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OTOACOUSTIC EMISSIONS IN THE SCOPE OF AUDIOLOGICAL DIAGNOSIS

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Otoacoustic Emissions emerged directly from two people in Audiology who were key to their development, namely: a) Dr. Thomas Gold, the scientist who came up with the idea that the auditory system could contain active components, and b) Dr. David Kemp, who actually discovered there was such auditory activity in the cochlea.

What are Otoacoustic Emissions? We will briefly describe them and some related topics of interest.

- 1) The first piece of information to note is that Otoacoustic Emission assessments are not tests of hearing, which are always subjective. Instead, Otoacoustic Emissions involve an objective test of cochlear function which allows the experimenter to separate those individuals with healthy cochlear function from those with unhealthy function.
- 2) Otoacoustic emissions are sounds generated by the activity of hair cells, that is, by the outer hair cells of the cochlea.
- 3) The outer hair cells function as a motor system, meaning that the cells

move in response to some type of sound stimulation, and this causes vibration of the basilar membrane, which in turn causes signaling by the inner hair cells.

- 4) The movement of the outer hair cells produces a sound that can be detected by means of a miniature high-quality microphone placed in the external acoustic meatus. This captured sound is called Otoacoustic Emissions.

- 5) Analysis of these sounds allows us to ascertain whether or not there is any type of impairment in the responses of the outer hair cells.

- 6) Any impairment in the responses of the outer hair cells correlates with decreased hearing ability.

- 7) Strong otoacoustic emissions depend on the integrity of the inner ear and middle ear.

- 8) Clinical application of otoacoustic emissions has become firmly established as an objective technique of auditory assessment allowing a non-invasive view into outer hair cell function.



Recognition of a role for emissions began around 1980 with a focus on studies directed to newborn hearing screening programs. However, there is another aspect to assessment by otoacoustic emissions which focuses on diagnosis, and this can often be performed in an outpatient setting. For audiological assessment, it is recommended that a battery of tests be carried out that includes, among others, testing for otoacoustic emissions, for this can help understand the clinical picture and the patient's audiological condition.

Diagnostic testing through otoacoustic emissions can help especially in the following conditions:

- When traditional audiological assessment is not possible;
- When there is any doubt in the behavioral assessment responses;
- In cases of noise-induced hearing loss;
- In cases of auditory neuropathy spectrum disease;
- Helping to identify hearing damage;
- Monitoring ototoxicity;
- Early identification of hearing loss.

Diagnosis using otoacoustic emissions involves a wide range of acquisition parameters, and so the operator needs to have a good knowledge of these parameters in order to interpret the findings accurately. To this end, the following recommendations will help make sure that all assessments are accurate and reliable:

- Do not use protocols designed only for screening;
- Normal values will diverge between infants, children, and adults;
- Use protocols that are appropriate for each age group assessed;
- Use protocols that are appropriate for different diagnostic purposes (Meniere's disease, ototoxicity monitoring, noise-induced hearing loss, etc.);
- Ensure the background noise level is low;
- Check the reproducibility values, both overall and by individual frequency;
- Analyze each frequency in detail;
- Analyze the signal/noise ratio;
- Ensure that the signal-to-noise ratio is at least 6 dB;
- Collect as many frequencies as your equipment allows;
- In the diagnostic process, improve your results by classifying them into

three categories: a) Presence of a response; b) Presence of a response but with altered amplitude; c) No response.

- The collection of readings must be replicated. ATTENTION: If your recordings are not repeatable, your exam is not complete;
- An audiogram within normal limits does not ensure that the otoacoustic emission responses will be normal.



For a good diagnosis, it is essential to use proper collection procedures and well-defined parameters and protocols. Remember that the results of an assessment should not be considered in isolation. Audiological diagnosis must always be based on the principle of crosschecking.

There are many articles and books that describe, in detail, the findings and studies on otoacoustic emissions from different perspectives and pathologies. One book that we strongly recommend is “Otoacoustic Emissions – Principles, Procedures, and Protocols”, second edition, by Dhar and Hall (2018), which conveys much knowledge in this area.

And stay tuned for our upcoming newsletters!

References consulted:

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