




# Otoacoustic Emissions (OAEs)

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- **What is it :**
  - An objective test
  - Function of outer hair cells. (Katz, J., et al., 2009)
  - OAEs: sounds that originate in the cochlea and propagate through the middle ear and into the ear canal where they can be measured using a sensitive microphone.

## Contraindications

- Drainage
- Bleeding
- Otitis externa
- Blockage of ear by wax or derbies or foreign body

## Types

- SOAE
- EOAE:
  - TEOAE
  - DPOAE

## Purpose of OAE test

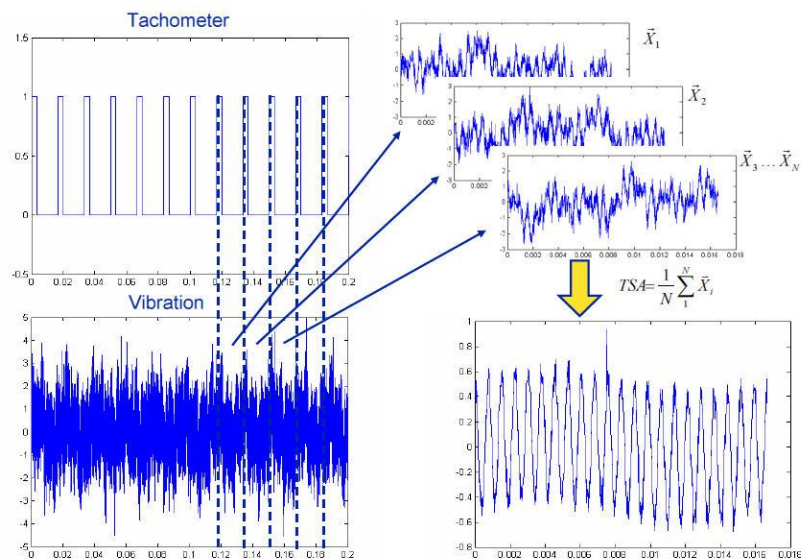
- function of outer hair cells.
- Identification of hearing loss.
- site of lesion (sensory vs. neural).
- effects of ototoxic drugs.
- Monitoring hearing loss that is caused by exposure to loud noise.

## Measurement of OAEs

- Probe: Houses the microphone and the sound source. Fits into the ear using a foam or rubber tips.
- Microphone: To record the OAEs coming from the ear.
- 2 Sound Sources.
- Amplifier.

## Averaging

- OAEs are low level signals.
- Time-synchronous averaging is used.



## Noise

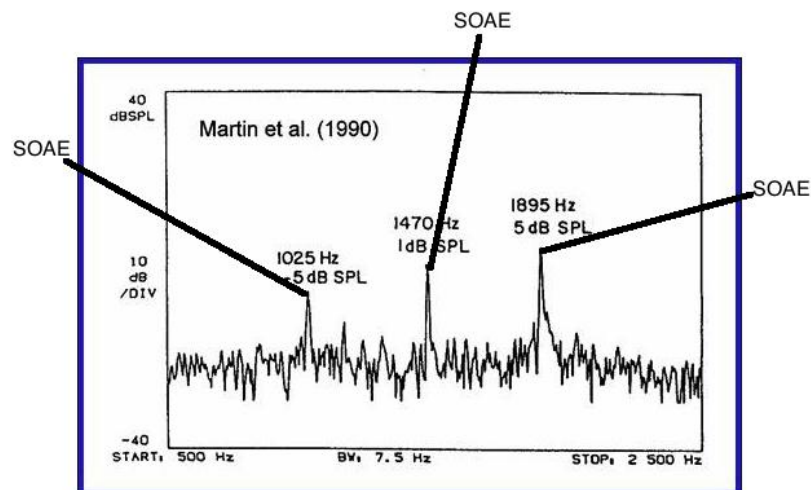
- Noise Sources: Environmental and internal.
- Effect on OAE size and test time.

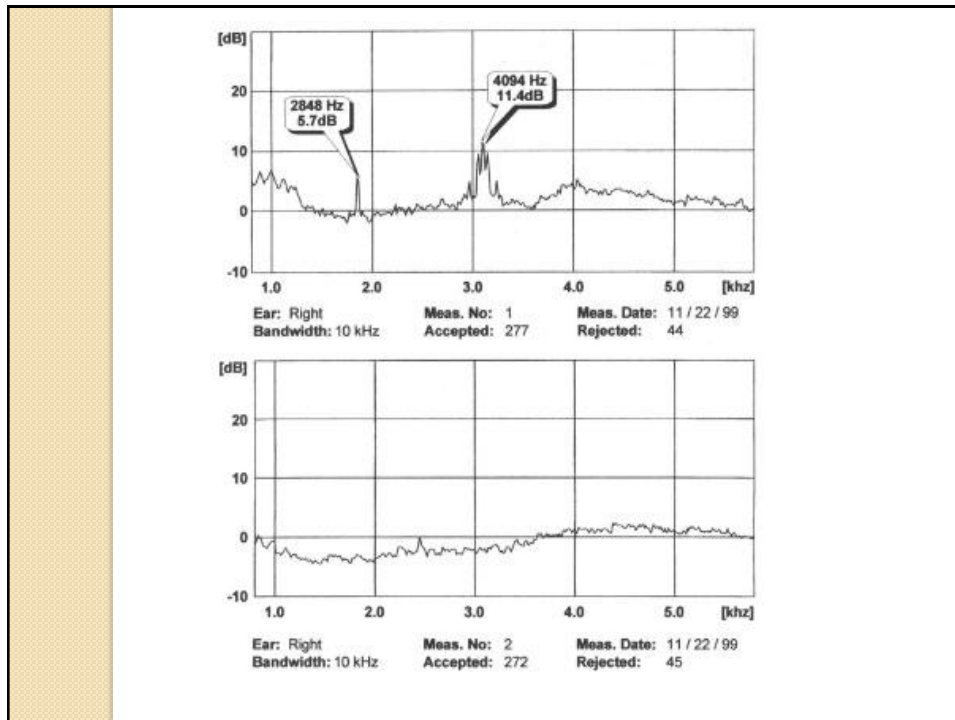
## Types

- SOAE generated in the absence of an acoustic stimuli.
- TEOAE are generated by clicks or tone bursts.
- DPOAE are generated by two continuous tones presented to the ear

## Spontaneous Otoacoustic Emissions (SOAE)

- Microphone amplifies the output.
- The output is viewed in the frequency domain.
- Adults mostly 1 and 2 kHz.
- Infants mostly 2 and 5 kHz.
- Only in 50% of normal hearing individuals.
- Not useful clinical test.
- The typical frequency range is from 1000 to 3000 Hz, while the amplitude varies between -10 and +10 dB SPL.
- Inaudible to the person in whom it is measured.
- It is possible to have more than one SOAE in one ear and to have otoacoustic emissions in both ears.



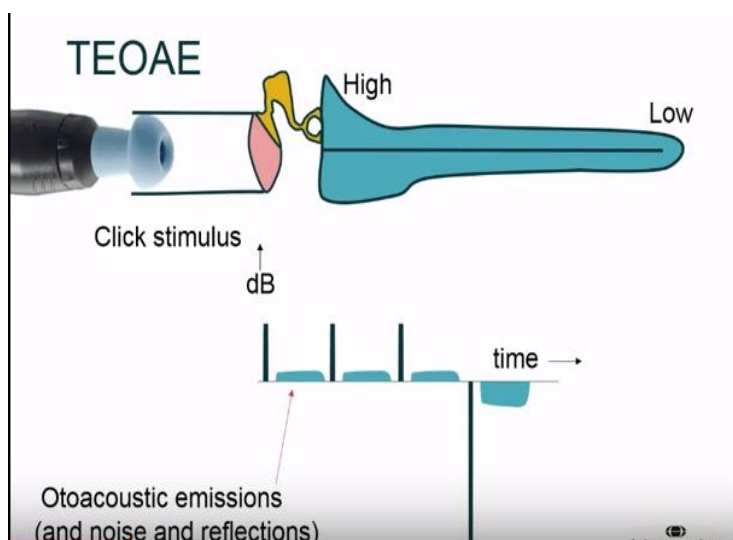


## Evoked Otoacoustic Emissions (EOAEs)

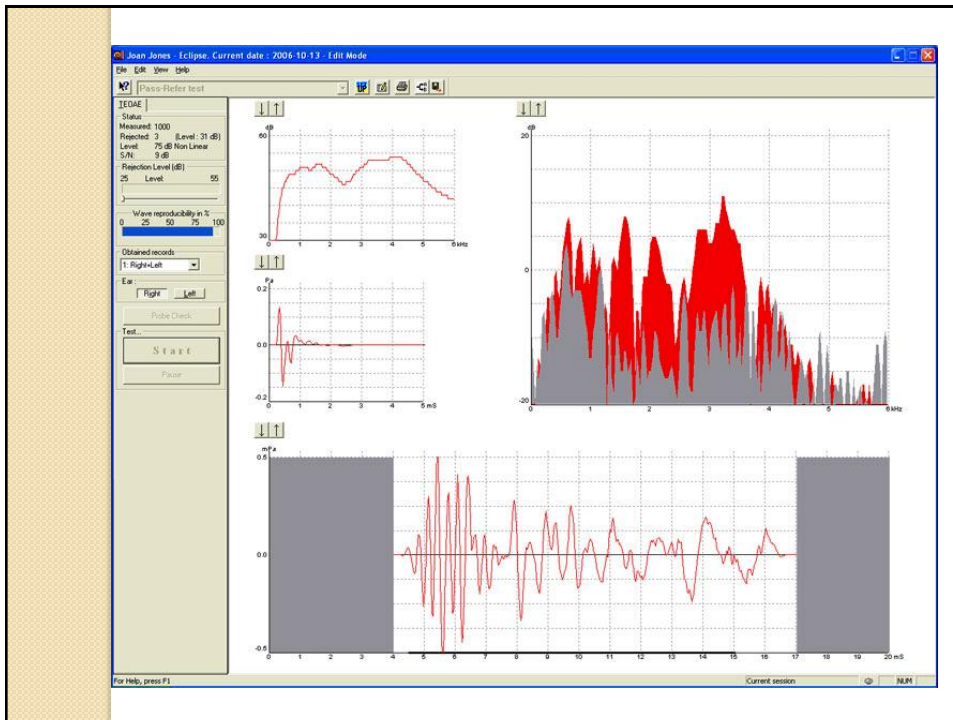
- Occurs either during or immediately following acoustic stimulation.
- Two major types: TEOAEs and DPOAEs.
- EOAE testing has come into the clinical use in:
  - The differential diagnosis of sensory/neural hearing
  - Hearing screenings of infants and other difficult-to-test patients
  - The monitoring of outer hair cell function in high-level noise exposure patients or patients undergoing ototoxic medication

## Transient-Evoked Otoacoustic Emissions (TEOAEs)

- TEOAEs are low level signals, such as clicks or tone pips.
- Signal-averaging equipment is used.
- Present in ears with normal sensitivity and normal middle ear function.
- Absent in the case of a SNHL that is about 40 dB.
- TEOAEs are very sensitive to cochlear pathology and in a frequency-specific way. When hearing thresholds exceed 20–30 dB HL TEOAE response will be absent
- Stimulus wave form.
- Stimulus spectrum (the energy of clicks is always spread over a wide frequency range).

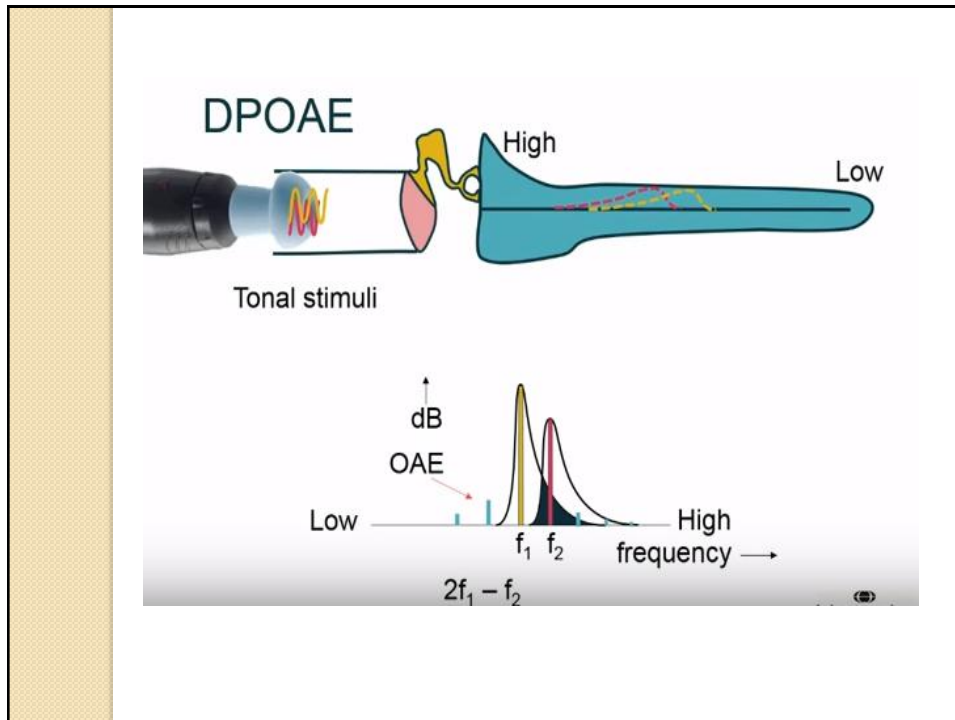






## DPOAEs

- Distortion: the output of energy at frequencies other than those contained in the input stimulus.
- Measured simultaneously with the presentation of two pure tone (primaries).
- Frequencies  $F_1$ ,  $F_2$  while  $F_2 > F_1$
- Levels  $L_1$ ,  $L_2$



## DPOAEs

- Present in ears with normal sensitivity and normal middle ear function.
- The hearing loss must not exceed 40 – 50 dB like the TEOAEs

## Choosing TEOAE or DPOAE for testing

- DPOAE identifies hearing loss at 4000 Hz better than TEOAE.
- TAOE is better at detecting hearing loss at frequencies 500 Hz- 1000 Hz.
- Hearing loss at 2000 Hz is identified with the same degree of accuracy using TOAE or DPOAE.
- Both can provide frequency specific information about the hearing loss. Frequencies higher than 5000 kHz can be tested using DPAOE.

## Interpretations of results

- Presence of OAE:
- normal functioning OHC and normal/ slightly abnormal conductive pathway.
- Normal OAE and abnormal PTA may indicate auditory neuropathy
- Normal OAE and abnormal ABR is a strong indication of auditory neuropathy

## Absence of OAE

- Impaired conductive pathway
- Cochlear pathology

## **Clinical applications of OAEs**

- 1- good cochlear condition
- 2- in difficult-to-test patients like
- 3- the activity of the cochlea
- 4- financial benefit
- 5- to insure audiometry results.
- 6- to screen infant hearing
- 7- differential diagnose in Audiological neuropathy

## **Medical and biometric importance**

- It's Important for newborn hearing screening program .
- Early intervention/ prevention / management (12).
- Brief test time
- Ear specificity
- simple technique
- Objective test
- Frequency specific (13) .
- very important for ototoxicity, monitoring