Improving OAE Screening Practices in Primary Healthcare Settings Using Combination OAE /Tympanometry

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Bradley Golner, MD, FAAP
Goals for Periodic OAE Screening

*Birth to Three*

1. Address loss to follow up
   - No follow-up after birth screen
   - Missed in the hospital
   - Born outside of AZ border
   - Late onset and progressives
2. Conduct routine screenings as part of the well child check
3. Identify Chronic OM
4. Address parental and PCP concerns
   - Hearing loss
   - Child not talking
   - Child not meeting developmental milestones
Implementation of OAE Screening Practices

In 2005, conducted a pilot project with 3 pediatric healthcare practices to investigate the feasibility and practicality of including OAE screening as part of their daily well and sick child check routines.

Examined:

- Protocols
  - Periodicity
    - How often should screenings be conducted
  - Screening
    - Follow-up plan for kids that don’t pass
- Training
- Outcomes
### Cumulative Refer Rates on Initial Screens
10/04-9/05

<table>
<thead>
<tr>
<th></th>
<th>Mountain Park</th>
<th>Dr. Golner</th>
<th>Clinica Adelante</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # kids</td>
<td>534</td>
<td>509</td>
<td>199</td>
</tr>
<tr>
<td>screened</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passed</td>
<td>415 (78%)</td>
<td>238 (47%)</td>
<td>164 (82%)</td>
</tr>
<tr>
<td>Referred</td>
<td>44 (8%)</td>
<td>102 (21%)</td>
<td>30 (15%)</td>
</tr>
<tr>
<td>CNT</td>
<td>45 (8%)</td>
<td>87 (17%)</td>
<td>3 (1.5%)</td>
</tr>
<tr>
<td>Inconclusive</td>
<td>15 (3%)</td>
<td>34 (7%)</td>
<td>3 (1.5%)</td>
</tr>
<tr>
<td>(pass or refer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>one ear/CNT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tymps Pass</td>
<td>47 (46%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tymps refer</td>
<td>37 (36%)</td>
<td></td>
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</table>
OAE Refers

Possible reasons for an OAE refer

- False positive
  - Poor probe fit
  - Noisy child (internal or external)
  - Noisy environment
  - Equipment malfunction (battery or blocked probe)
- Middle ear dysfunction (not always detectable)
- Hearing Loss
Benefits of Adding Tympanometry Screening

Provides more information about the OAE “refer”

- False Positives
- Improved ability to detect effusion
- Eliminates un-necessary visits to audiologist
Barriers or Challenges with Tympanometry Screening

- Logistics of equipment
- Lack of training (turnover)
- Non-compliant child

= TIME
Effectiveness of Identifying ME Effusion: Visual Otoscopy

A review of the literature shows that:

- Static otoscopy often is not capable of identifying a non-infected middle ear effusion or TM retraction. Pediatricians commonly use static otoscopy which has “limited” ability to aid in diagnosis (Nelson, 1988; Sassen, Van Aarem, & Grote, 1993).

- KC, Guragain, & Sinha, 2007 found a Sensitivity of 78.7% and Specificity of 22.2% in N=121 ears
Pneumatic Otoscopy

- The current standard for diagnosing otitis media is pneumatic otoscopy (Alper, Bluestone, Casselbrant, Dohar, & Mandel, 2004).

- The diagnostic accuracy is affected by the anatomy of the infant’s ear, the medical professional’s training, and the equipment used to visualize the tympanic membrane.

- **The average accuracy score for general practitioners was 45%. The score for pediatricians was 50%.** For otolaryngologists, the score was 73%. Primary care doctors reported an average of 58% certainty in their diagnosis of AOM in infants under a year of age (Froom, Culpepper, Grob, Bartelds, Bowers, Bridges-Webb, Grava-Gubins, Green, Lion, Somaini, Stroobant, West, and Yodfat, 1990).

- Pneumatic otoscopy has been found to have good sensitivity but only fair specificity for the diagnosis of OM (Nozza, Bluestone, Kardatzke, & Bachman, 1994).
  - KC, Guragain, & Sinha, 2007 found a **Sensitivity of 90.40 % and Specificity of 33.3 % in N=121 ears.**
Nozza et al, reported sensitivity of 83% and specificity of 87% at best.

When combining tympanometry and pneumatic otoscopy, sensitivity increases to 90–98% and specificity to 80–93%.

Among children ≥6 months of age, effusion was diagnosed in 80.2% of ears with flat tympanograms, Smith et al, Pediatrics 2006.
Swanepoel, 2007: did a study of (0-4 weeks of age) neonatal ears, comparing 1000 Hz probe tone tympanometry and DPOAE screening and concluded that initial reports demonstrate that high frequency immittance measurements using a 1000 Hz probe tone assist in clarifying false positive screening results due to middle ear pathology or transient middle ear effusion.

Concluded that correct identification of middle ear status in the neonatal period could direct timely and correct referrals to medical and audiological personnel that may lead to improved efficacy of neonatal hearing screening programmes.
Is the addition of a tympanometry screen helpful in validating failed OAE results?

Are the results of the 2 screens consistent?

Is the information provided by the combination screen useful to the physician?

How well does the equipment perform on young children?
Study
101 Ears

- Tested 53 kids in a high volume community health clinic and pediatrician’s office
  - Both well and sick kids
  - Screenings conducted by medical assistants
  - Both offices previously screened with OAE’s
  - Conducted both OAEs and Tympanometry (226 and 1000 HZ)
## Pass / Fail Criteria

<table>
<thead>
<tr>
<th>DPOAE</th>
<th>Tympanometry:</th>
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<tbody>
<tr>
<td>Number of frequencies: 4</td>
<td>226 Hz Probe Tone</td>
</tr>
<tr>
<td>F2 frequencies (as presented):</td>
<td>Ear Canal Volume: 0.2 – 2.0 ml</td>
</tr>
<tr>
<td>5, 4, 3, 2 kHz</td>
<td>Compliance Peak: 0.2 – 1.4 ml</td>
</tr>
<tr>
<td>P1/P2: 65/55</td>
<td>Peak Pressure: -150 - +100</td>
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<tr>
<td>Avg Time: 2 seconds per frequency</td>
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<tr>
<td>SNR for a passing frequency:</td>
<td></td>
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<tr>
<td>6 dB</td>
<td></td>
</tr>
<tr>
<td># of passing frequencies for overall PASS: 3 of 4</td>
<td>Tympanometry: 1000 Hz Probe Tone</td>
</tr>
<tr>
<td>Minimum DP Amplitude: -5 dB</td>
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EroScan Pro Data

Phoenix Pediatrics: 40 Ears: OAE Pass = 28 / OAE fail=12
Average Test Time: 5.5 minutes

<table>
<thead>
<tr>
<th>OAE Refer/ Tymp Refer</th>
<th>Pneumatic Otoscopy</th>
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<tbody>
<tr>
<td>11</td>
<td>10 with effusion</td>
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</table>

<table>
<thead>
<tr>
<th>OAE Pass/ Tymp Pass</th>
<th>OAE Pass/ Tymp Refer</th>
<th>OAE Refer/ Tymp Pass</th>
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</thead>
<tbody>
<tr>
<td>26</td>
<td>2</td>
<td>1</td>
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MPCHC: 61 Ears: OAE Pass = 44 / OAE Fail=17
Average Test Time: 5.2 minutes

<table>
<thead>
<tr>
<th>OAE Refer/ Tymp Refer</th>
<th>Visual Otoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>5 with effusion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OAE Pass/ Tymp Pass</th>
<th>OAE Pass/ Tymp Refer</th>
<th>OAE Refer/ Tymp Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

OAE / 1000 Hz Probe Tone Results: Combined Sites

<table>
<thead>
<tr>
<th>OAE Pass/ Tymp Pass</th>
<th>OAE Refer / Tymp Refer</th>
<th>OAE Pass/ Tymp Refer</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
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Practical Considerations

- Enhancement and validation of OAE refer
- Helps to expedite the course of treatment
- Improves patient flow in the office
- Practical enough to incorporate into a busy practice
Case Study: SJ

- Full Term, Passed Newborn Hearing Screen
- 1st Week: Administered antibiotics due to a kidney infection
- First 2 Year well child checks: normal developmental milestones
- 2 Year Check: Parental concerns, sitting too close to TV
- Failed OAE, Passed Tympanometry
- Visit to Audiologist: Bilateral, Moderate to Severe SNHL
  - Hearing Aids, AU