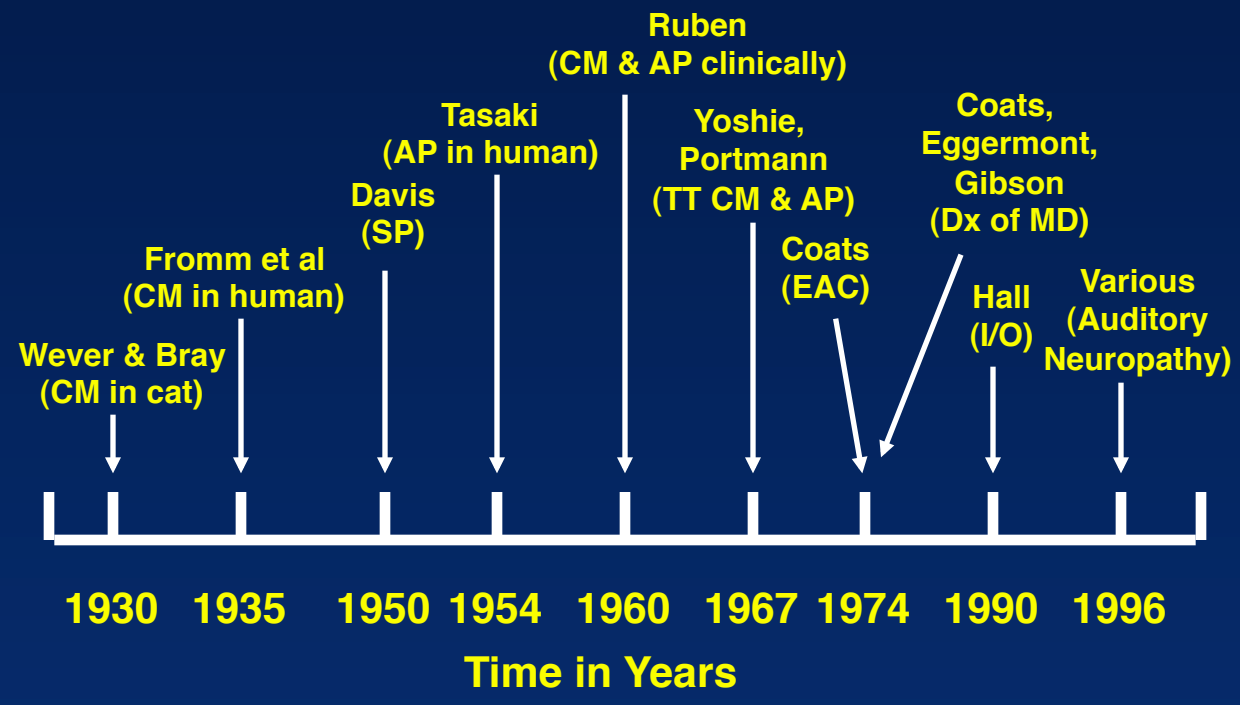
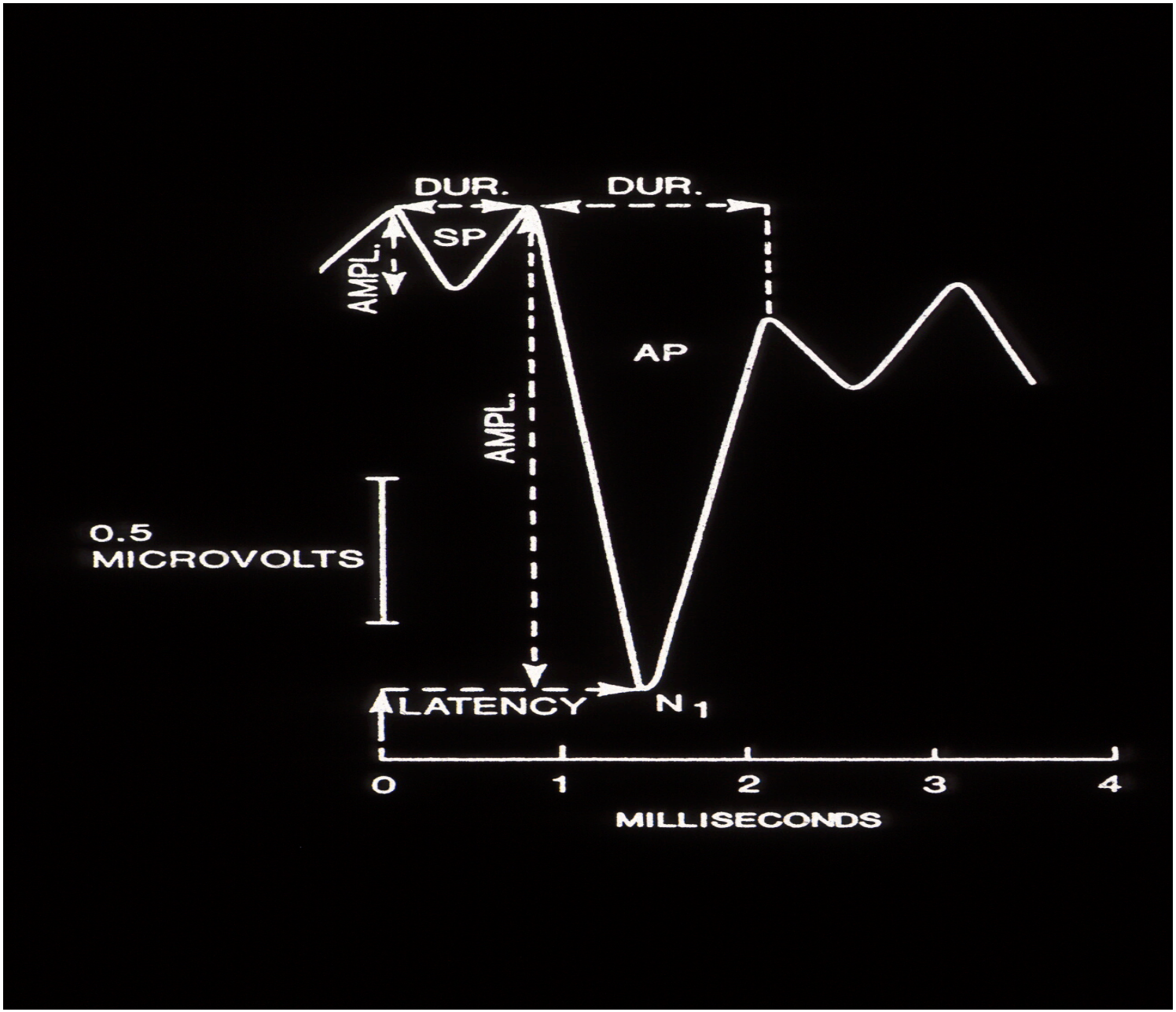
Original Description of Electrocochleography (ECochG)

Wever EG and Bray CW. 1930. Action currents in the auditory nerve in response to acoustic stimulation. Proceedings of the National Acad of Science (USA) 16: 344-350.

Wever EG and Bray CW. 1930. Auditory nerve impulses. Science 71: 215.

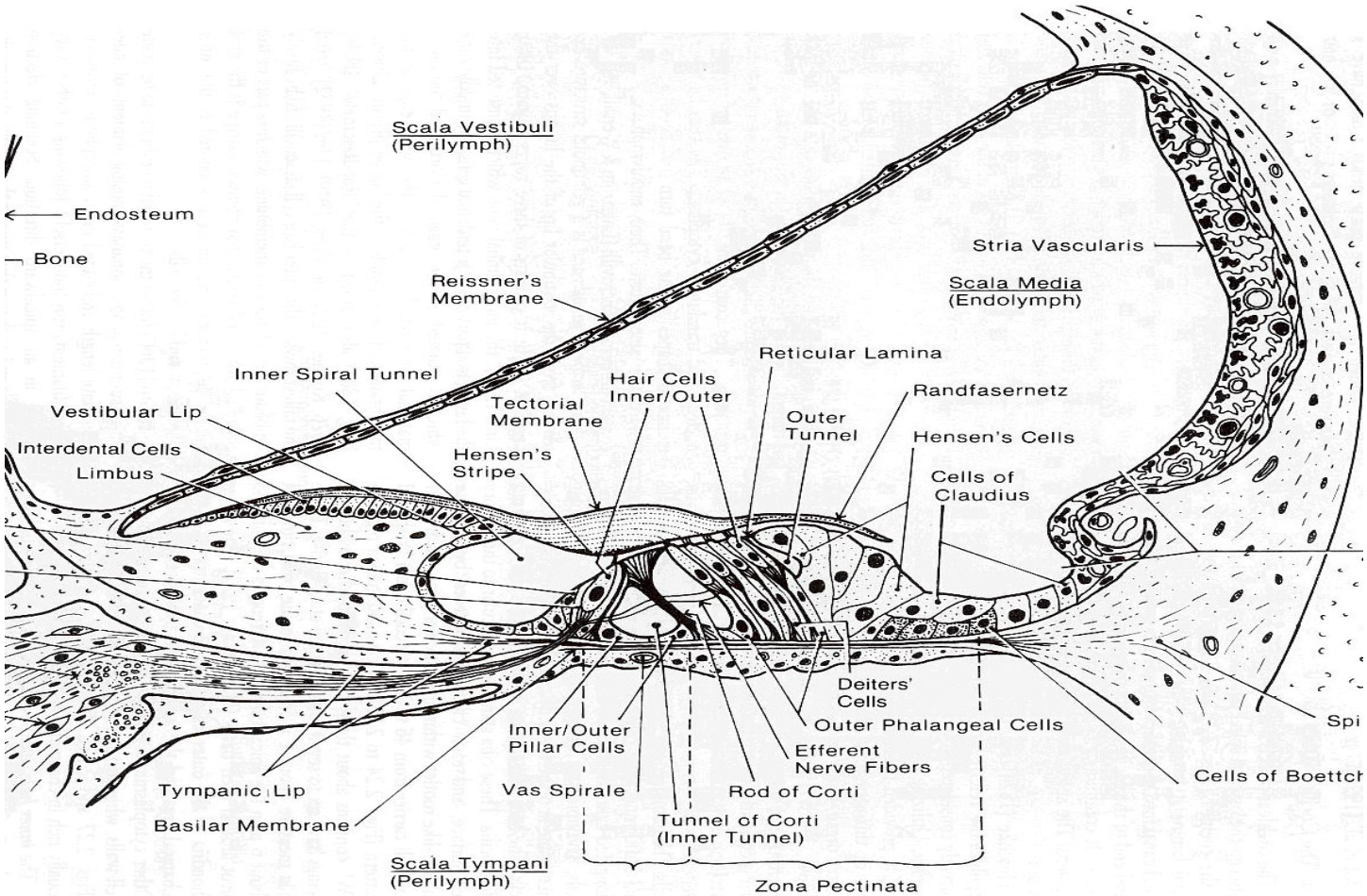
ELECTROCOCHLEOGRAPHY:
Get Ready to Celebrate the 75th Anniversary!




DUR.
DUR.
SP
AMPL.
AP
AMPL.
0.5
MICROVOLTS
LATENCY
N 1
0
1
2
3
4
MILLISECONDS

ELECTROCOCHLEOGRAPHY: Generators

- Cochlear microphonic (CM)
  - outer hair cells
  - receptor potentials
- Summating potential (SP)
  - inner hair cells (> 50%)
  - outer hair cells
  - organ of Corti
- Action potential (AP)
  - afferent fibers in distal 8th cranial nerve
  - spiral ganglion

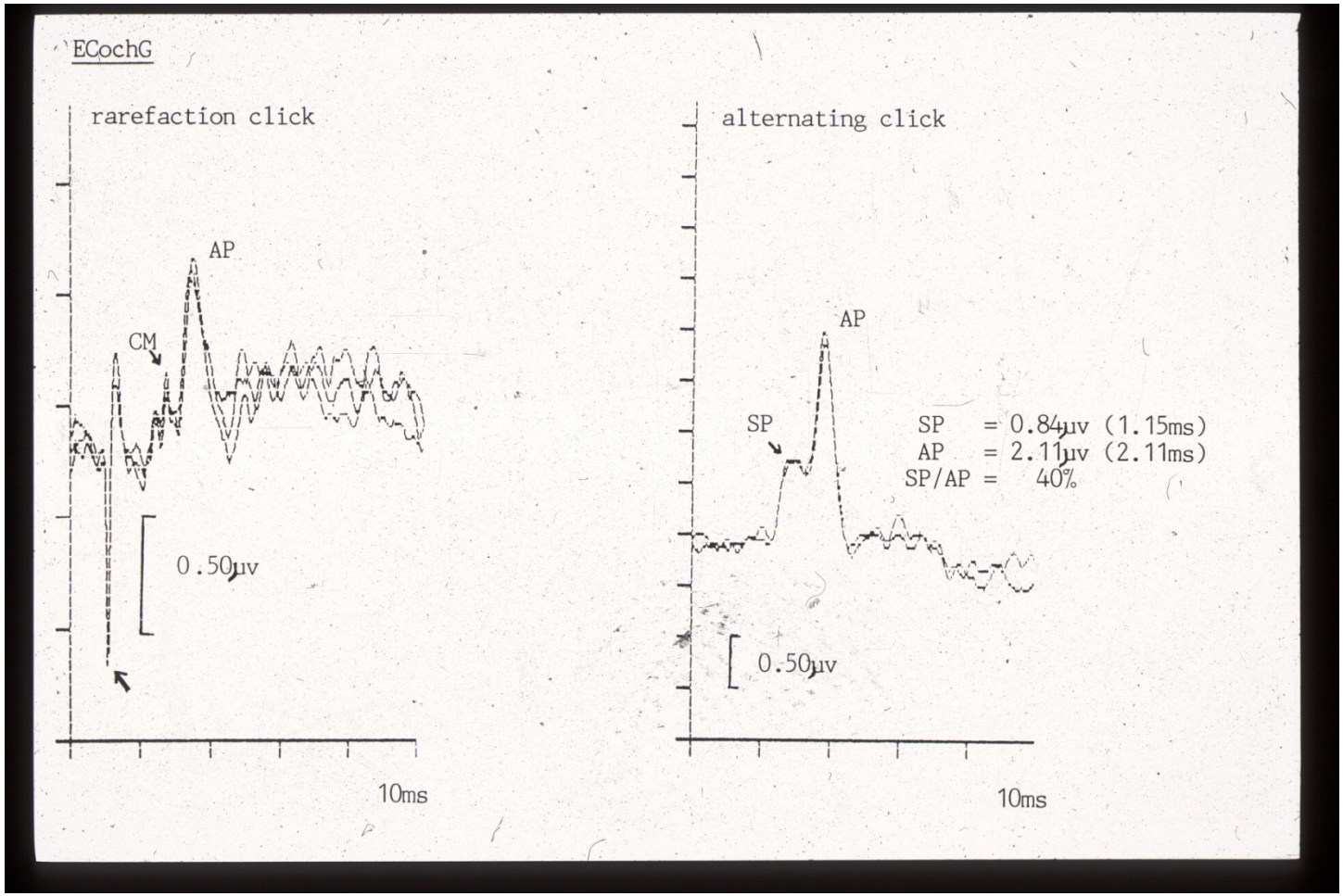


is is a diagrammatic sketch showing the cytologic structures of the cochlear duct. Courtesy of H. Davis, Central Insti-
n University, St. Louis, Missouri. (Davis, 1962)

ECochG TEST PROTOCOL (1)

Stimulus Parameters

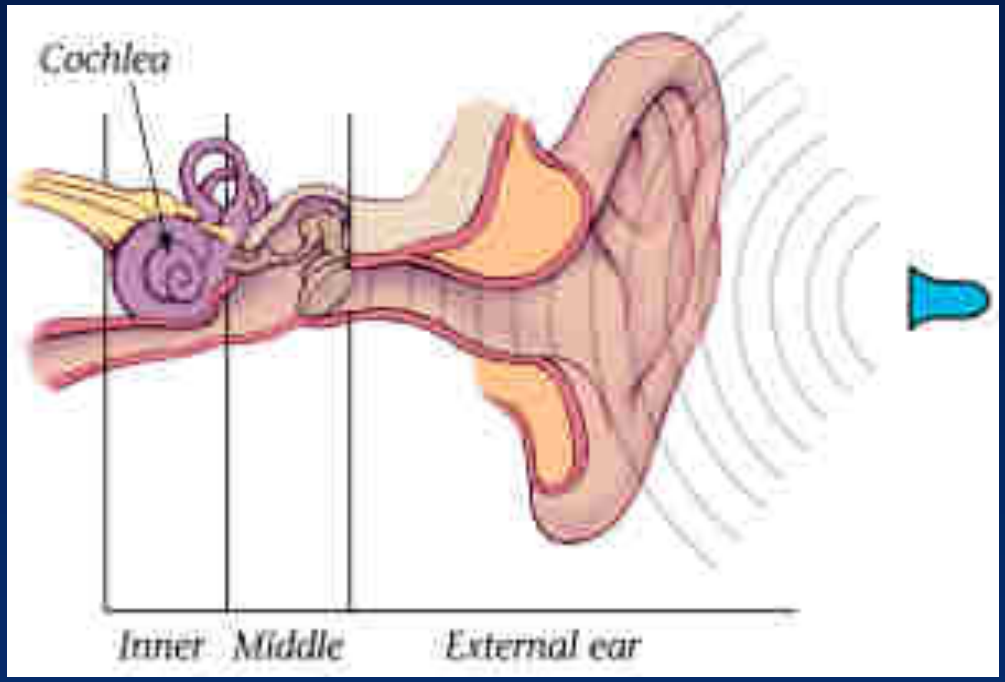
Type	clicks
Duration	0.1 msec
Rate	7.1/sec or slower as necessary
Polarity	alternating (for AP) or rarefaction (for CM)
Intensity	maximum or lower
Transducer	Insert
Masking	never needed (response is ipsilateral)

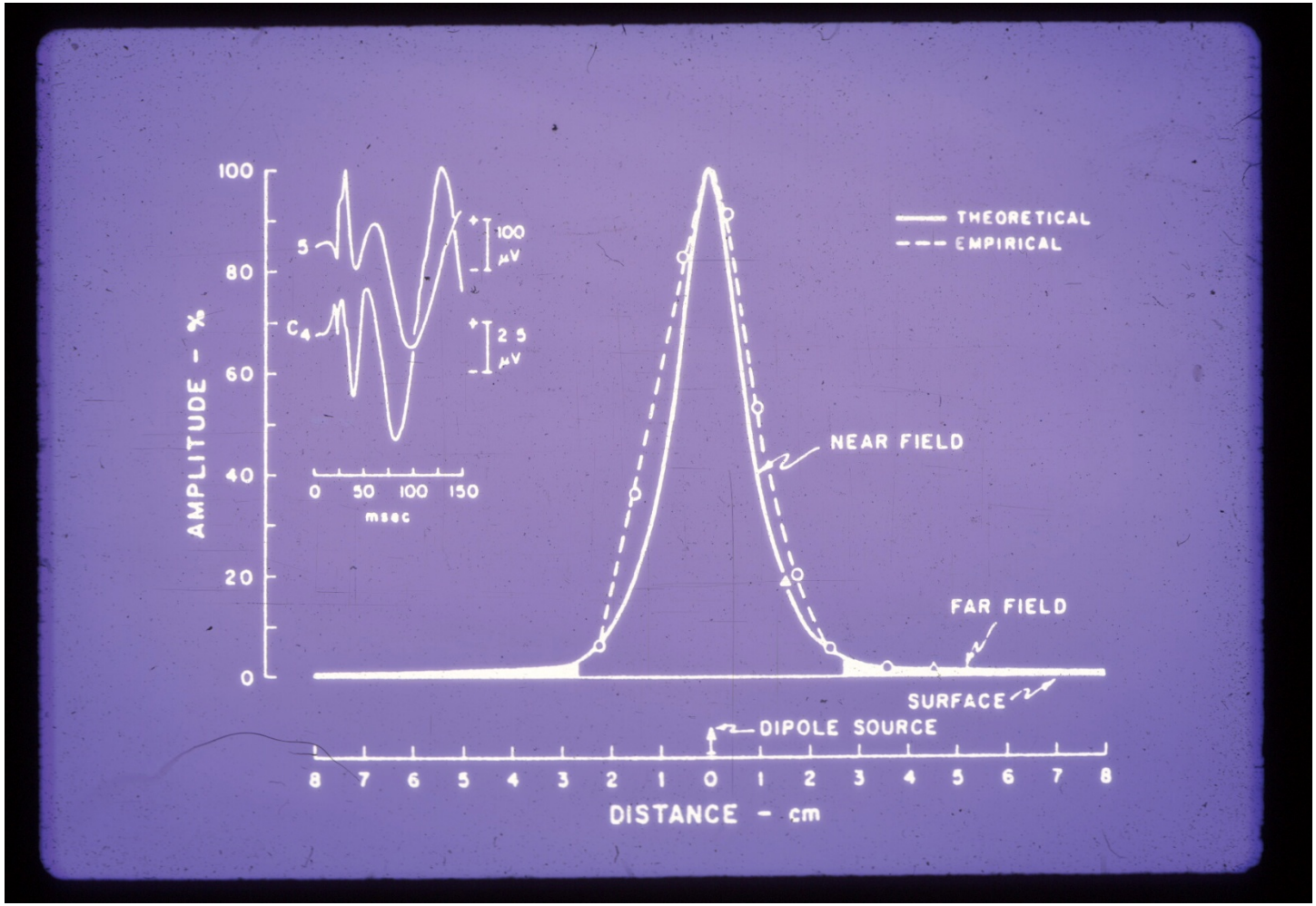

ECochG
rarefaction click
AP
CM
0.50μv
10ms
alternating click
AP
SP
SP = 0.84μv (1.15ms)
AP = 2.11μv (2.11ms)
SP/AP = 40%
0.50μv
10ms

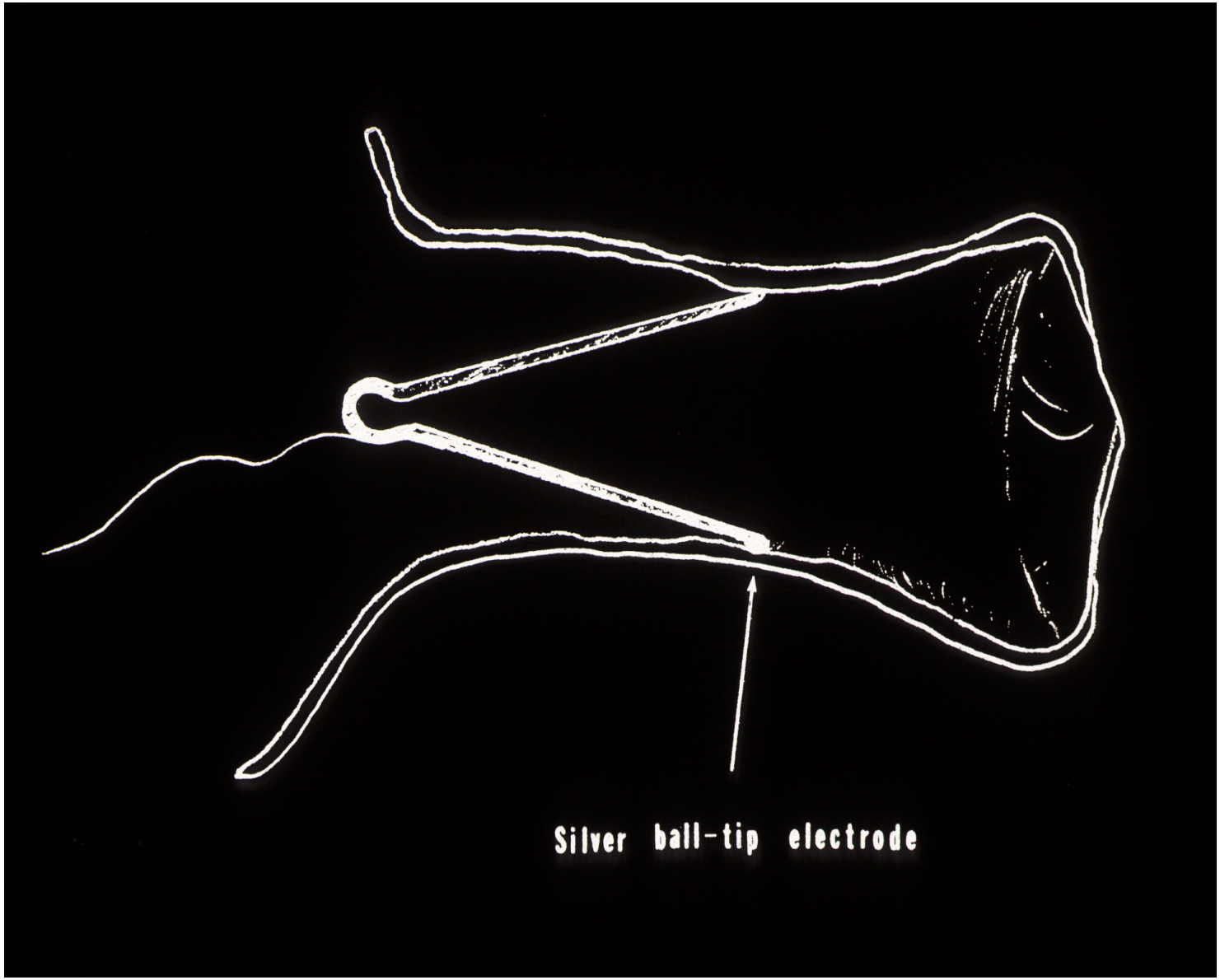
ECochG TEST PROTOCOL (2)

Acquisition Parameters	
Amplification	75,000 or less
Analysis time	5 or 10 msec
Sweeps	500 or less
Filters	10 to 1500 Hz
Notch filter	never
Electrodes	
option 1	Fz to tympanic membrane
option 2	Fz to tiptrode
option 3	Fz to transtympanic needle

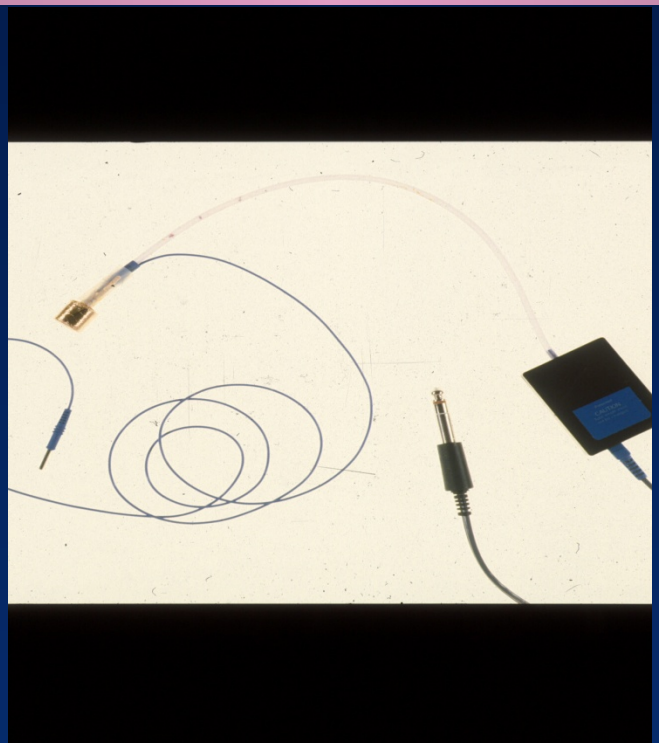
Anatomy of OAEs: External Ear




100
80
60
40
20
0
AMPLITUDE - %
S
C4
100 μV
2.5 μV
0 50 100 150
msec
THEORETICAL
EMPIRICAL
NEAR FIELD
FAR FIELD
SURFACE
DIPOLE SOURCE
8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8
DISTANCE - cm


Silver ball-tip electrode

TIPtrode:
Part transducer and part electrode



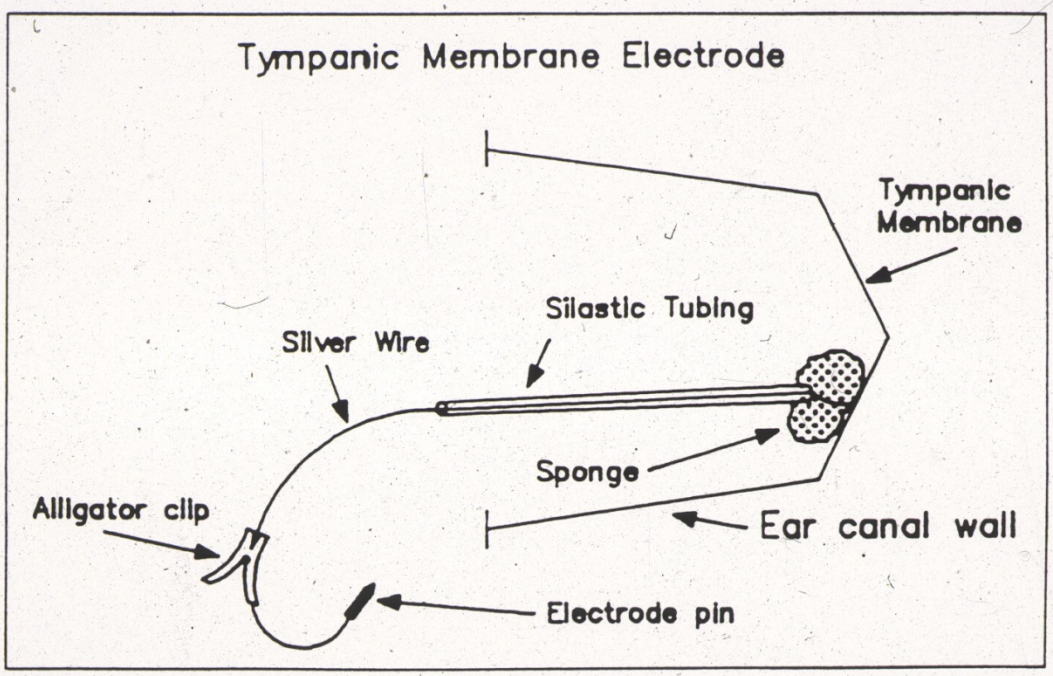
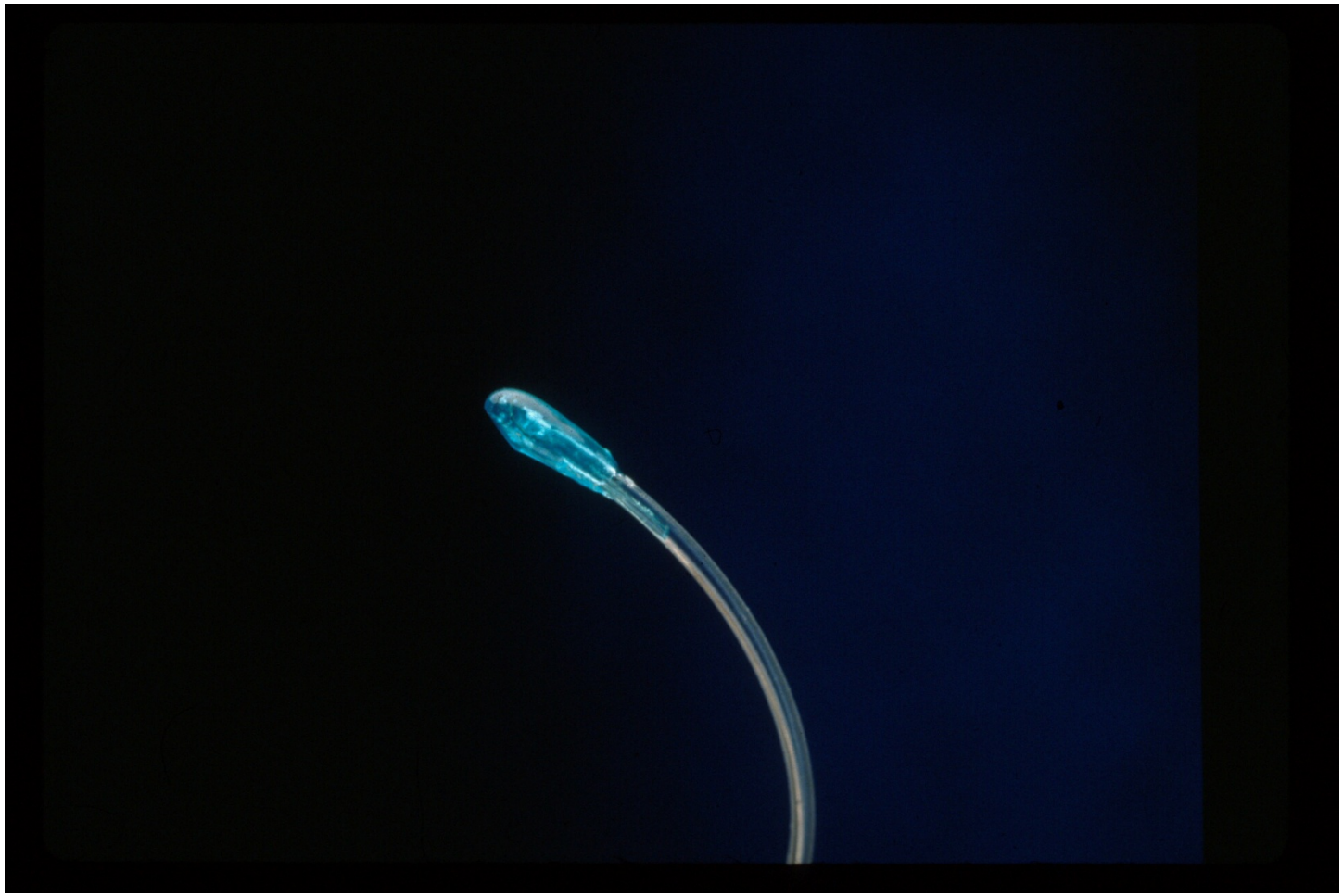
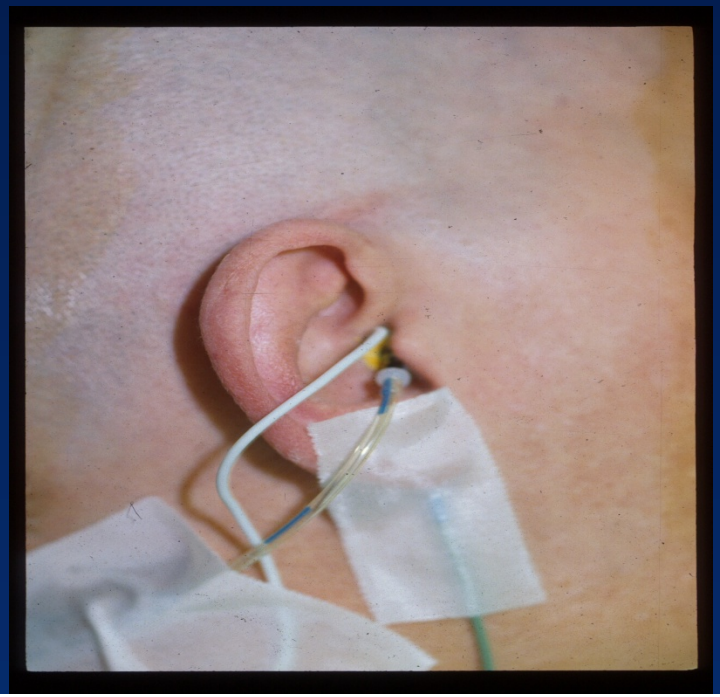
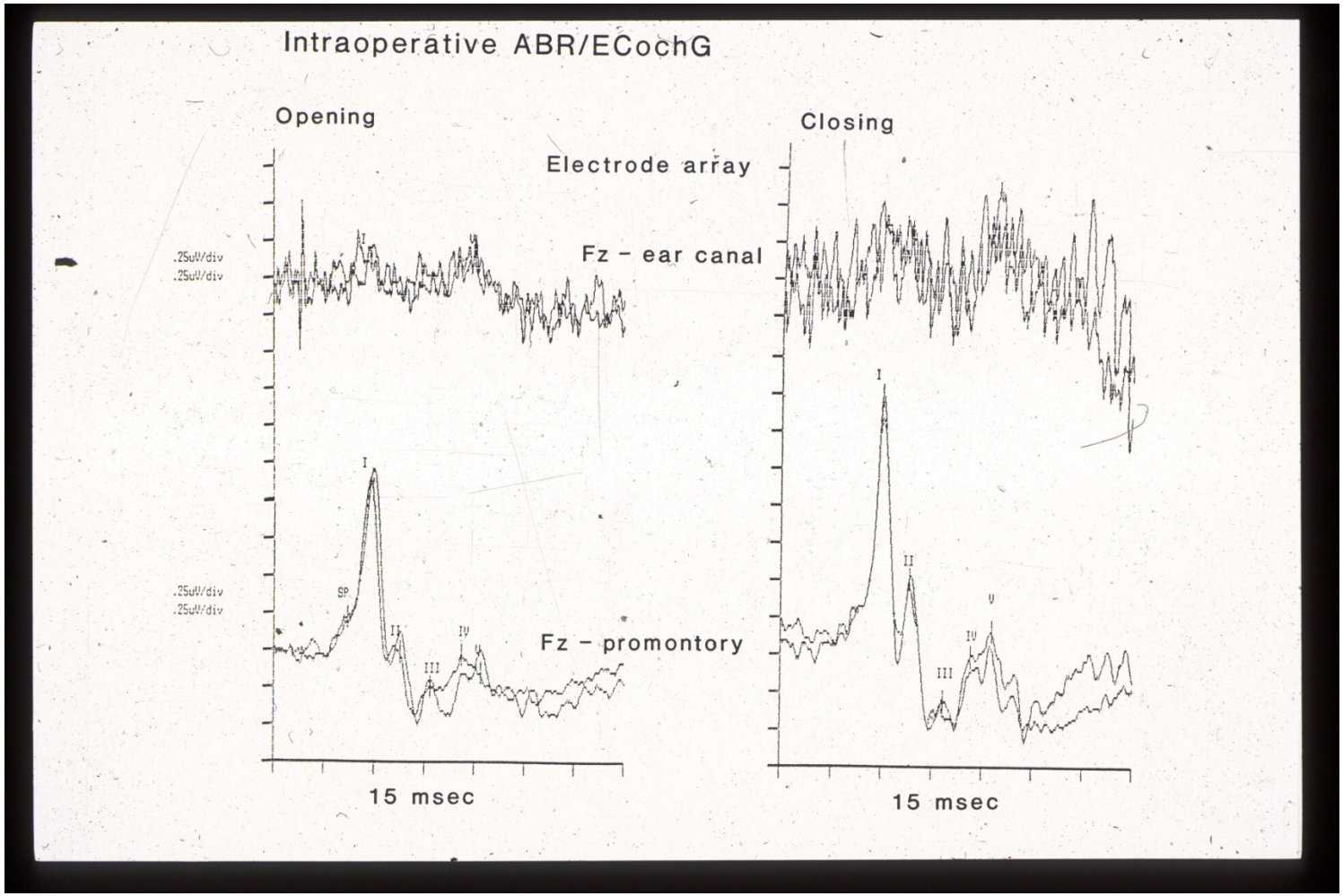


Figure 5–3. TM electrode design (sometimes called a "tymptrode"). Silver wire runs through a flexible plastic tube and connects with sponge or cotton at the tip. When the tymptrode is inserted into the ear canal, the tip makes contact with the lateral surface of the TM.



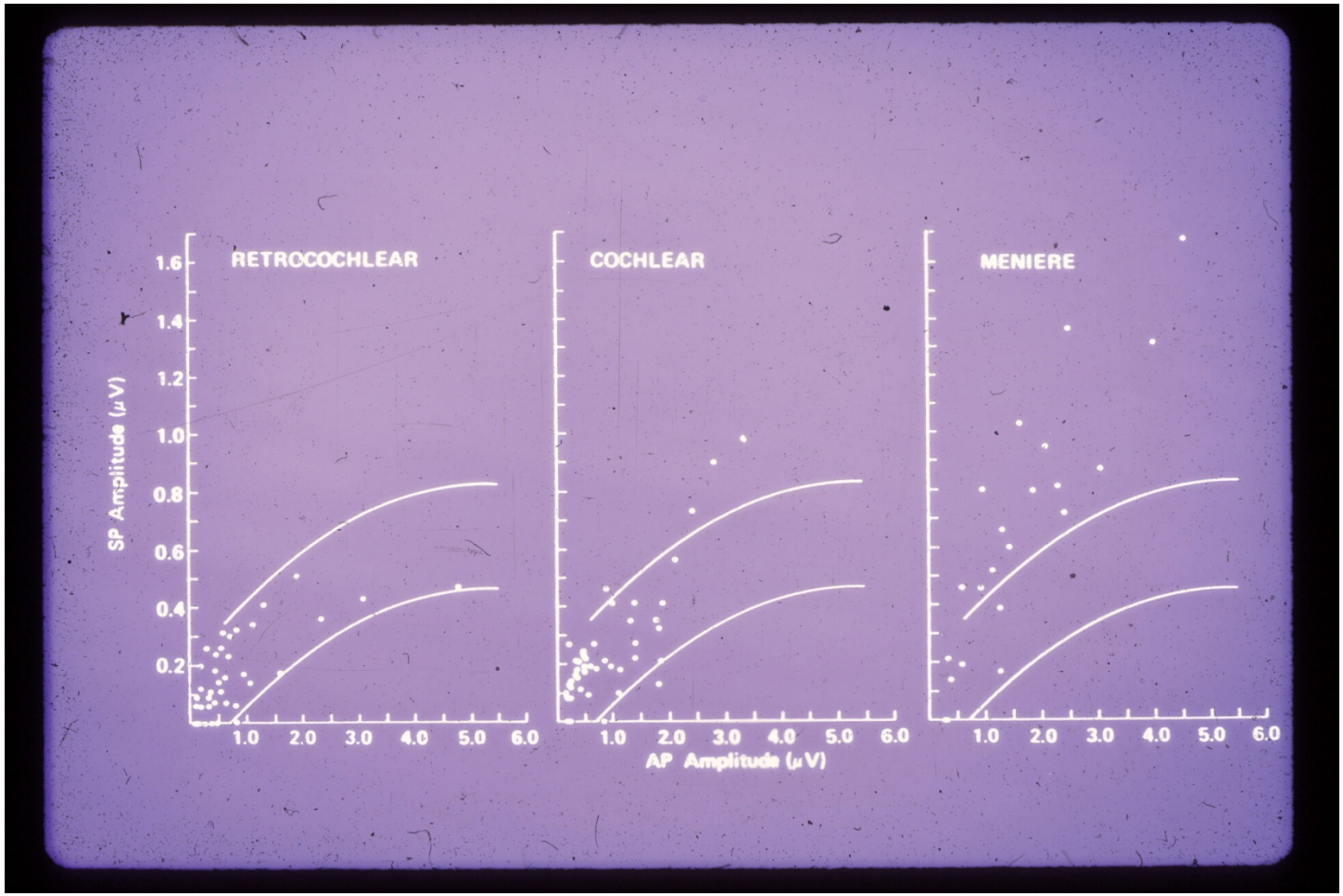
Transtympanic Electrode Technique: Subdermal Needle Electrode to Promontory




Intraoperative ABR/ECochG
Opening
Closing
Electrode array
Fz – ear canal
.25uV/div
.25uV/div
.25uV/div
.25uV/div
SP
I
II
III
IV
V
Fz – promontory
15 msec
15 msec

ELECTROCOCHLEOGRAPHY (ECochG): Clinical Applications

- Enhancement of ABR wave I
- Intraoperative monitoring
- Documentation of cochlear status in auditory neuropathy
- Diagnosis of Meniere's disease


RETROCOCHLEAR
COCHLEAR
MENIERE
SP Amplitude (μV)
AP Amplitude (μV)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1.0
2.0
3.0
4.0
5.0
6.0

ELECTROCOCHLEOGRAPHY:
Selected recent papers

- Pou, Hirsch, Durrant et al. Efficacy of tympanic ECochG in the diagnosis of endolymphatic hydrops. AJO 17: 1996.
- Durrant et al. Are inner or outer hair cells the source of summating potentials recorded from the round window? JASA 104: 1998.
- Levine, Margolis, Daly. Use of ECochG in the diagnosis of Meniere's Disease. Laryngoscope 108: 1998.
- Orchik, Shea, Ge. Summating potential and action potential ratio in Meniere's Disease before and after treatment. AJO 19: 1998.
- Krueger, Wagner. Needle placement with transtympanic ECochG. Laryngoscope 107: 1997