Smart Note

TEOAE Suppression
using SmartTrOAE

What is TEOAE Suppression?

There are three types of TEOAE Suppression. Ipsilateral suppression is a methodology by which the stimulus is alternated between a masking white noise signal and a click signal in the same ear, where the recordings are acquired in the time frame where the cochlear response would correspond to the click stimulus. Contralateral suppression uses a white noise stimuli presented in an alternated manner or continuously to the opposite ear to the one where the measurements are being made. Suppression can also be achieved by providing binaural suppression stimuli, which yields the highest suppression effect (Berlin et al., 1995). By comparing a suppressed transient OAE recording, acquired using the white noise masking, to one that is acquired normally, conclusions can be drawn about the workings of the efferent nerve fibers and the suppression of sound.

The OAE Probe

The Probe is the standard device used to acquire OAE recordings. It consists of a highly sensitive microphone and a couple of transducers. For acquisition of suppression data, they may need to be coupled with insert earphones as a secondary stimulator in order to provide contralateral or binaural masking.

Patient Preparation

The patient must be placed in a comfortable and quiet environment, preferably a sound booth where the patient lies down or sits comfortably. Even thought the patient does not need to be in a relaxed state for this test, it would be recommended, in order to minimize noise. It is recommended that the patient avoid stimulants, such as caffeine, before testing.

To obtain a better recording it is recommended to inspect the patient's ear canal. Cerumen or debris may partially block the stimulus signals, resulting in an incorrect result. Cleaning of the ear canal shall only be performed by a person trained in such procedure in order to prevent any irreversible middle ear damage.

Place the OAE probe in the test ear using an appropriate ear tip. If using a contralateral or binaural suppressor, place the corresponding insert earphone on the opposite ear using an appropriate ear tip.

Setting up SmartTrOAE

1. From the main menu, select **[Protocol > Modality > Transient (Linear)]**.
2. Access the Stimulus Generation window from **[Stimulus > Select Stimulus]**. Make sure the stimulus is set to a 75 us click and that it is only present while acquiring by checking the box.
3. Set the number of sweeps to 1024, set the intensity of the stimulus to 60 or 65 dB, and start the acquisition by clicking on the button corresponding to the ear. This will yield a baseline recording without suppressor.
4. Turn ON suppression by clicking on **[Suppression > Turn ON]** then choose either Ipsi, Contra, or Binaural as needed. Set the suppressor level to 60 or 65 dB from the same menu, now that the options are active.
5. Set the suppressor time to 400 ms and the ISI to 10 ms.
6. Now acquire from the same ear with the suppressor active.
7. Once done, set the suppressor level to 0 dB and acquire again.
8. Repeat acquisition, alternating between the Suppressor ON and OFF, until you have a few recordings using both conditions.

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TEOAE Suppression

Analysis

The suppression analysis module can be found in the main menu under **[Suppression]**. The module will appear with the selected recording loaded in both buffers. The buffer color legend for the graphs can be seen over the frequency domain graph. To compare recordings acquired under the same conditions:

- From the File menu, click on **[Load Buffer]** A or B to load the recordings you want to compare.
- Observe the index Cxy on the information panel on the right hand side, which is a measure of coherence. The closer Cxy is to 1, the better the repeatability of the response.

To compare recordings acquired with and without the suppressor:

- From the File menu, click on **[Load Buffer A]** and select one or more recordings that were acquired without the suppressor. When including multiple recordings in a single buffer, the recordings will get averaged together.
- Click on **[Load Buffer B]** and select one or more recordings that were acquired with the suppressor. Note that you should load the same number of recordings in each buffer.
- Note that when the module was opened, the cursors in the time domain graph were automatically placed at 8 and 18 milliseconds, the most commonly used time region to study suppression effects.
- You may move the cursors in increments of 0.5 milliseconds by clicking the left and right arrows. The time region may also be modified by dragging the cursor handles seen at the top of the graph.

When the cursor positions are modified, the analysis module will update the calculated RMS information shown on the right hand side table:

- **RMS:** Root Mean Square.
- **RMS A-B:** Noise Suppression Effect.
- **Rxy:** RMS Coherence or Repeatability.

You should normally find 1 to 6 dB suppression effect. It can be found with as little as 100 sweeps; however, it is recommended to do 2000 to 4000 sweeps for each condition to obtain a good average.

General Information Tips

- Binaural noise is most effective in suppressing emissions (Berlin et al., 1995)
- Greater suppression occurs when the click follows the noise by 1 to 10 msec than for longer time separations (Berlin et al., 1995).
- Noise durations greater than 300-400 msec yield the greatest suppression.
- The amount of suppression increases with increasing noise levels.
- The greatest suppression is observed for 55 dB peak SP clicks and decreases at higher intensities (Hood et al., 1996).

Reference Materials

Berlin CI, Hood, LJ, Hurley A, Wen H, Kemp DT. 1995. Binaural noise suppresses click-evoked otoacoustic emissions more than ipsilateral or contralateral noise. Hear Res 87:96-103.

Hood LJ, Berlin CI, Goforth-Barter L, Bordelon J, Wen H. 1999. Recording and analyzing efferent suppression of transient-evoked otoacoustic emissions. In Berlin CI: The Efferent Auditory System. San Diego: Singular Publishing Group.

Hood, L. J., Berlin, C. I., Hurley, A., Cecola, R. P., & Bell, B. (1996). Contralateral suppression of transient-evoked otoacoustic emissions in humans: Intensity effects. Hearing Research, 101, 113-118.

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