Wideband Acoustic Immittance and Age Effects of the Middle Ear

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Outline

- Background
- Purpose
- Methods
- Results
- Discussion
- Conclusion
Background

Measurements of the middle ear

- **226 Hz or 1000 Hz Tympanometry**
  - Standard practice for > 50 years
  - Stiffness dominated
  - Admittance, width, pressure, and volume

- **Wideband acoustic immittance**
  - Wider frequency range
  - Absorbance vs reflectance
  - Potential utility in identifying ME disorders
Wideband Acoustic Immittance

- Wideband click stimulus and response (250 – 8000 Hz)
- Sensitive to the developmental and pathological changes of the middle ear

\[ \text{Energy Reflectance (ER)} = \text{Reflected Energy} - \text{Incident Energy} \]

(Keefe et al., 1993; Feeney et al., 2003; Feeney & Sanford, 2004; Allen et al. 2005; Vander Werff, 2007...etc.)
Typical Adult Response

Otitis Media with Effusion

Otosclerosis

Ossicular Disarticulation

Data from Feeney, Grant & Marryott (2003)
Purpose

Present wideband acoustic immittance (WAI) data with overall aims of identifying ages at which significant differences in WAI are present.
Methods

Age groups
- 6-11 mos, 1-5yrs, 10-15yrs, 20-30yrs, 45-55yrs, 65-75 yrs

- Recruited from the Pocatello, ID and Boise, ID area
- No history of chronic middle-ear infections or middle-ear surgery
- Clear ear canals
- Tympanometric criteria:
  - 6-11 mos: positive peaked 1000 Hz tympanogram
  - 1-5 yrs: Peak Ytm > 0.2 ml
  - 10-75 yrs: Peak Ytm > 0.3 ml and peak pressure +/- 100 daPa
Methods

Testing protocol

- Tympanogram (226 Hz or 1000 Hz)
- Wideband acoustic immittance
- Distortion product otoacoustic emissions (DPOAEs)
- Behavioral testing
  - Visual reinforcement audiometry
  - Conditioned play audiometry
  - Conventional audiometry
Methods

Equipment and Analysis

- Interacoustics Titan
- Stimuli consisted of clicks at 65 dB SPL
- WB tympanogram data extracted at ambient pressure (0 daPa) are shown
- Results are reported in terms of absorbance
Results: Absorbance at Ambient Pressure

- **6 months - 1 year**
  - N = 6 (11 ears)

- **1 - 5 years**
  - N = 34 (59 ears)

- **10 - 15 years**
  - N = 40 (72 ears)
Results: Absorbance at Ambient Pressure

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Sample Size</th>
<th>Total Ears</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 30 yrs</td>
<td>N=88</td>
<td>169</td>
</tr>
<tr>
<td>45 - 55 yrs</td>
<td>N=53</td>
<td>100</td>
</tr>
<tr>
<td>65 - 75 yrs</td>
<td>N=74</td>
<td>136</td>
</tr>
</tbody>
</table>
Results

Age Comparison
Comparison to past studies

Data from Keefe et al (1993)
Discussion

- Increased absorbance for the low to mid frequencies (250-1500 Hz) as age increases
- Absorbance for the higher frequency range (1500 to 4000 Hz) is higher by as much as 40% for all pediatric groups compared to adult groups
- Absorbance across the entire measured frequency range is similar for the adult groups
- Different data sets may not be needed for adult populations
- Separate normative data may be necessary for some of the pediatric population (based on this and prior data)
Conclusion

● Could help identify which disorder is present
● Potential use in a clinical and hospital setting
● Age specific norms need to be created
Questions/Comments