Special considerations for hearing aid fitting in young children: new and emerging developments
Age at hearing aid fitting

For 2012/13, median age at hearing aid fitting was 80 days
A CHALLENGE: SIZE MATTERS

130 dB SPL

136 dB SPL

142 dB SPL
Implications for small ears

[Adapted from Seewald & Scollie, 1999]
Solution: measure sound level in the ear canal

Direct in-situ measurement

“Correction” added to test box response

[Clinical procedure described by Moodie et al (1994) using an insert transducer and an HA2 coupler]
Ear-to-Coupler Level Difference: ECLD
(ANSI S3.46-2013)

[Adapted from Bagatto et al, 2002]
Why measure in each child?

- Children differ from adults
- Children of same age differ
- Each child changes over time
Similar right and left ears

[Adapted from Munro & Howlin, 2010]
Influence of RECD/ECLD transducer

[Adapted from Munro & Toal, 2005]
Integrated RECD/ECLD measurements
A CHALLENGE: BRIDGING THE GAP

Hearing aid fitting

Behavioural assessment
Frequency-specific ABRs provide an accurate prediction of hearing thresholds in infants, but ……

• behavioural thresholds often deviate from predicted threshold by 10 dB, and occasionally by 20 dB (Stapells, 2011)
• in severe hearing loss, no ABR (Stelmachowicz, 2008)
• middle-ear disease and concomitant medical problems can complicate (Stelmachowicz, 2008)
• ABRs typically absent in some populations e.g., auditory neuropathy (Roush et al, 2011)
Patient Public Involvement

- motivate and reassure parents
- reassure audiologist
  - appropriateness of amplification settings
  - alert when current intervention may be inappropriate
  - expedite alternative strategies
    - e.g., frequency lowering devices, cochlear implant
Cortical auditory evoked potentials

- 100 normal-hearing (4-39 wks)

- Stimuli (/m/, /g/, /t/) 65 dB SPL from loudspeaker

- Infant alert on parents lap

- Recorded:
  - test duration, completion rate, response detection rate, parent rating scale and interview
Completion Rate: >95%

**Test Duration**

- Preparation: 00:13:31
- Testing: 00:06:15
- Total: 00:20:22

**Detection Rate**

- /m/: 60%
- /t/: 80%
- /g/: 90%

Percent showing a response
Parent rating scale
1=most favourable response, 8=least favourable

1. Information about procedure 1.2
2. Parents view about procedure 1.3
3. Distress to baby 1.7
4. Tolerating procedure 1.6
5. Maintaining attention (quiet but alert) 2.5
6. Parents views on attaching electrodes 1.6
7. Information about outcome 1.5
8. Test environment 1.6
Important next steps

• What proportion of time is a response to an audible stimulus absent?

• What proportion of absent cases show a response on retest?
Personalisation of prescription

**Age**

Children prefer more gain than adults

**Language**

More low-frequency gain for tonal languages

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[Dillon, 2011]
COCHLEAR DEAD REGIONS

Organ of Corti

Dead region

Bronx Waltzer mutant mouse
[courtesy of Andy Forge]
Tuning curves: the most effective masker

**NO DEAD REGION**

**DEAD REGION**
Fast Tuning Curves

[Malicka et al, 2009]
Current clinical procedure: T.E.N. test

**NO DEAD REGION**

**DEAD REGION**
Diagnosing in children

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<tr>
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[Malicka et al, 2013]
Children with moderate/severe loss

n=6 (9-12 year olds)

[Malicka et al, 2013]
Children with severe/profound loss

$n=5$ (8-13 year olds)

[Malicka et al, 2013]
TAKE-HOME MESSAGE

1. Size matters
   - account for ear canal acoustics

2. Bridging the gap
   - supplement existing procedures

3. Prescription targets
   - personalisation
   - Little evidence to change prescription if DR