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

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

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

No ABR > 80 dB HL

No ASSR > 120 dB HL
Estimation of Frequency-Specific Auditory Thresholds with Auditory Electrophysiology: DSL Hearing Aid Fitting
Management of Infant Hearing Loss:
Cochlear Implants
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
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

<table>
<thead>
<tr>
<th>Auditory dysfunction</th>
<th>ABR</th>
<th>ASSR</th>
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</thead>
<tbody>
<tr>
<td>Normal hearing</td>
<td>♦</td>
<td>♦</td>
</tr>
<tr>
<td>Conductive HL</td>
<td>♦</td>
<td>♦</td>
</tr>
<tr>
<td>Sensory HL</td>
<td>♦</td>
<td>♦</td>
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<tr>
<td>Neural / Auditory</td>
<td>♦</td>
<td>♦</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>♦</td>
<td>♦</td>
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</tbody>
</table>

- **Normal hearing**:
  - ♦ accurate estimation
  - ♦ may over-estimate thresholds if patient is not sedated

- **Conductive HL**:
  - ♦ ear-specific findings
  - ♦ 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

OAE/ABR Screening
Refer Outcome

- Normal?
  - Wave I
  - Wave I-V
  - 20 dB nHL
  - Tone Burst
    - ABR or OAEs

- Click ABR
  - Delayed Wave I?
    - Bone Conduction
      - ABR

- Abnormal ABR or No Response
  - Wave I only?
    - CM only?
      - ASSR

- Auditory Neuropathy