WIRELESS COMMUNICATIONS IN OTOACOUSTIC EMISSIONS AND AUDITORY EVOKED POTENTIALS (505)

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Objective

To introduce new wireless technology in obtaining Evoked Potential measurements.

Problems with Wired

In conventional Auditory Evoked Potentials (AEP) or Otoacoustic Emissions (OAE) systems, long cables, typically up to 6' (2 m), are necessary to reach the patient from the device.

Practical Problems

- Audiologist needs to be next to the patient.
  - Not always feasible: infant incubators and operating room.
- Wires are "in the way".
- Wires prevent patient motion.

How Wireless Overcomes These Problems

Removal of the wires will result in a removal of the problems:

- Audiologist can conduct tests from a different room
  - Out of the way from the surgical team during an operation.
- No wires to "trip on".
- Patients can move during test.
- Battery power removes potential line noise.

Bluetooth®: A Natural Wireless Solution

A natural wireless solution is to employ a Bluetooth® communication between the computer and the data-collecting module. Bluetooth® is a wireless communications protocol that enables computers and other digital devices communicate via a broad radio-frequency band.

Bluetooth®: Does Not Introduce New Problems

No Introduction of Noise

- Bluetooth® operates at a very low energy, which is below the background level of electromagnetic field.
- Bluetooth® operates at a frequency range orders of magnitude beyond the measured OAE and AEP frequencies.

Uncompromising Security

- Bluetooth® produces a random-noise-like digital signal composed of encoded binary data. Encoding makes it extremely secure for data exchange, which is important in medical applications.
- A unique Bluetooth® PIN can be assigned to each wireless unit.

Bluetooth®: Wireless Features

- Does not introduce noise itself because it has very low energy, below the background level of electromagnetic field.
- Functions within a 30 ft (10 m) radius.
- Can transmit through walls.
- Independent of computer direction and altitude
- Has been already implemented in many medical applications, including audiology:
  - HIMSA's NOAHlink™ is used for wireless programming of hearing aids.
  - GN Otometrics' OTOflex™ performs tympanometry, acoustic reflex tests, and other immittance tests.

Clinical Importance

Convenience

The data-collecting module (such as VivoLink™) can be placed on the adult's chest and secured with a lanyard, or placed next to a baby or be held by the baby's mother. Testing can be performed anywhere within the reach of Bluetooth®, including situations where cabled instruments cannot be used at all.

Infant testing

- Possibility for the caregiver to carry the infants or push in a stroller and comfort them during the test.
- Audiologist can perform the test from office near parking lot, where infant is sleeping in a car seat.
- Tests can be performed while an infant is enclosed in an incubator.

Adult testing

- While a test is paused, patients can take a break without the inconvenience of detaching and reattaching the electrodes and other wires.
  - This is especially important for senior patients.

Operating room

- Intra-operating monitoring can be performed from a distance.
- Neither the Audiologist nor any cables will get in the way of surgeons and nurses!

References

Saltzstein, W.E. "Bluetooth: The Future of Wireless Medical Technology?" Medical Device & Diagnostic Industry, 24(2): 44-52, 2002.

Vivosonic's Integrity™ System

This wireless interface module for auditory electro-physiology is a universal platform: It performs ABR, ASSR, DPOAE, and TEOAE tests, and has the potential to add other testing modalities on the same platform. It is operated by a microprocessor, controlled from a remote computer through Bluetooth®, and powered by batteries.

New Applications

Research Tool

Wireless AEP and OAE measurements introduce a freedom of motion previously unknown, opening the door to new possibilities…

Centrifuge

- High gravity threshold tests.

Sports physiology

- Latency between starters gun and hearing.
- How well does an athlete hear his coach while running?

Acknowledgements

Isaac Kurtz, Aaron Steinman and the Vivosonic Development Team.

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Presented at the 28th Midwinter Meeting of the Association for Research in Otolaryngology, New Orleans, LA, February 19-24, 2005