

**Application of Auditory Steady State Response (ASSR)
in Diagnosis of Infant Hearing Loss in the Era of Universal
Newborn Hearing Screening**

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Year 2000 JCIH Position Statement: Protocol for Confirmation of Hearing Loss In Infants and Toddlers (0 to 6 months)

- Child and family history**
- Otoacoustic emissions**
- ABR during initial evaluation to confirm type, degree & configuration of hearing loss (ASSR now also?)**
- Acoustic immittance measures (including acoustic reflexes)**
- Behavioral response audiometry (*if feasible*)**
 - ✓ **Visual reinforcement audiometry *or***
 - ✓ **Conditioned play audiometry**
 - ✓ **Speech detection and recognition**
- Parental report of auditory & visual behaviors**
- Screening of infant's communication milestones**

Auditory Steady State Responses (ASSRs): Selected Literature from the Australian Group

- ❑ Rickards & Clark. Steady-state evoked potentials to amplitude modulated tones. In *Evoked Potentials II*. Boston: Butterworth, 1984.
- ❑ Rickards et al. Auditory steady-state evoked responses in newborns. *British Journal of Audiology* 28: 1994.
- ❑ Rance, Rickards et al. The automated prediction of hearing thresholds in sleeping subjects using steady state evoked potentials. *Ear & Hearing* 16: 1995.
- ❑ Rance, Dowell, Rickards et al. Steady-state evoked potential and behavioral hearing thresholds in a group of children with absent click-evoked ABRs. *Ear & Hearing* 19: 1998.
- ❑ Rance, Beer, Cone-Wesson et al. Clinical findings for a group of infants and young children with auditory neuropathy. *Ear & Hearing* 20: 1999.
- ❑ Rance & Briggs. Assessment of hearing in infants with moderate to profound impairment: The Melbourne experience with auditory steady-state evoked potential testing. *Ann Otol Rhinol Laryngol* 111: 2002

Auditory Steady State Responses (ASSRs): Selected Literature from the Canadian Group

- ❑ Linden, Campbell, Hamel, Picton: Human auditory steady state evoked potentials during sleep. *Ear & Hearing* 6: 1985.
- ❑ Stapells, Makeig, Galambos. Auditory steady-state response threshold prediction using phase coherence. *EEG & Clin Neurophysiol* 67: 1987.
- ❑ Valdes, Perez-Abalo et al. Comparison of statistical indicators for the automatic detection of 80 Hz auditory steady state responses. *Ear & Hearing* 18: 1997.
- ❑ Picton et al. Objective evaluation of aided thresholds using auditory steady-state responses. *JAAA* 9: 1998.
- ❑ John & Picton. Human auditory steady-state responses to amplitude-modulated tones: phase and latency measurements. *Hearing Research* 141: 2000.
- ❑ John & Picton. MASTER: A Windows program for recording multiple auditory steady-state responses. *Computer Methods and Programs in Biomedicine* 61: 2000.
- ❑ Dimitrijevic, John, van Roon, Picton. Human auditory steady-state responses to tones independently modulated in both frequency and amplitude. *Ear & Hearing* 22: 2001.

Auditory Steady State Response (ASSR): Clinical Devices

□ GSI VIASYS

- ♦ **Audera**
- ♦ **Descendant of Melbourne Australia system Field
(Rickards, Gary Rance, Barbara Cone-Wesson, et al)**

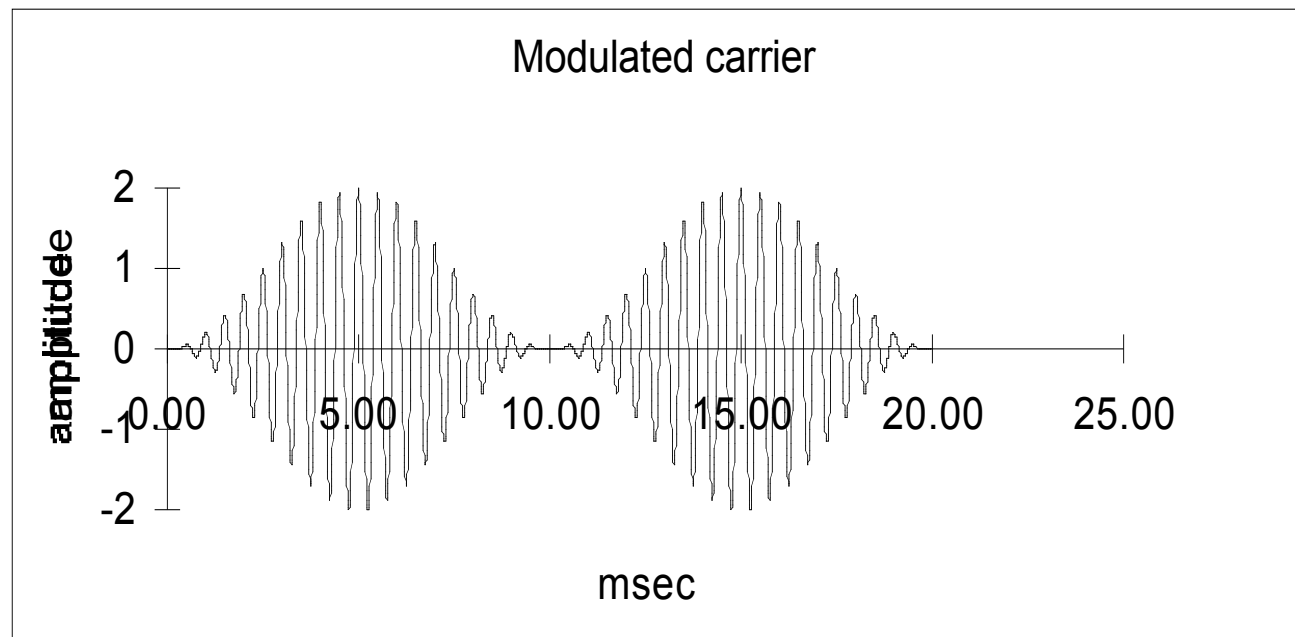
□ Bio-Logic Systems Inc.

- ♦ **MASTER**
- ♦ **Descendent of Canadian system
(Terry Picton et al)**

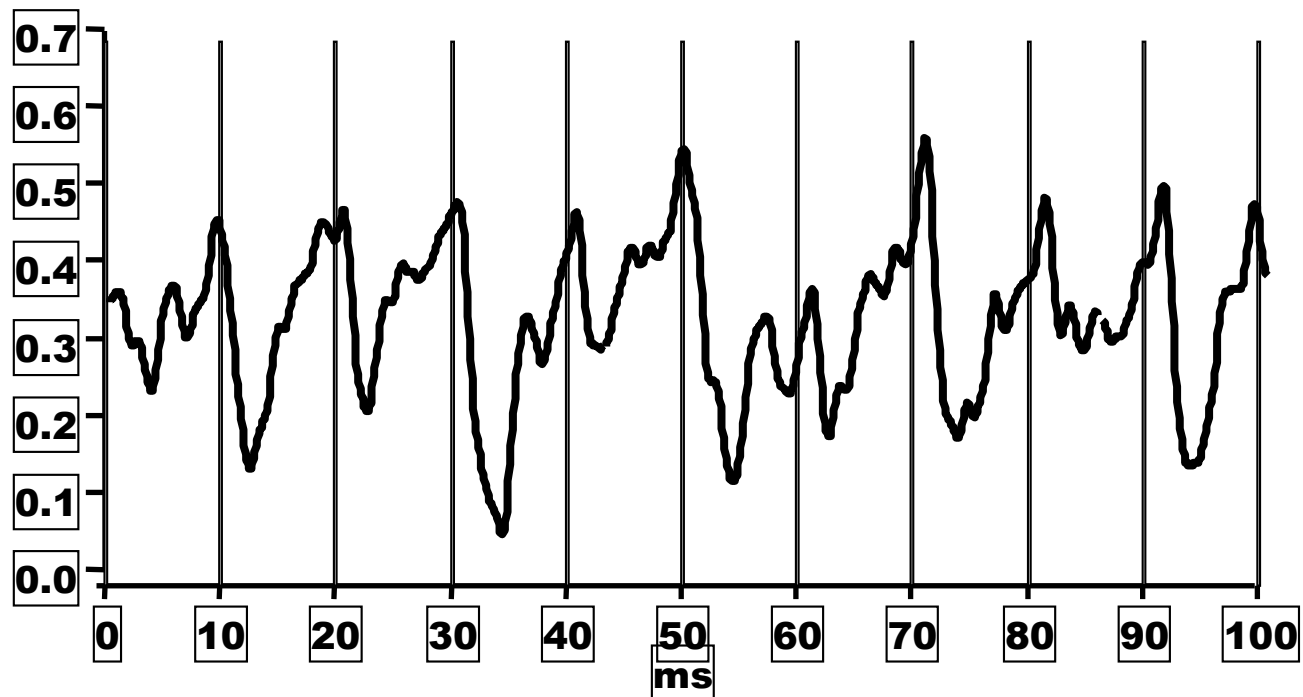
ASSR: General Principles

- ❑ An electrophysiologic response, similar to ABR.
- ❑ Instrumentation includes:
 - ◆ Insert earphones
 - ◆ Surface electrodes
 - ◆ Averaging computer
- ❑ Stimuli are pure tones (frequency specific, steady state signals) activating cochlea and CNS
- ❑ ASSR is generated by rapid modulation of “carrier” pure tone amplitude (AM) or frequency (FM).
- ❑ Signal intensity can be as high as 120 dB HL
- ❑ ASSR phase or frequency is detected automatically (vs. visual detection)

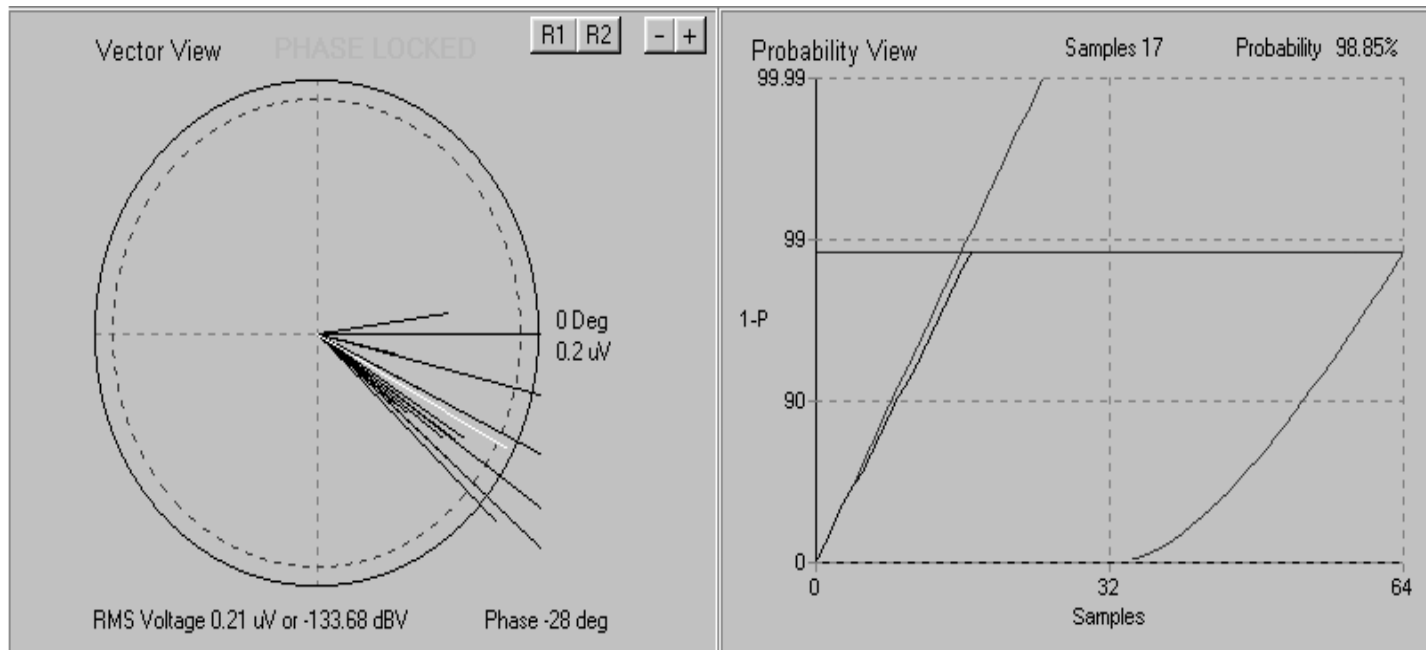
**ASSR:
2000 Hz tone modulated at rate of 100 Hz**



**ASSR:
Response imbedded within EEG**

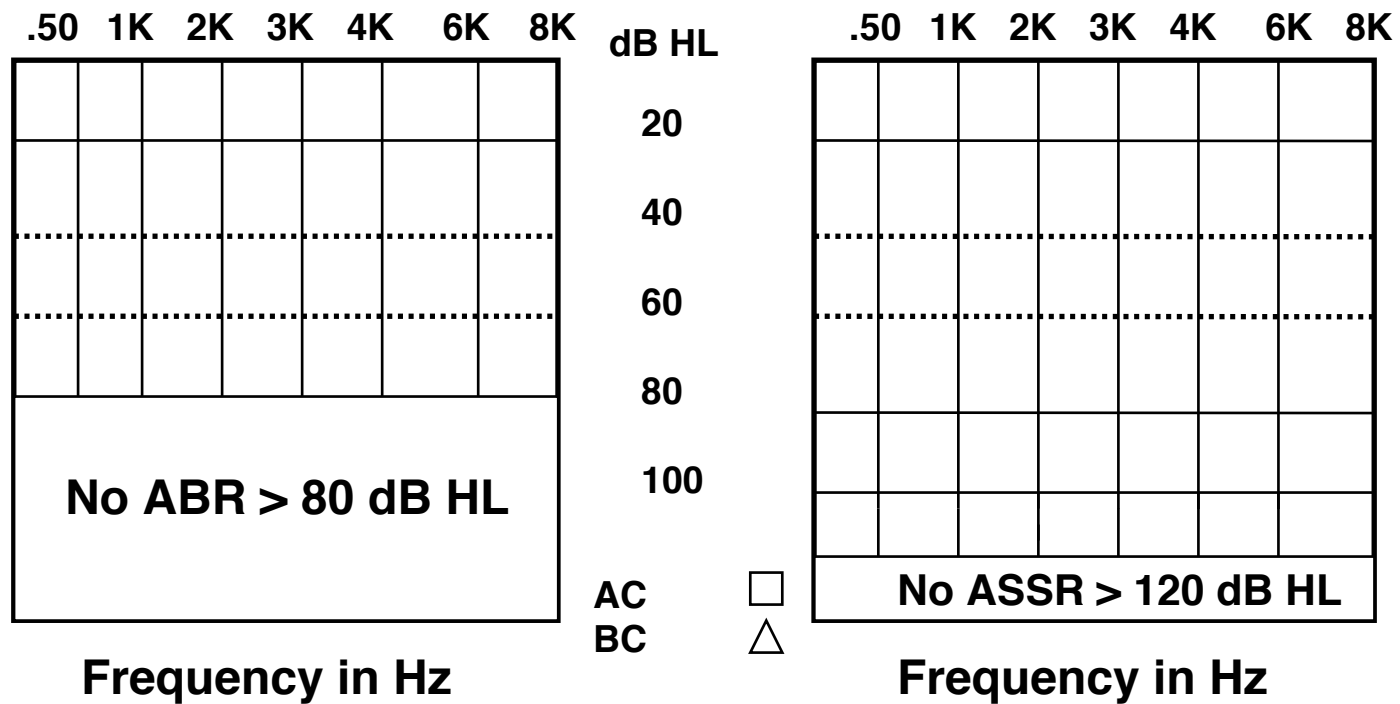


ASSR (Audera): Significant phase coherence

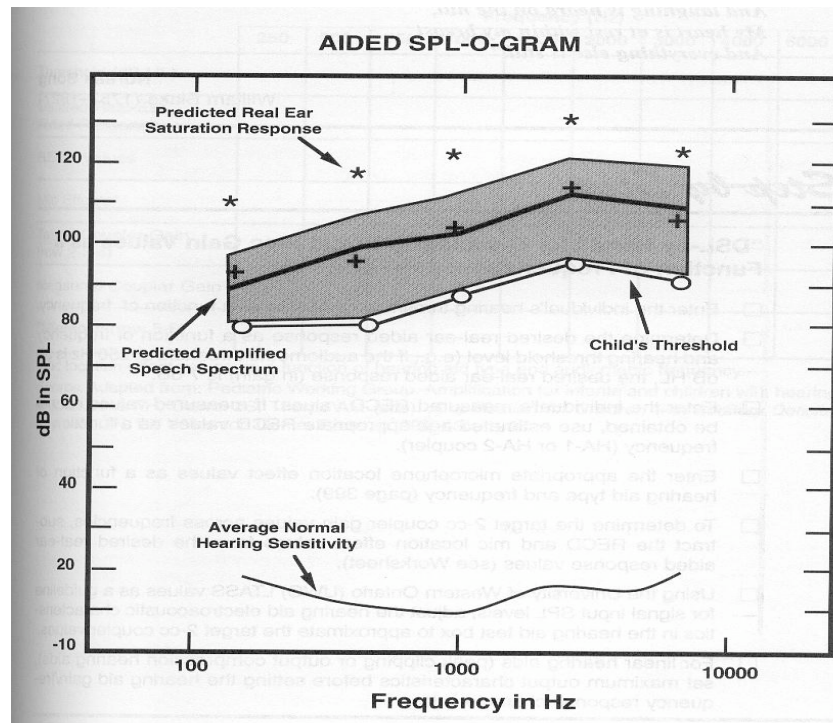




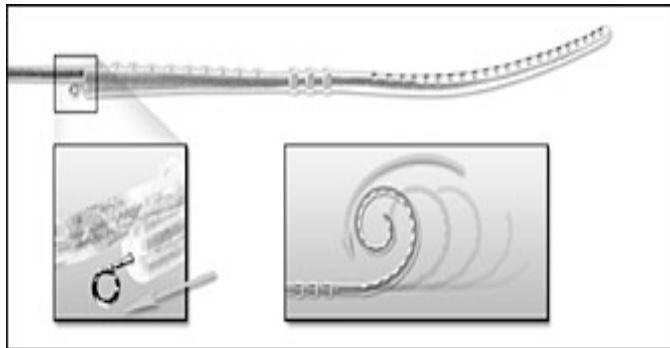
Limitation of Tone Burst ABR in Severe-to-Profound Hearing Loss



Estimation of Frequency-Specific Auditory Thresholds with Auditory Electrophysiology: DSL Hearing Aid Fitting



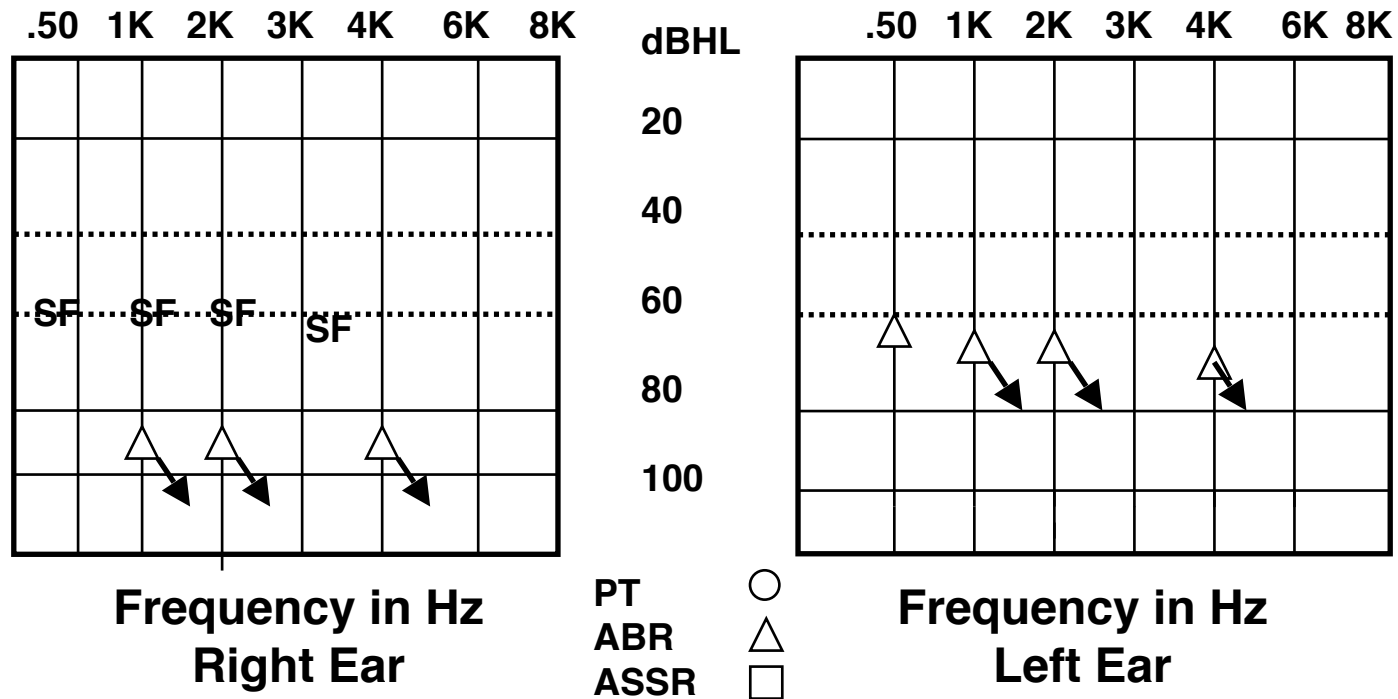
Management of Infant Hearing Loss: Cochlear Implants



ASSR: Case Report

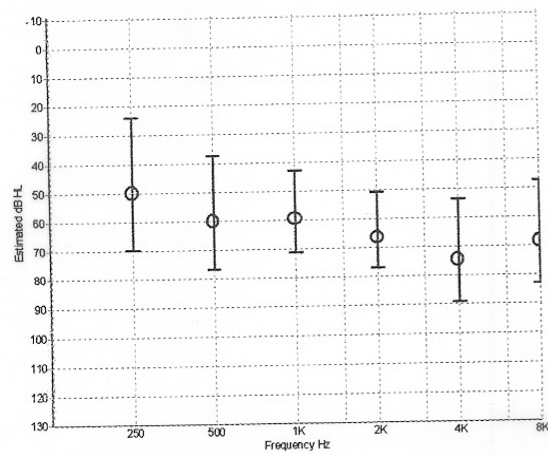
- 2 year old girl**
- Previous audiologic assessment**
 - ◆ **sound field behavioral audiometry indicated moderate hearing loss (apparently since birth)**
 - ◆ **ABR threshold only for 500 Hz tone burst in left ear**
 - ◆ **no ear specific hearing thresholds**
 - ◆ **Inadequate hearing aid fitting (language delay)**
- Referred to University of Florida for ASSR under light anesthesia**

ASSR Case Report: Estimating Auditory Thresholds (previous inconclusive behavioral and ABR findings)

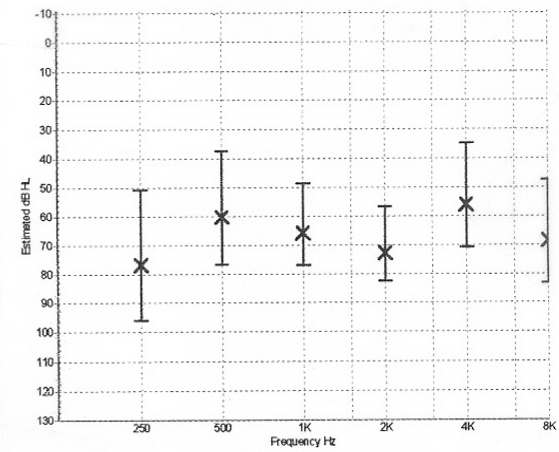


ASSR Case Report: Estimating Auditory Thresholds

Estimated Audiogram - Right Ear



Estimated Audiogram - Left Ear



ASSR, ABR, and Pure Tone Audiometry: Asking the clinically relevant question

Not:

Which frequency-specific electrophysiologic technique is best ... tone burst ABR or ASSR?

But:

How does the ASSR technique complement click and tone burst ABR techniques in the infant test battery?

Tone Burst ABR versus Auditory Steady State Response (ASSR): Advantages and Disadvantages

Auditory dysfunction	ABR	ASSR
Normal hearing	♦ accurate estimation	♦ may over-estimate thresholds if patient is not sedated
Conductive HL	♦ ear-specific findings bone conduction without masking (wave I presence)	♦ bone conduction tone-burst measures but masking required
Sensory HL	♦ accurate only to moderate HL degree	♦ accurate from moderate to profound HL
Neural / Auditory Neuropathy	♦ identified with wave I or CM	♦ cannot distinguish profound sensory versus neural HL

Role of ASSR in Frequency-Specific Estimation of Hearing Sensitivity in Infancy

