtaining audiometric information is common.**
- **Persistent, frequent monitoring of hearing and communication ability is recommended.**

Thanks for Listening

