SPAU315 Audiology Practicum I

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What are OAEs?

- Biological sounds/vibrations of the inner ear, as it extracts information from sound to pass to the brain, that are recorded in the external auditory canal.
- By-products of the active processes in the cochlea.
- Pre-neural phenomenon: this means that they can be measured even when the VIII CN has been severed.
- They are unaffected by stimulus rate
- Vulnerable to acoustic trauma, hypoxia and ototoxic agents, as these cause hearing loss and damage to OHCs.

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Theory of OAE's

- Limited by our understanding of cochlear mechanics
- OAEs are a by-product of cochlear mechanics
- What we measure is this leakage of vibrational energy in the external auditory canal
- The middle ear and a closed external auditory canal are essential to measure
- OHC: source that generates them

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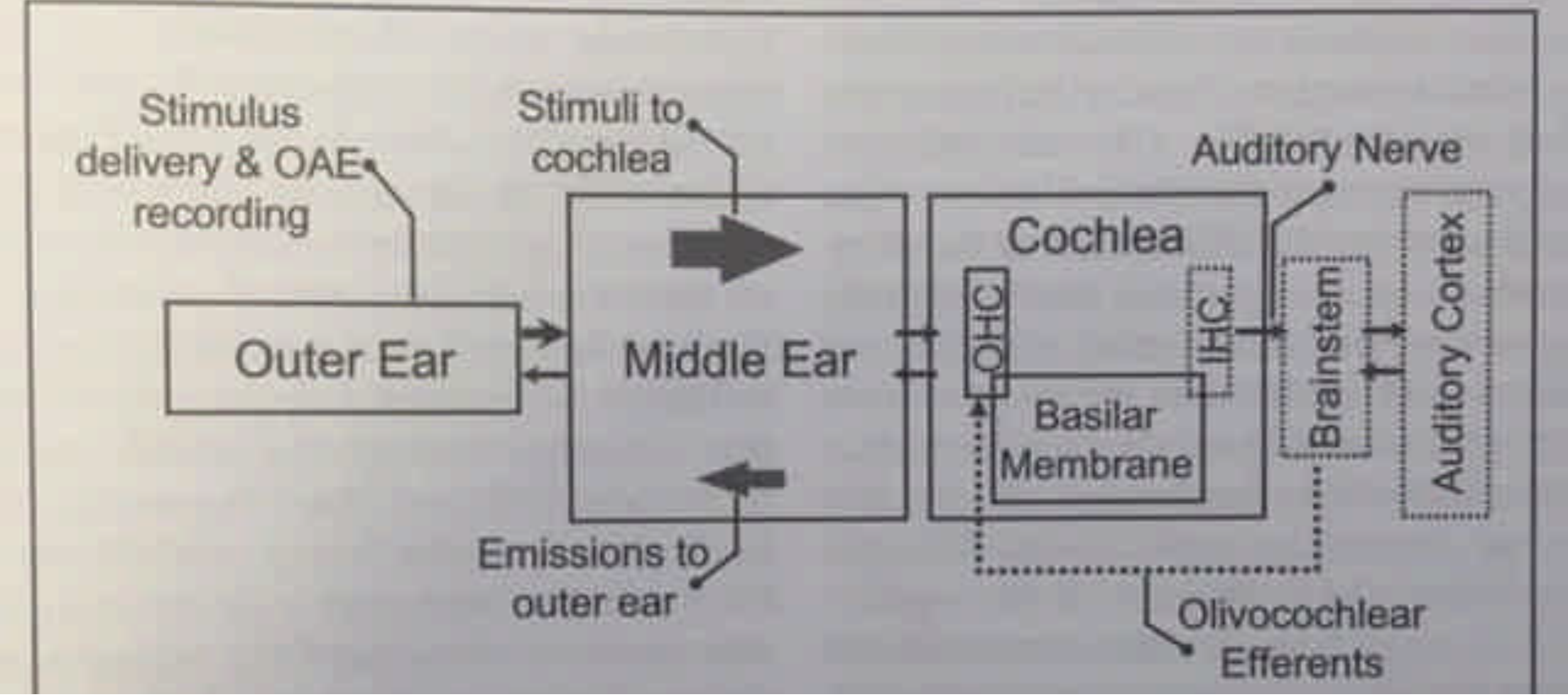

Anatomy and Physiology in OAE measurement
(Dhar and Hall, 2012)

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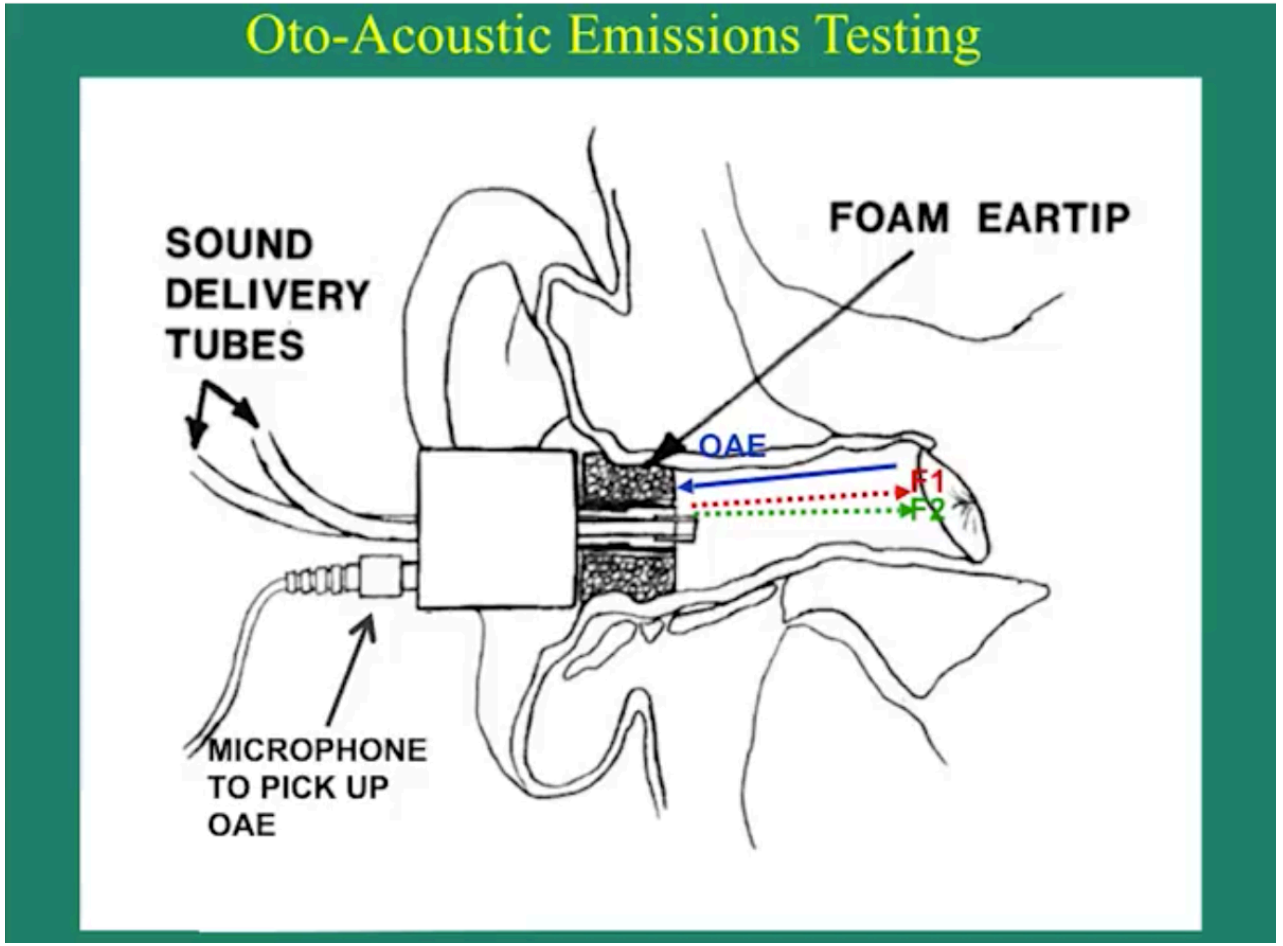
Oto-Acoustic Emissions Testing



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Main structures involved in OAEs

External ear canal:

- Delivering stimulus signals: length of canal, probe placement, resonance of canal, microphone location, probe fit, leakage, debris, wax, differences in anatomy due to development (adults vs infant)

Middle ear:

- Serves two purposes: Stim travels in and OAE travels out. Mechanical advantage of sound travelling in vs out
- Developmental differences, negative MEP

Cochlea

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Stimulus-based Classification

- **TEOAEs**: Transient Evoked
- **DPOAEs**: Distortion Product
- **Spontaneous Emissions**: measured in the absence of external stimulation. Does not occur in all normal hearing individuals (range 40-72%), thus not used clinically
- **SFOAEs**: Stimulus Frequency (occur at the same time and frequency as a continuous pure tone applied to the ear. Not used clinically as not studied extensively enough, and no commercial devices to record SFOAEs)

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TEOAEs

- Are elicited by a click stimulus (80-85dB SPL) and can reflect cochlear function in the 1-4 kHz region
- Averaging used to reduce noise in the trace, but there is still stimulus artefact at the start of the recording, therefore the first few ms of the trace are usually eliminated from the final waveform.
- Often evaluated in terms of level, %age reproducibility and SNR
- Very widely used clinical tool
- Absent in ears with SNHL greater than 30-50dBHL (Kemp 1978, and others)

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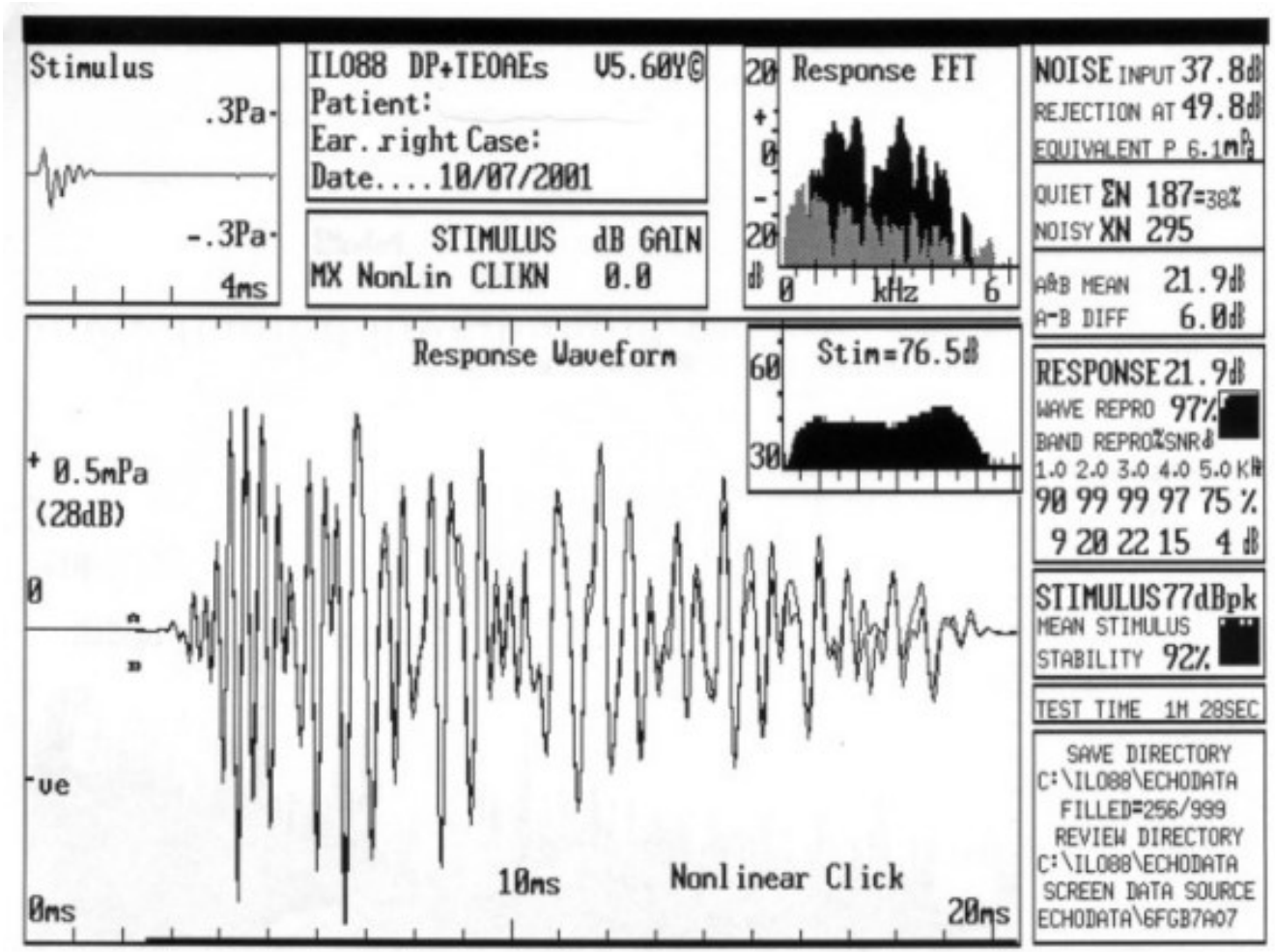
TEOAEs



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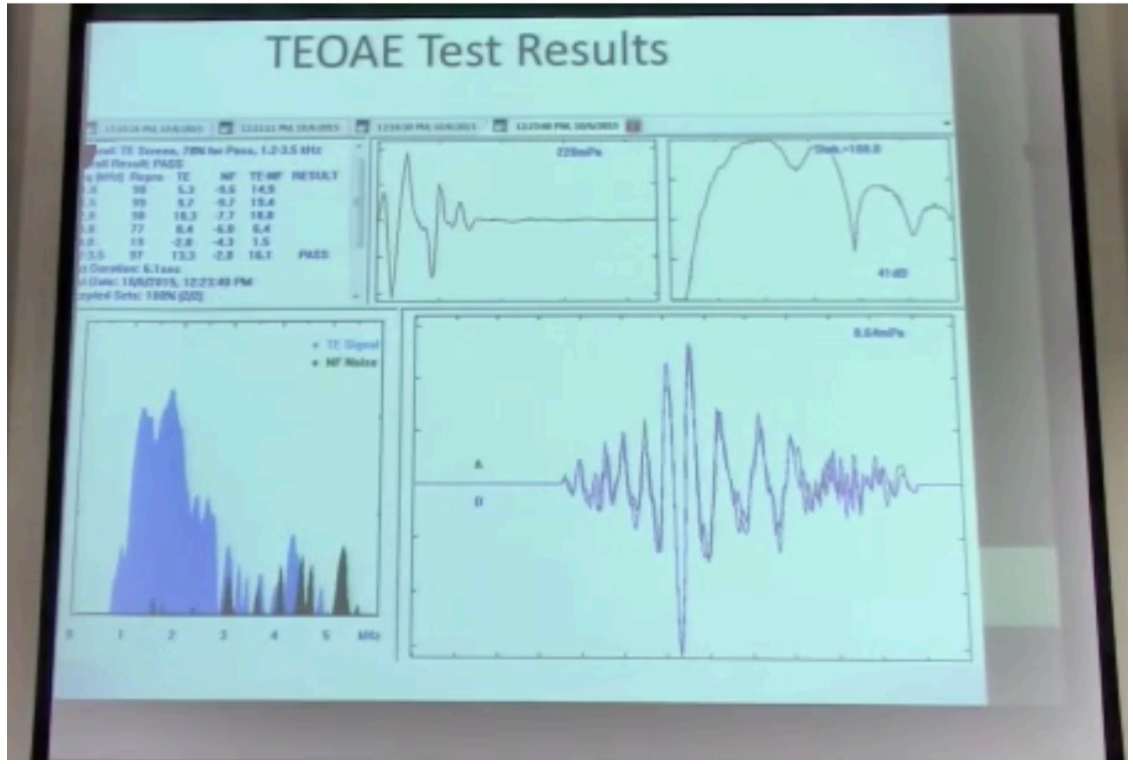

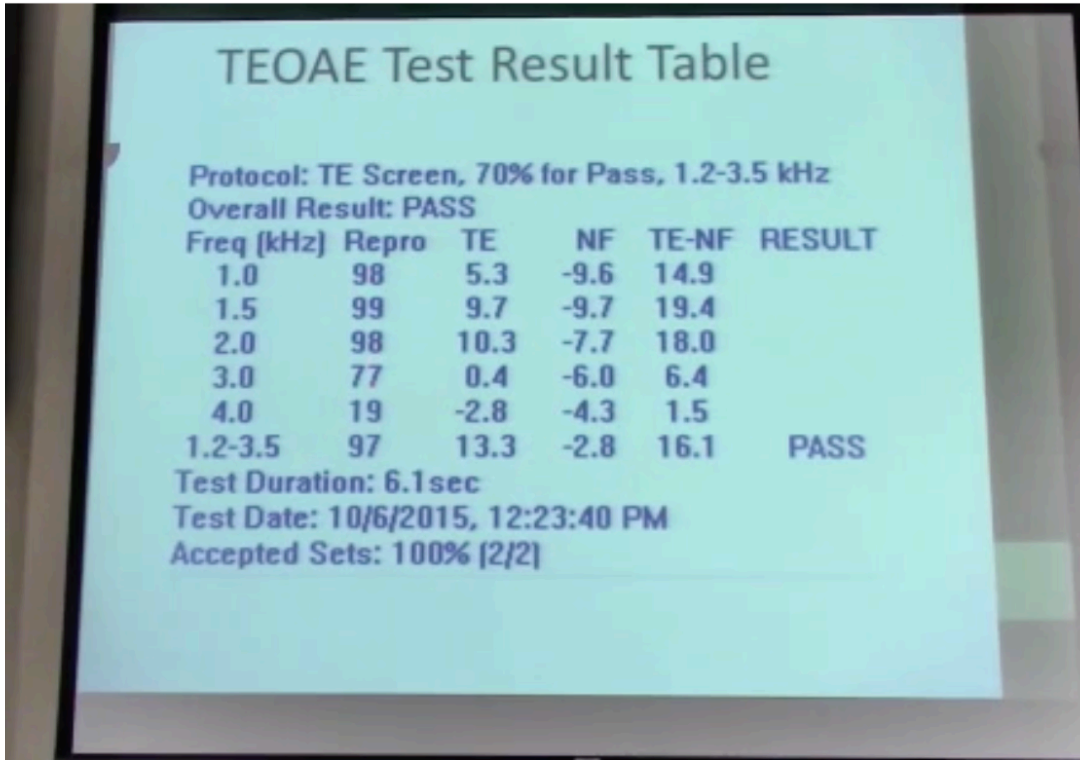

TEOAE Test Results

- Pass -

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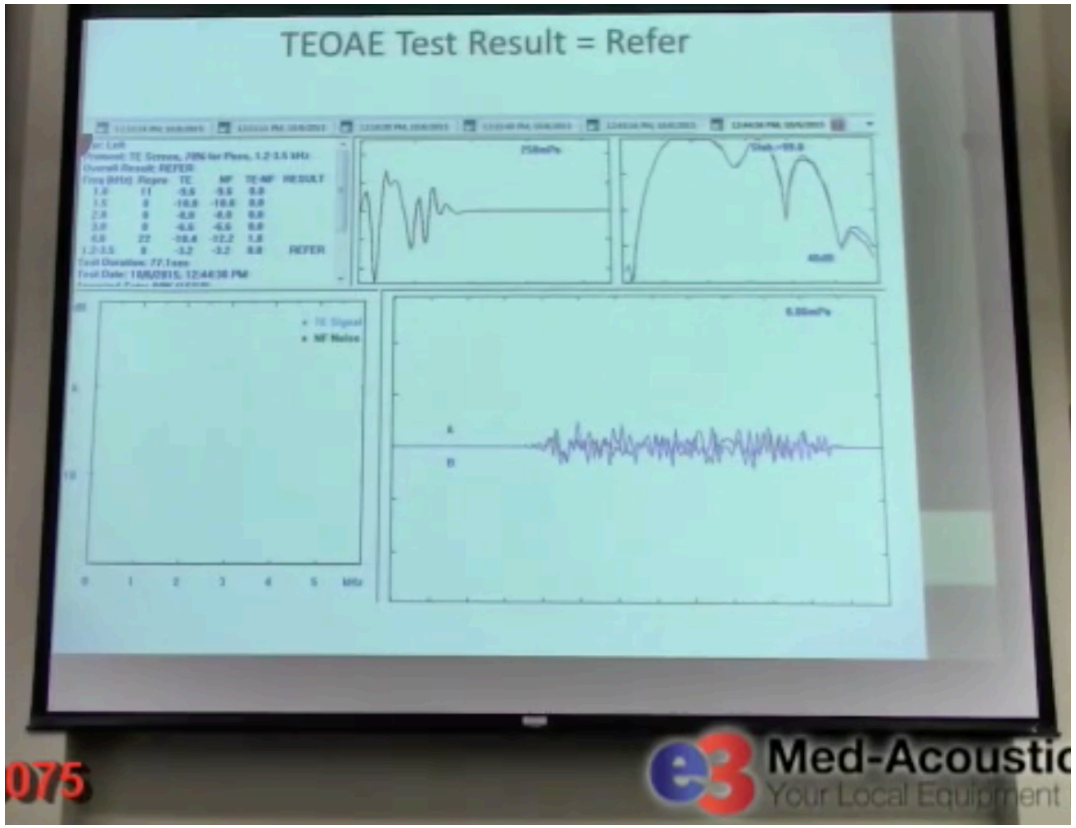

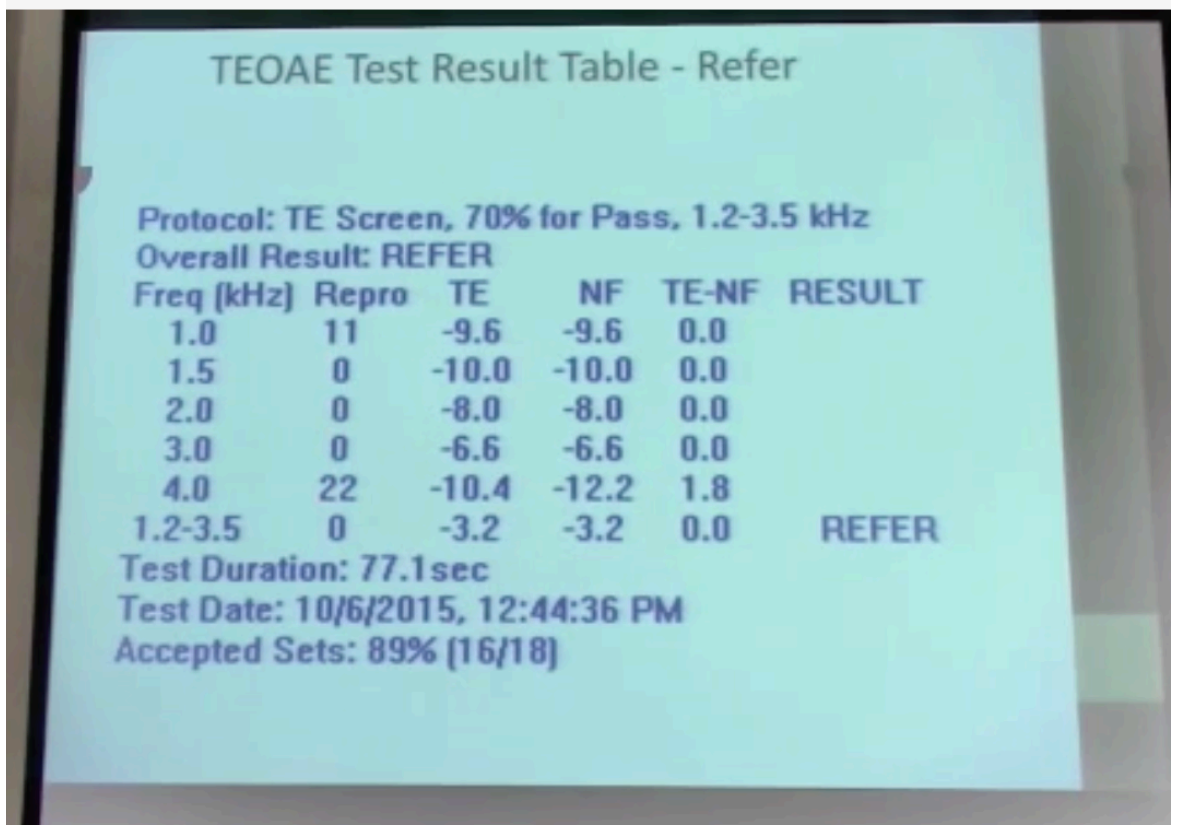

TEOAE Test Results

- Refer -

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DPOAEs

- Are evoked in the form of intermodulation products by two pure tones with specific frequency and amplitude ratios
- Stimulus: Two pure tones (primaries) presented simultaneously to the ear (f1 and f2) and at two intensity levels (L1 and L2).
- The relationship between L1-L2 and f1-f2 dictates the frequency response.
- Optimal response: set intensities so that L1= or > L2. 65/55 dB SPL often used.
- The DPOAE at 2F1-F2 is of highest amplitude and is detected in almost all normally hearing ears. Energy at the appropriate freq=emission and energy at other frequencies = noise.
- Will be present with cochlear loss up to 35-45 dBHL

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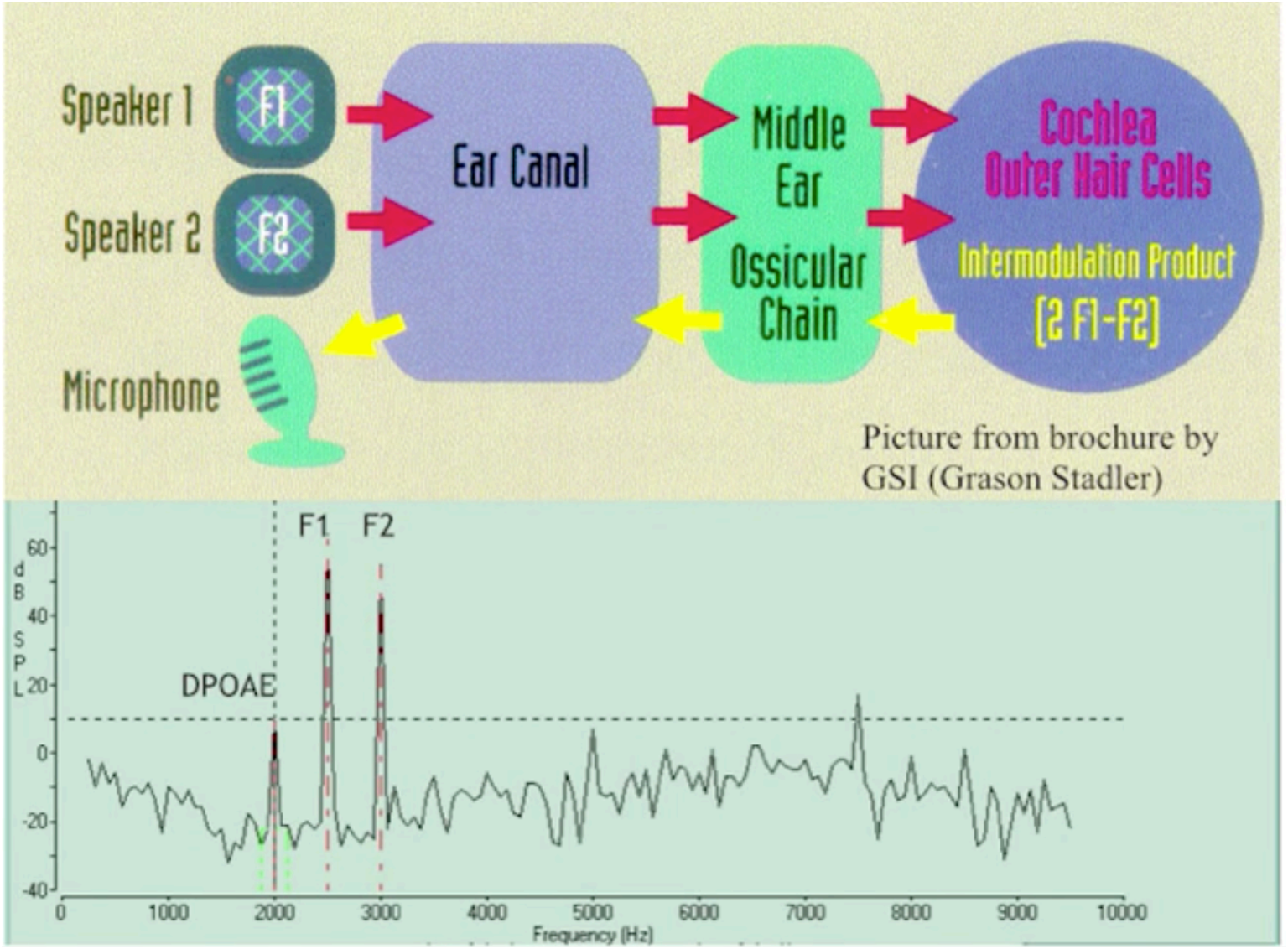

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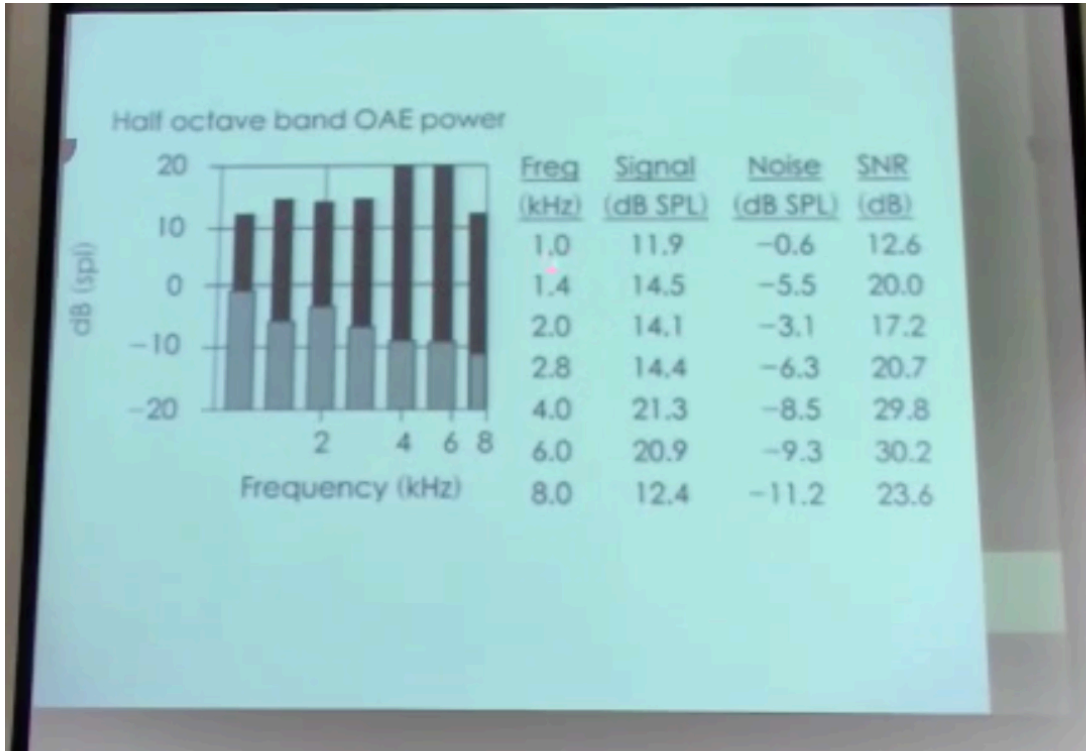
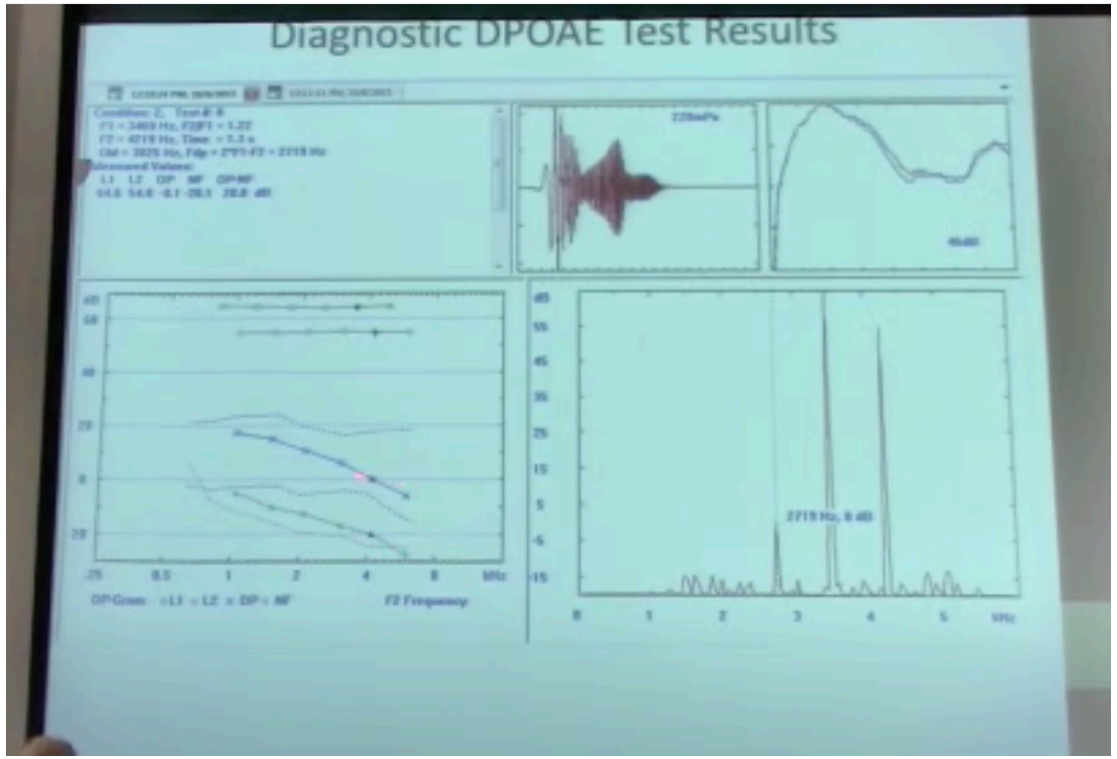


Freq (kHz)	Signal (dB SPL)	Noise (dB SPL)	SNR (dB)
1.0	11.9	−0.6	12.6
1.4	14.5	−5.5	20.0
2.0	14.1	−3.1	17.2
2.8	14.4	−6.3	20.7
4.0	21.3	−8.5	29.8
6.0	20.9	−9.3	30.2
8.0	12.4	−11.2	23.6



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Prerequisites for OAEs

- Unobstructed ear canal
- Good seal with probe
- Absence of middle ear pathology
- Functioning OHC
- A relaxed, quiet patient
- Relatively quiet environment

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How to record TEOAEs?

- Protocol as per NHSP
- Probe fitting most important: collect the most sound and exclude the most external noise
- Possible problems: debris, blocking sound tubes, fluid and or debris immobilizing TM, collapsed ear canal, poorly fitting probe
- Screening vs diagnostic criteria

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Recommended Watch

- https://www.youtube.com/watch?v=yiWoQ0lc0B8
- https://www.youtube.com/watch?v=eZc404tKwsw
- https://www.youtube.com/watch?v=5gEEE2Vf-cg
- https://www.youtube.com/watch?v=HLdSXl3jcsE
- https://www.youtube.com/watch?v=xwnvEBb5I4E
- https://www.youtube.com/watch?v=GrmSSx3YdWU

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Recommended Reading

- https://abrpeerreview.co.uk/onewebmedia/NHSP%20TEOAE_protocol.pdf

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