Auditory Brainstem Response: Conductive Hearing Loss

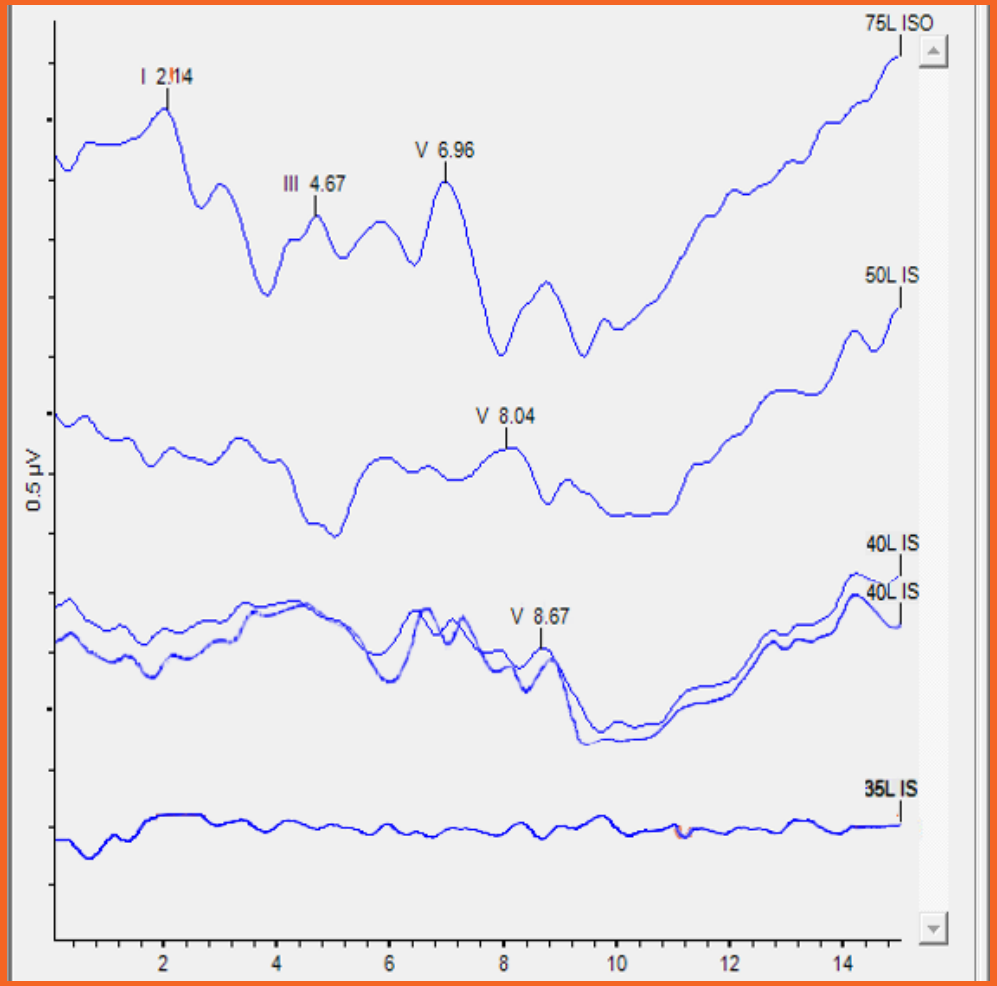
Maryam Aghamolaei, PhD
Assistant professor
Audiology Department
Shahid Beheshti University of Medical Sciences

Common disorders with conductive hearing loss:

- Cerumen impaction
- External ear canal stenosis
- Congenital aural atresia
- Otitis media
- Eustachian tub dysfunction

ABR pattern in CHL:

- **Elevation in AC-ABR thresholds**
- **Delayed absolute latencies**
  All components are delayed (I, II, V)
- **Good waveform morphology**
  including clear and reliable wave I
- **Normal inter-wave latencies**
  Normal I-III, I-V and III-V IWIs
- **Normal BC-ABR thresholds**



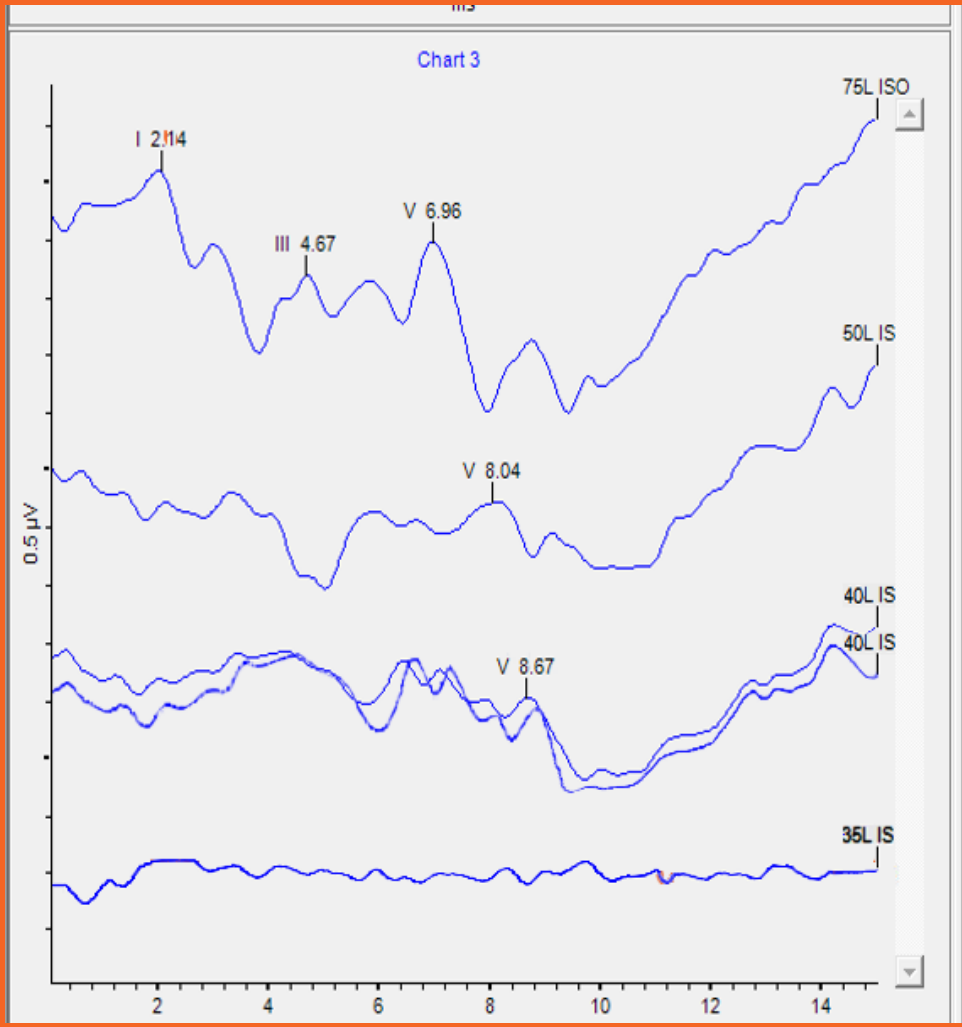


Chart 3
75L ISO
I 2.14
III 4.67
V 6.96
50L IS
V 8.04
40L IS
40L IS
V 8.67
35L IS
0.5 µV
2
4
6
8
10
12
14


I 1.63
III 4.29
V 6.46
75R IS
45R IS
V 7.25
V 8.75
20R IS
20R IS
1 µV
2
4
6
8
10
12
14
ms

CHL

Normal

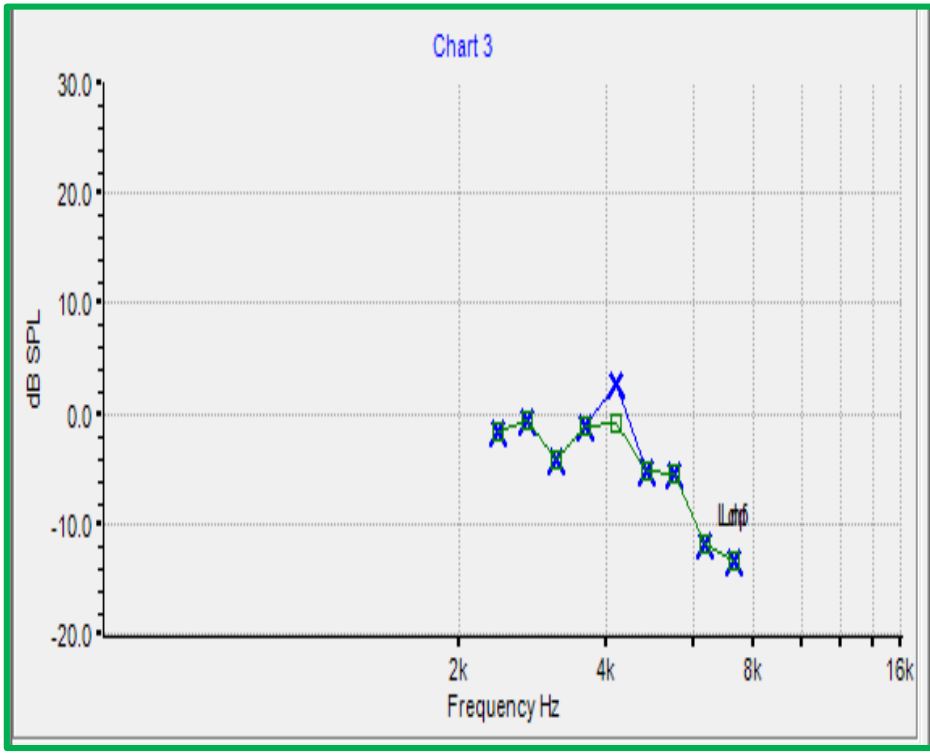


Chart 3
30.0
20.0
10.0
0.0
-10.0
-20.0
dB SPL
2k
4k
8k
16k
Frequency Hz

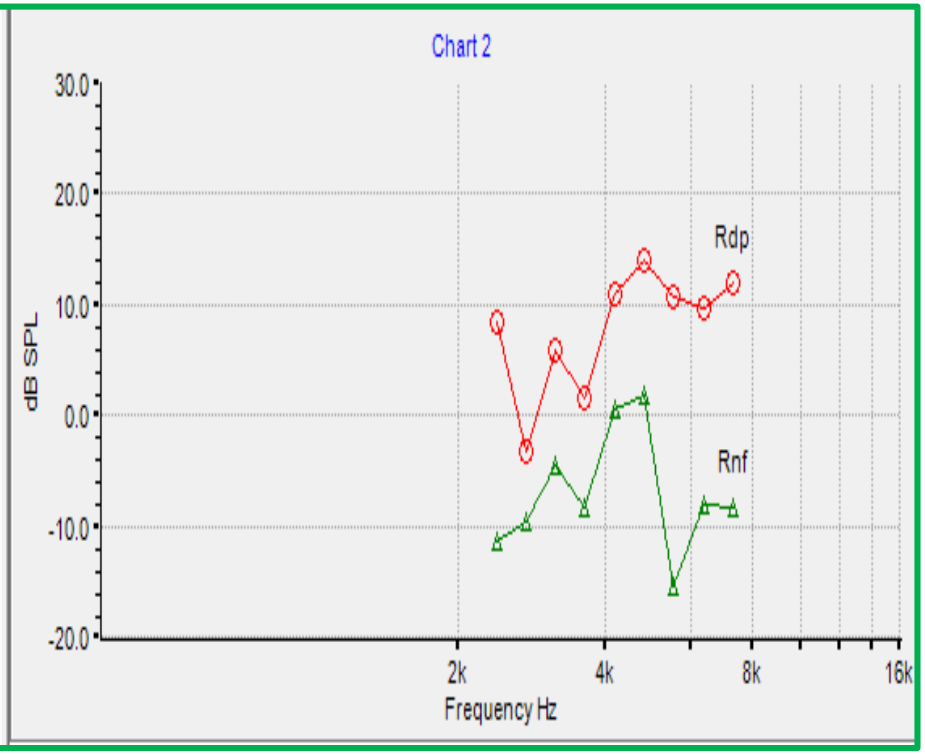
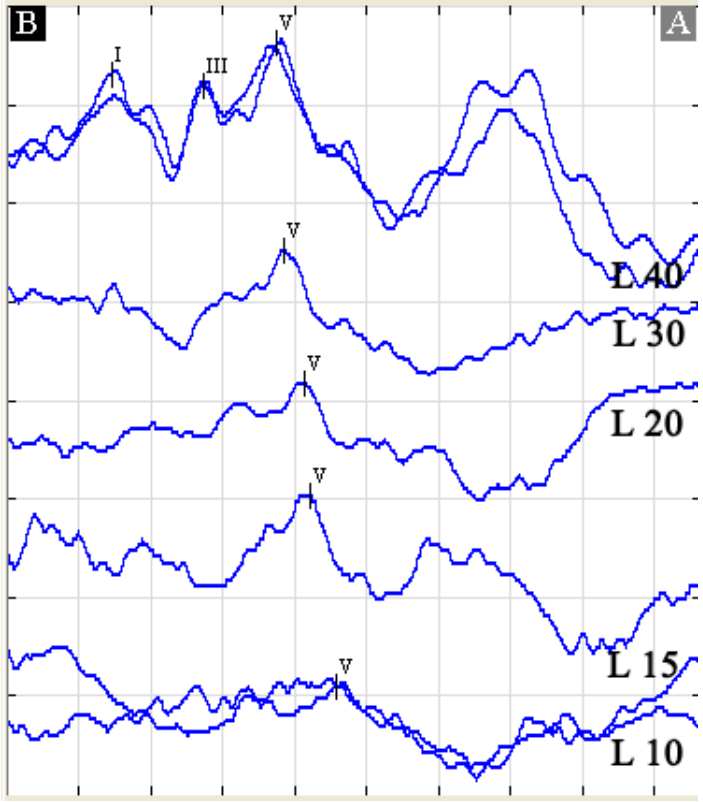


Chart 2
30.0
20.0
10.0
0.0
-10.0
-20.0
dB SPL
Rdp
Rnf
2k
4k
8k
16k
Frequency Hz

Left ear:

Normal BC-ABR



Clinical goal for BC-ABR:

To determine type of hearing loss

Conductive ?

Sensorineural ?

Mixed ?

Clinical indications for BC-ABR :

History of middle ear disorder/ possibility of CHL

Auditory test results consistent with middle ear dysfunction (e.g., otoscopy, immittance measures)

Abnormal pattern of AC-ABR consistent with CHL
(delayed wave I)

Challenges of BC-ABR

Challenge 1

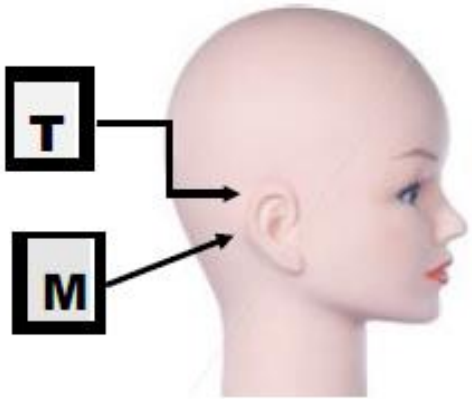
Stimulus artifact

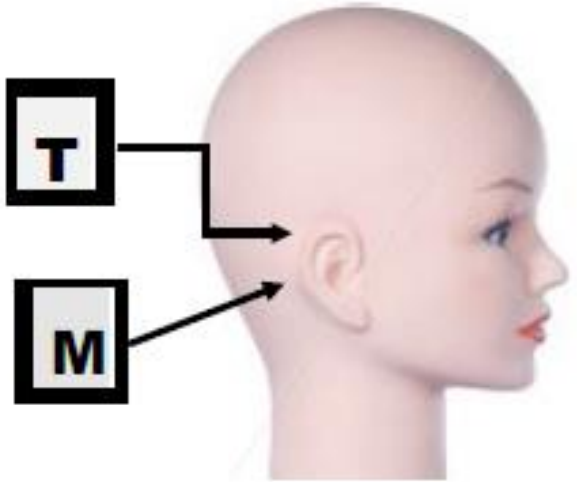
- Close distance between reference electrode and transducer

Challenge 2

Which cochlea is responding?

- Low IA values for bone-conduction stimuli




T
M

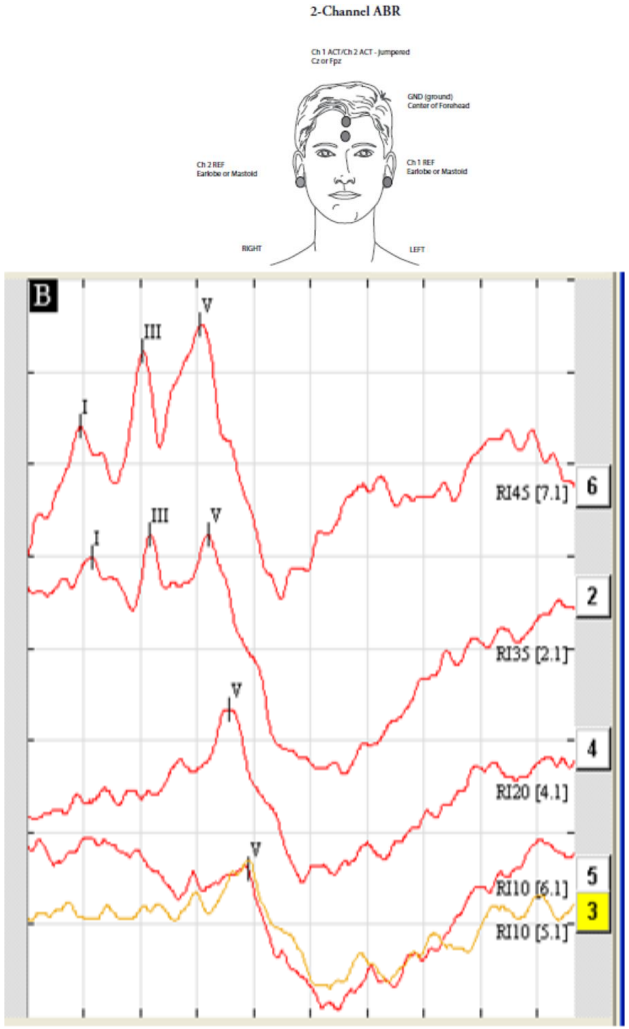
Stimulus and acquisition parameters for BC-ABR

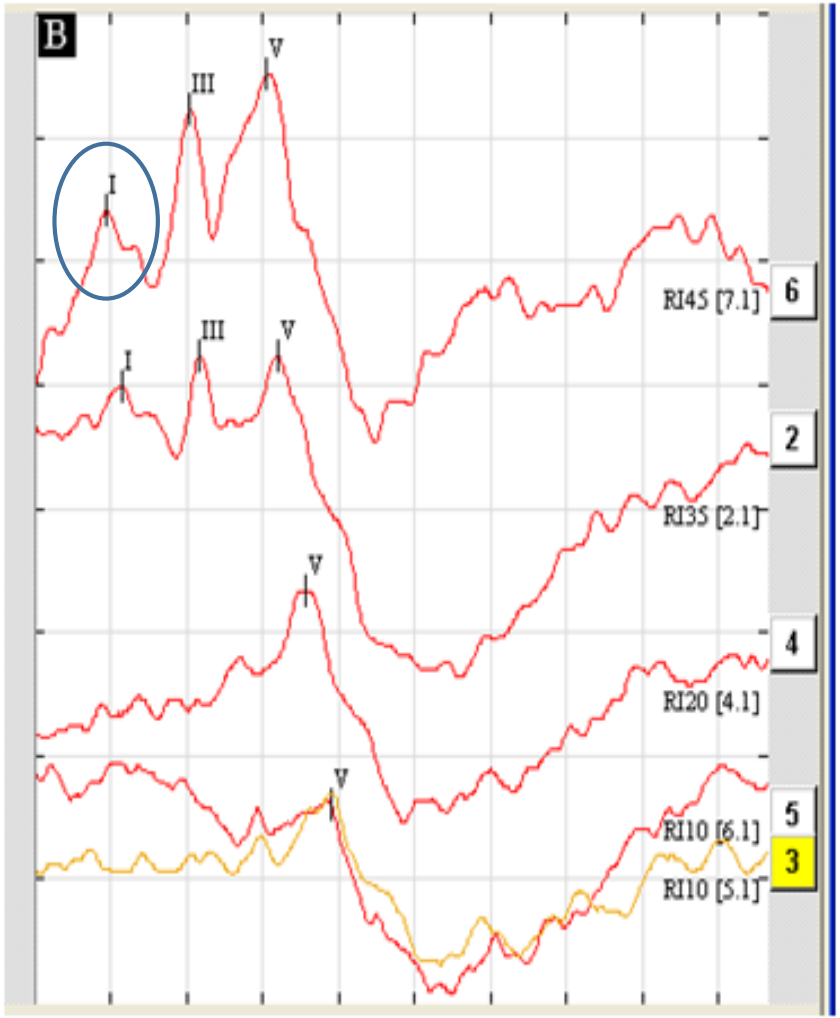
Stimulus parameters

- **Stimulus type:**
Click or tone-burst
- **Intensity:**
Variable
- **Polarity:**
Alternative
- **Stimulus rate:**
Low rate (e.g., 11.1/s) for better detection of wave I

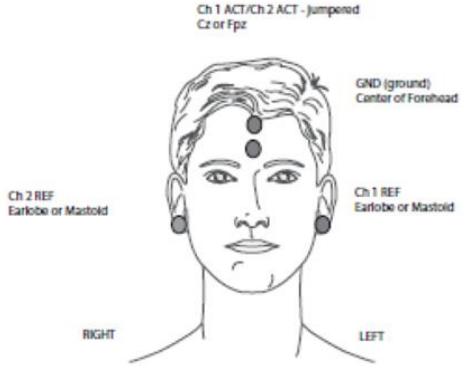
Acquisition parameters

- Filter setting: 30-1500 Hz
- Time window: 15 ms for click and 20 ms for tone-bursts
- Sweeps: variable (depending on SNR)
- 2-channel (ipsi/contra) ABR recording



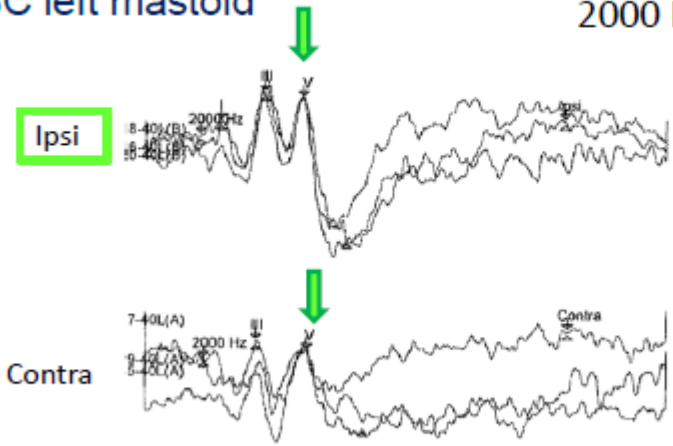


2-Channel ABR

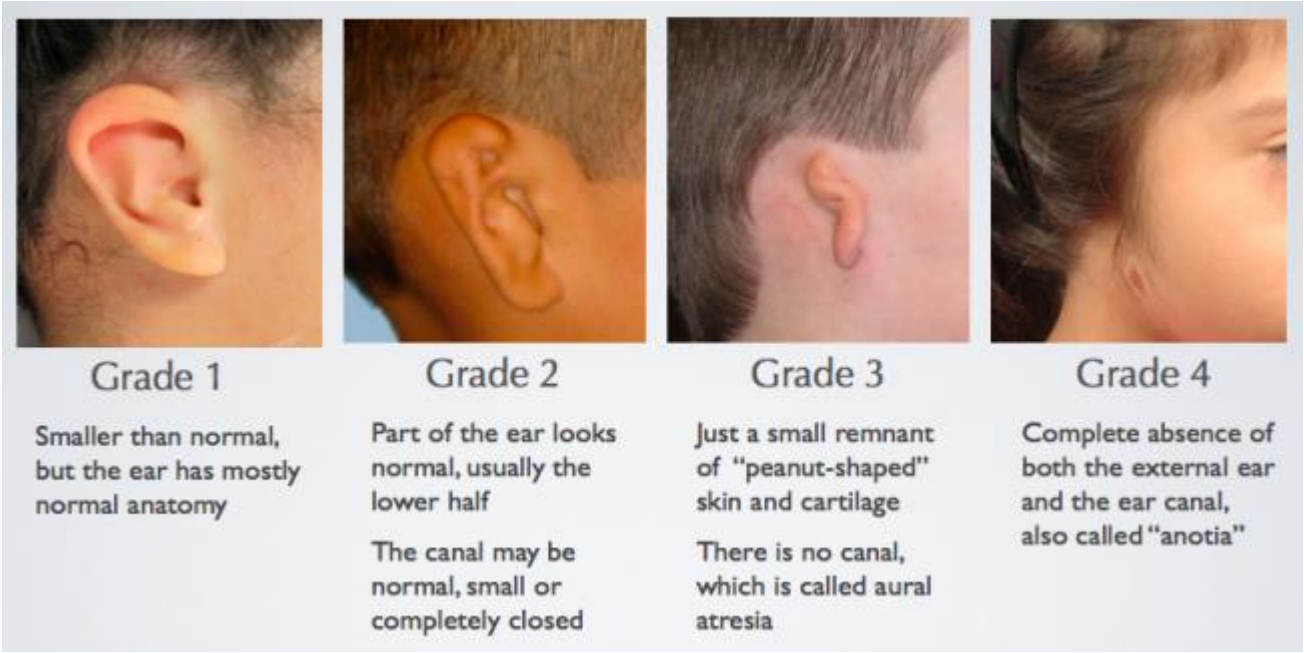


BC left mastoid

2000 Hz @ 40 dB nHL



Congenital Aural Atresia



Grade 1

Smaller than normal, but the ear has mostly normal anatomy

Grade 2

Part of the ear looks normal, usually the lower half

The canal may be normal, small or completely closed

Grade 3

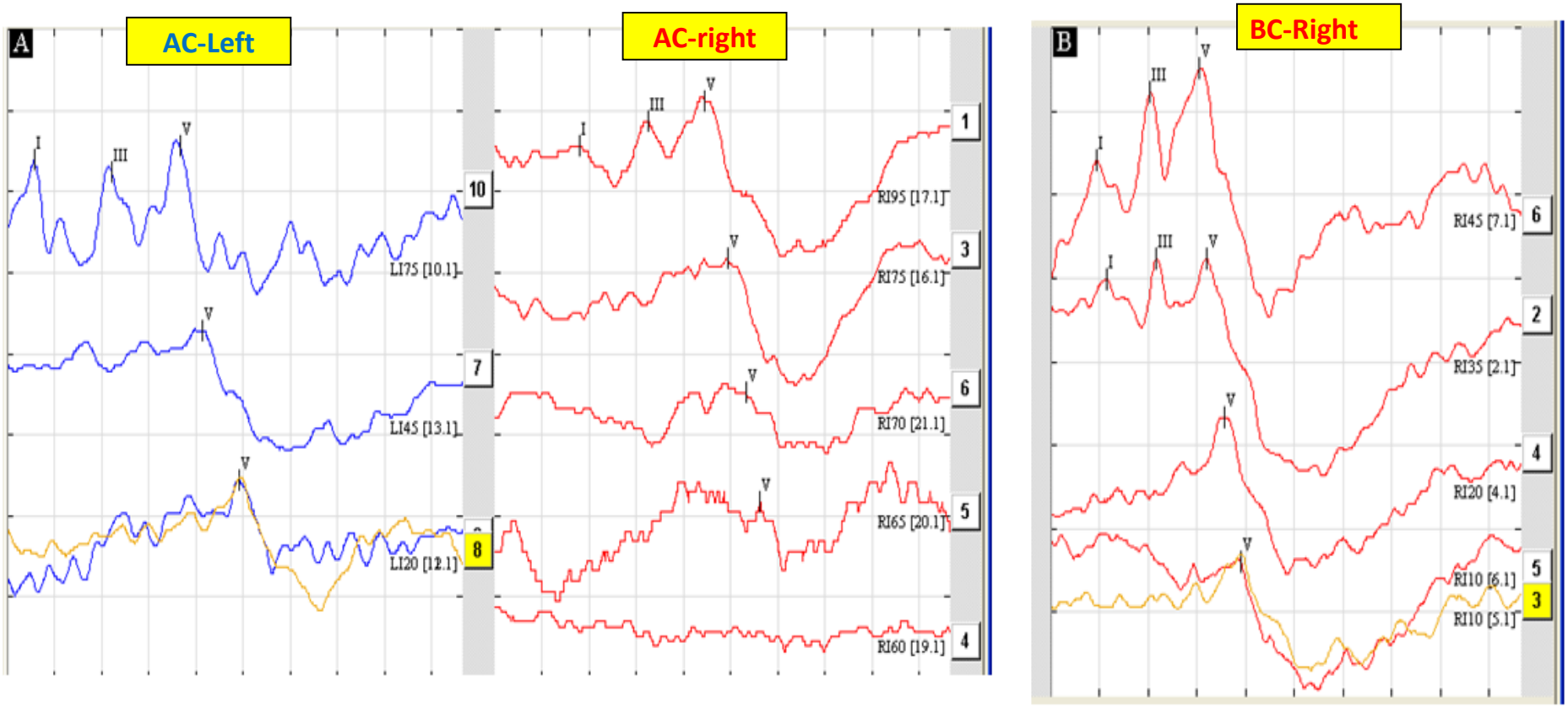
Just a small remnant of "peanut-shaped" skin and cartilage

There is no canal, which is called aural atresia

Grade 4

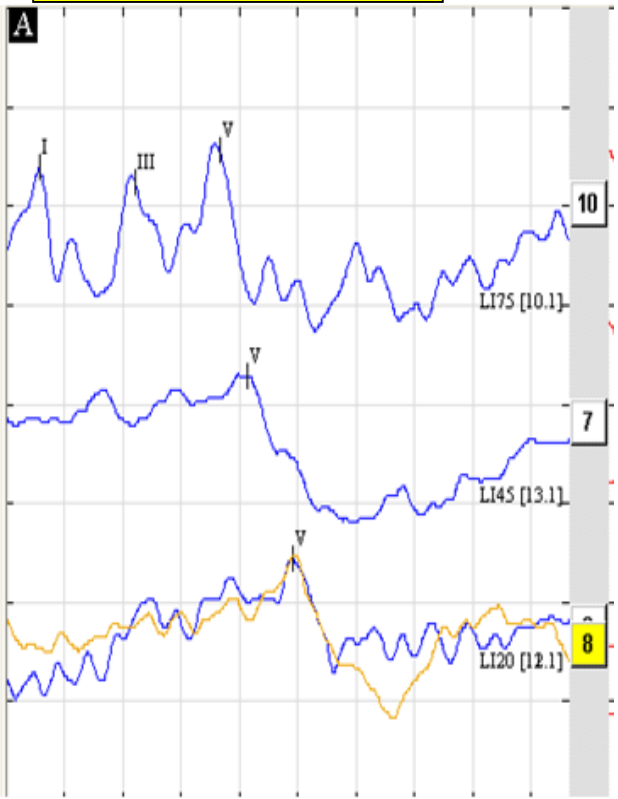
Complete absence of both the external ear and the ear canal, also called "anotia"

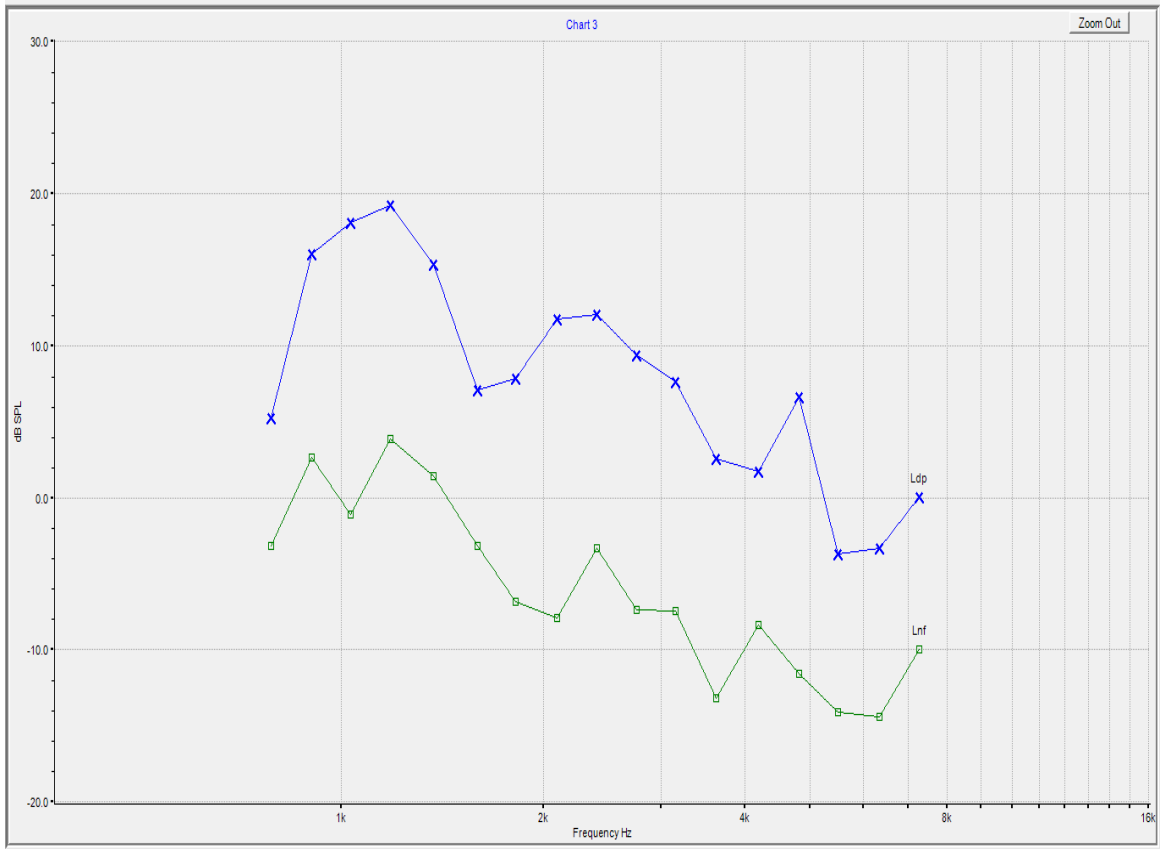
Unilateral aural atresia: 4-month-old boy, right ear atresia



Left: AC Click-ABR

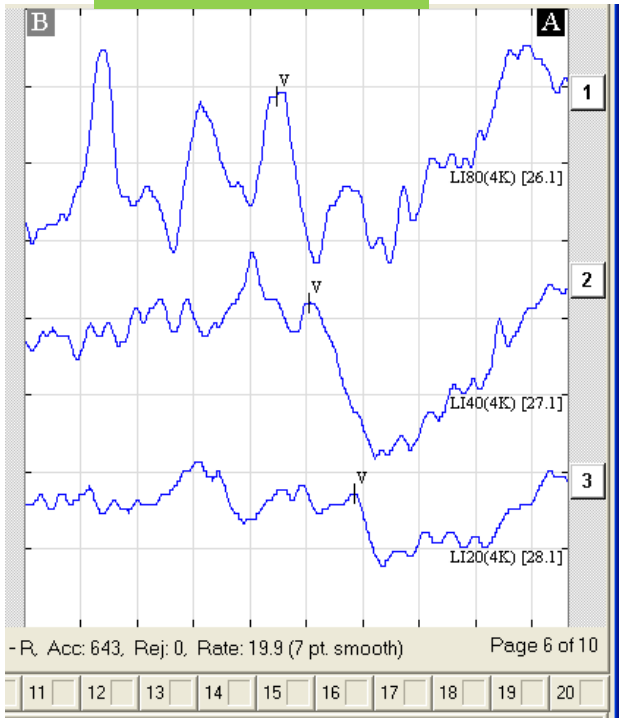
Insert phone



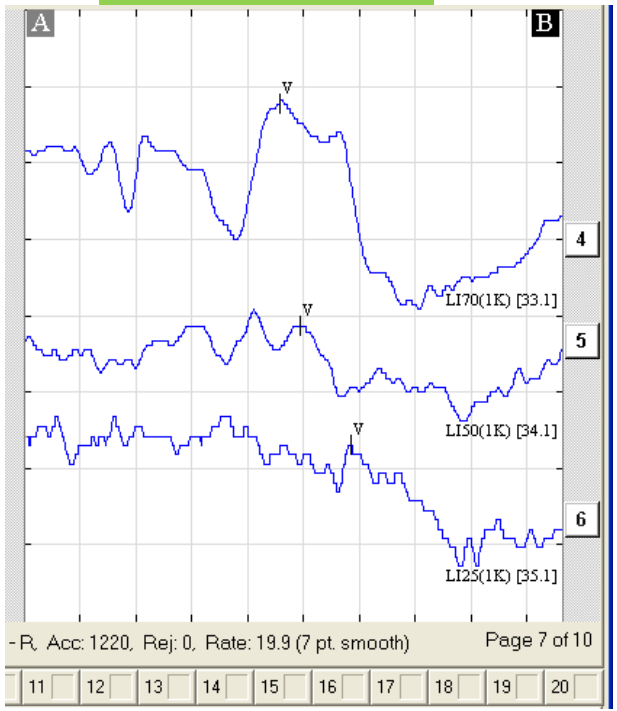


Left ear tone-burst ABR

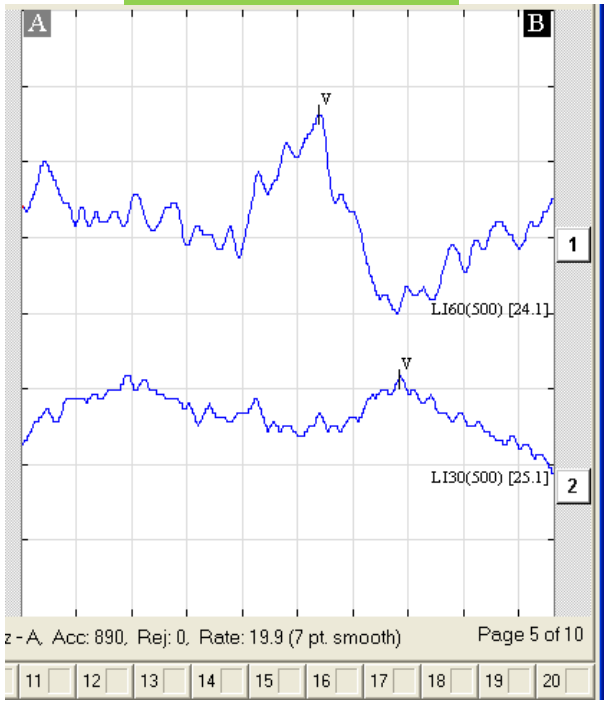
4000 Hz



1000 Hz

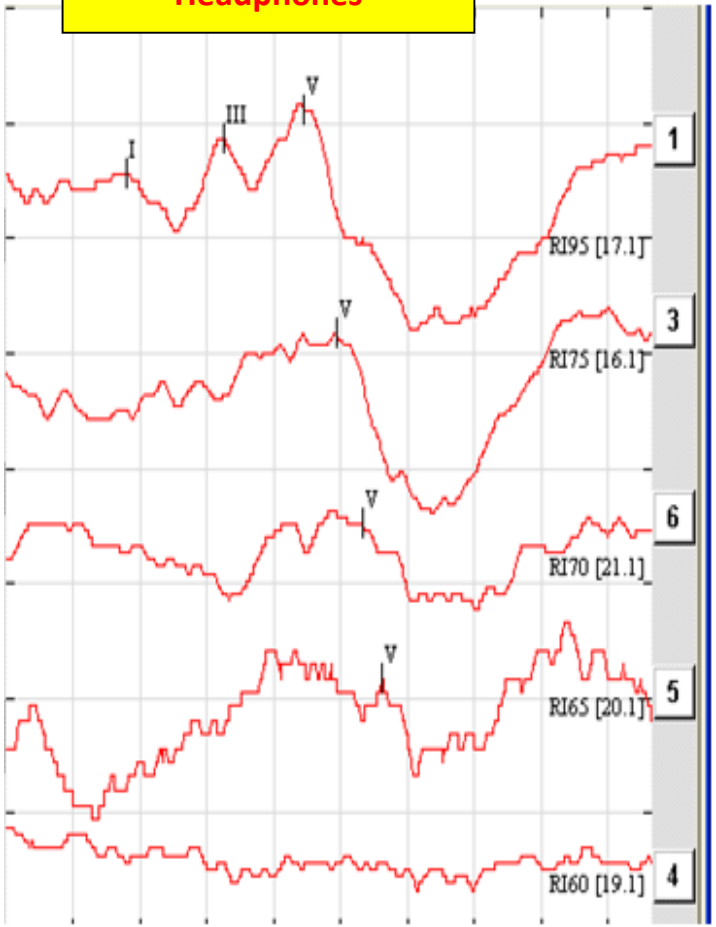


500 Hz

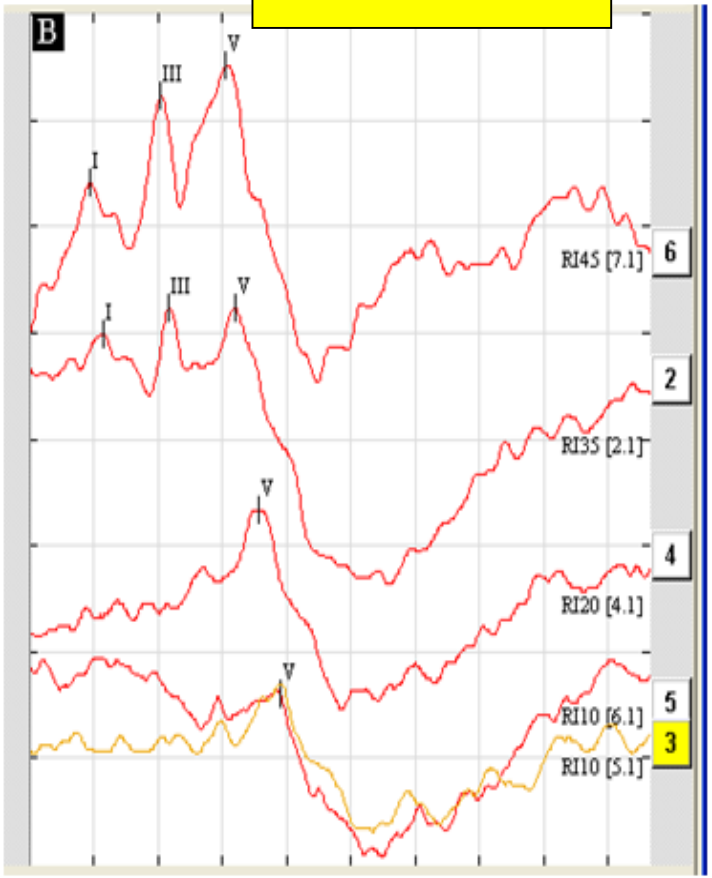


Right: AC-click ABR

Headphones



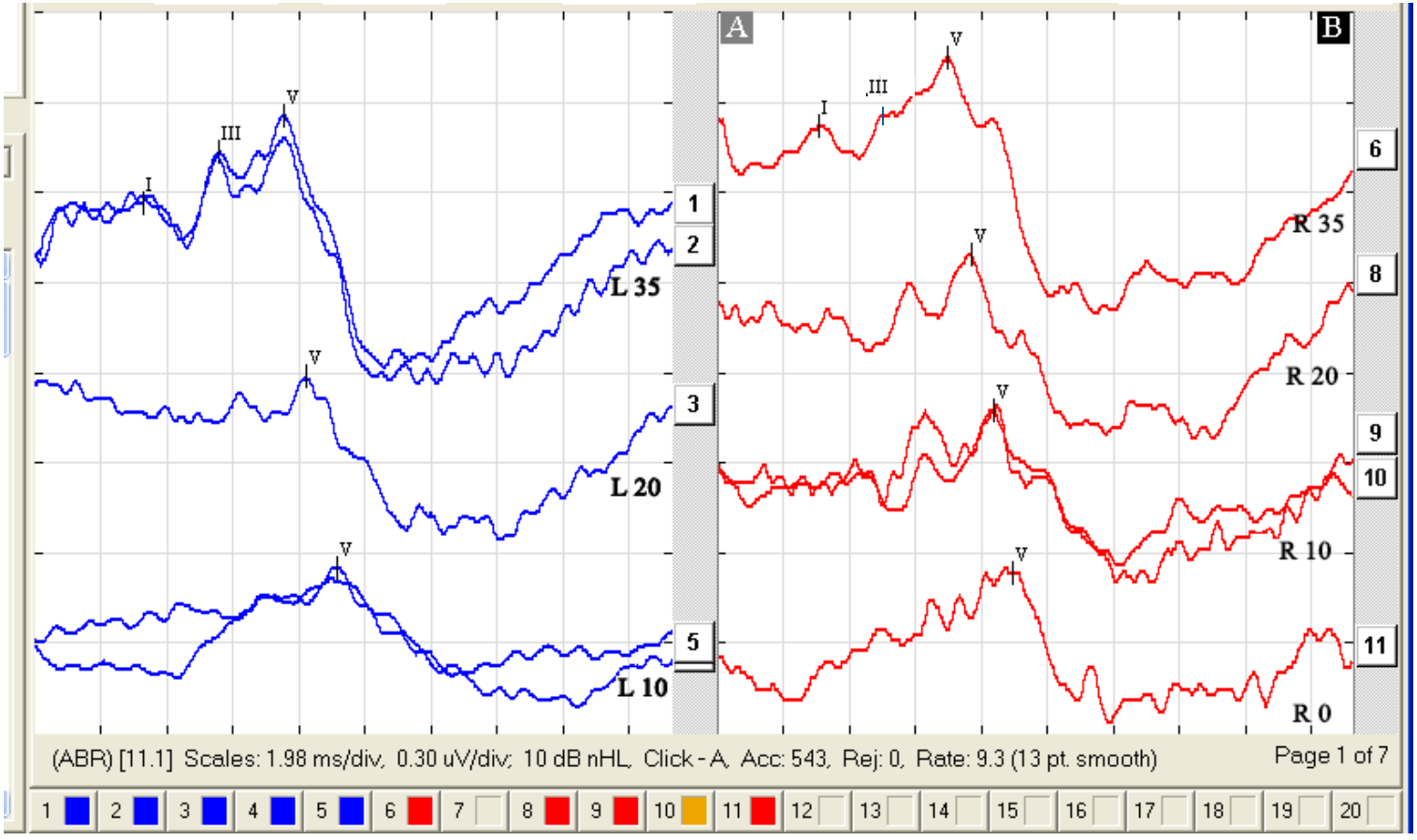
Right: BC-ABR (click)



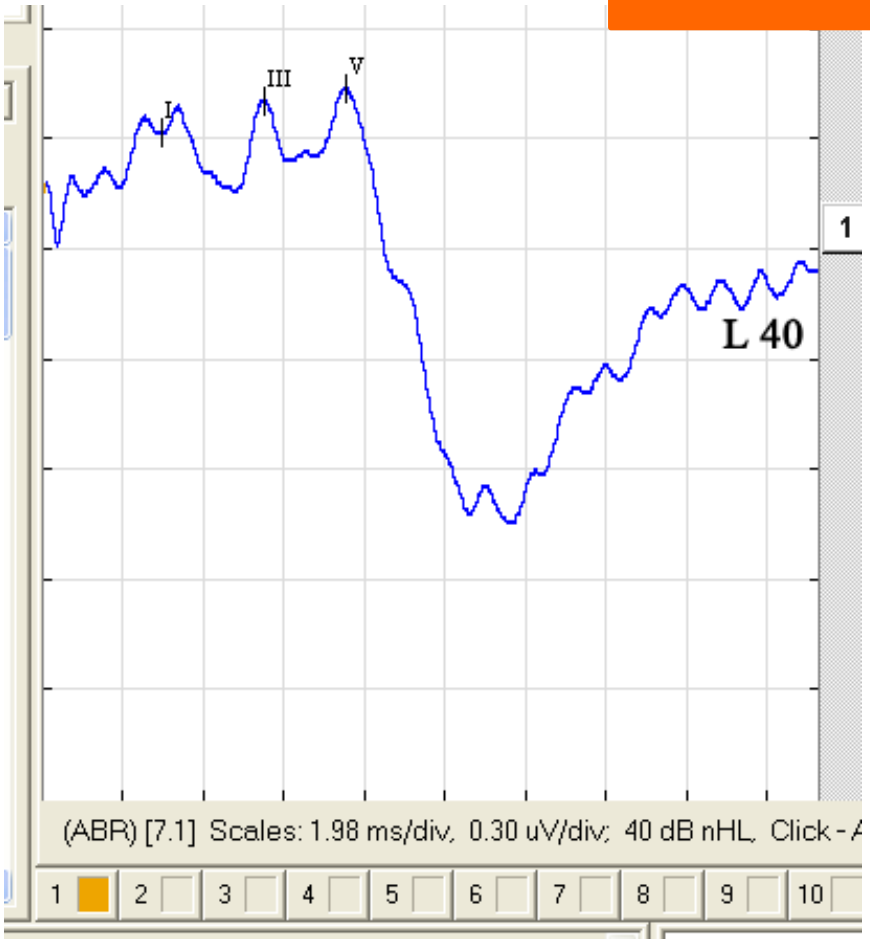
Bilateral aural atresia:

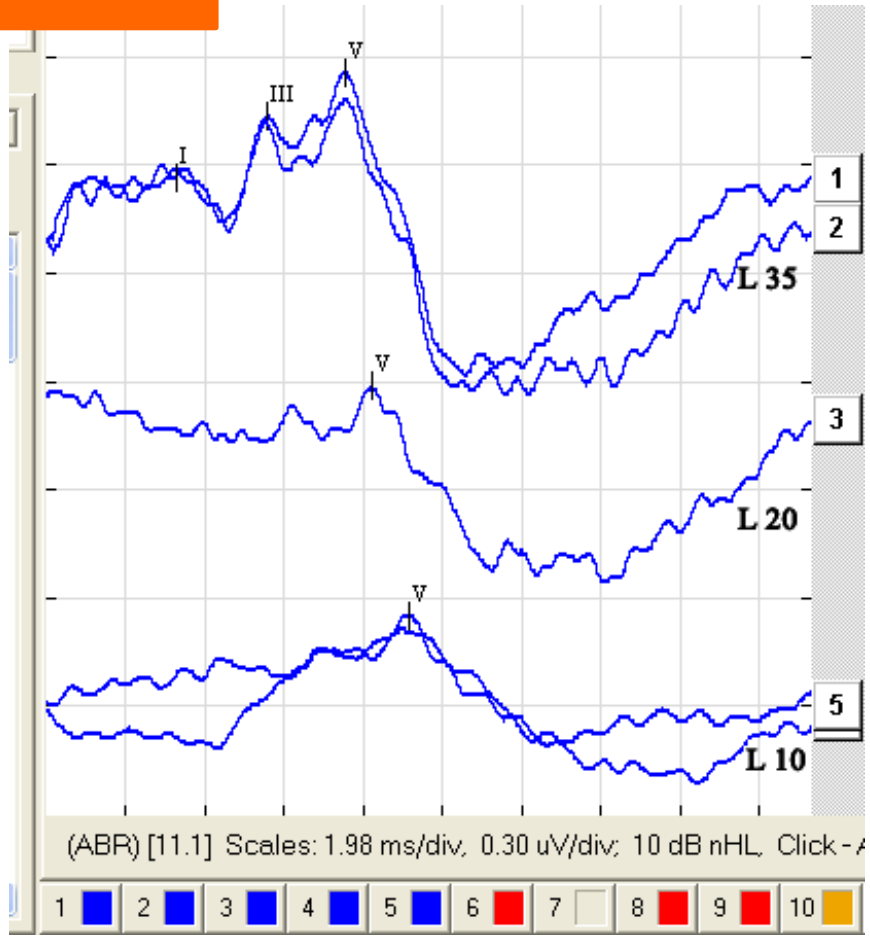
Boy, 5 months old, bilateral atresia

BC-ABR

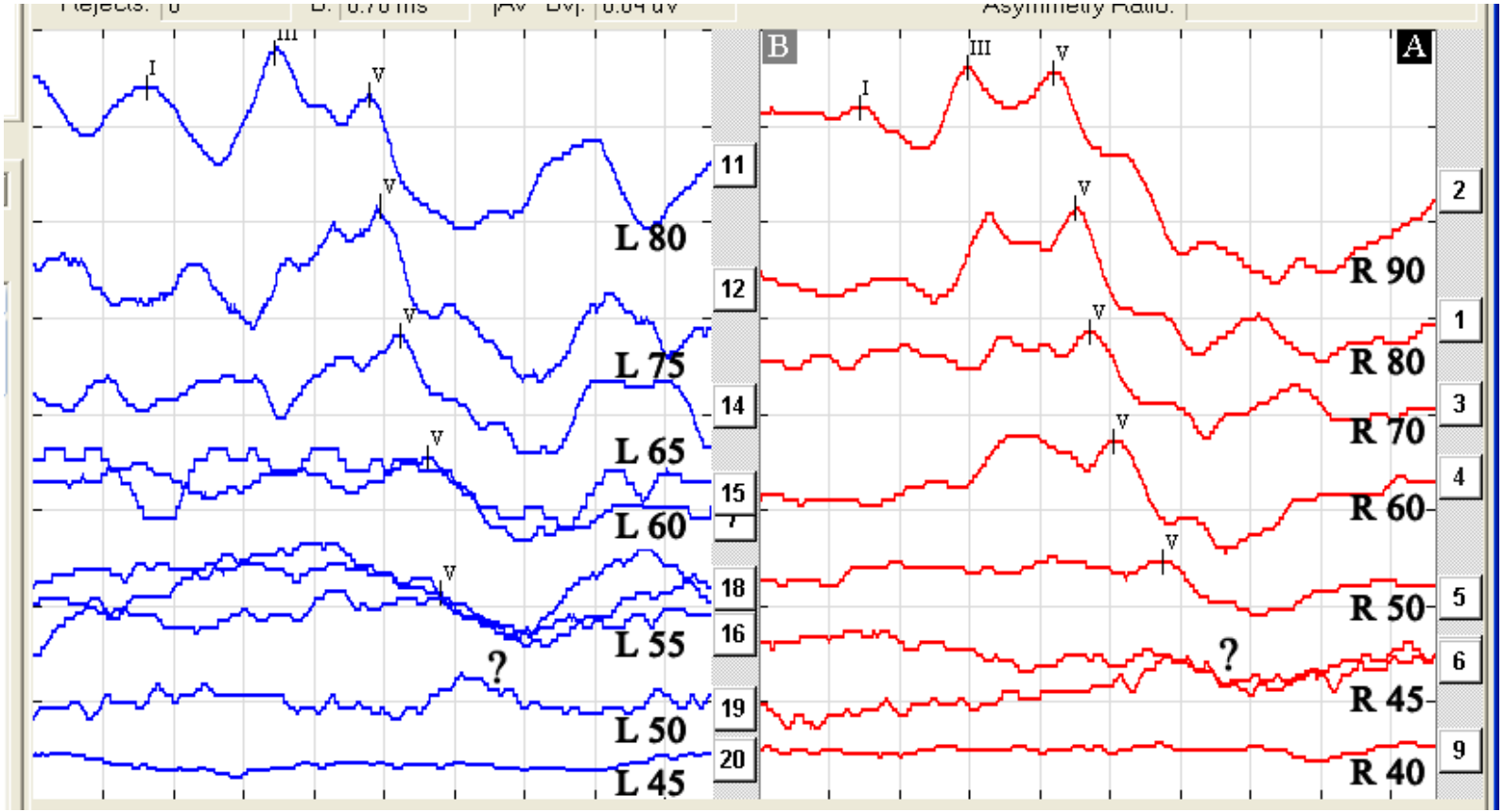

A
B
I
III
V
L 35
L 20
L 10
R 35
R 20
R 10
R 0
1
2
3
5
6
8
9
10
11
(ABR) [11.1] Scales: 1.98 ms/div, 0.30 uV/div; 10 dB nHL, Click - A, Acc: 543, Rej: 0, Rate: 9.3 (13 pt. smooth)
Page 1 of 7
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

BC-ABR

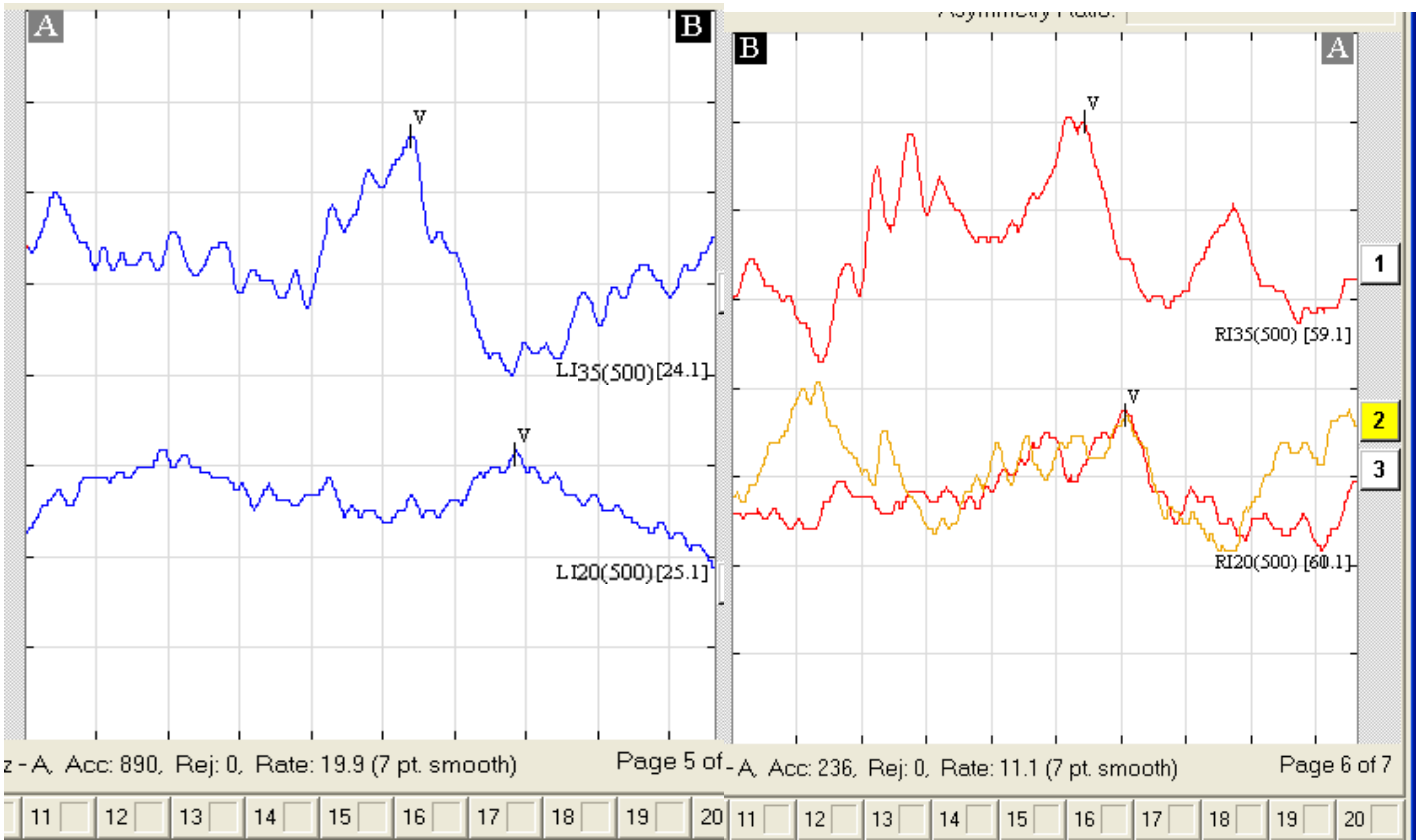

I
III
V
L 40
1
(ABR) [7.1] Scales: 1.98 ms/div, 0.30 uV/div; 40 dB nHL, Click - A
1 2 3 4 5 6 7 8 9 10


I
III
V
L 35
L 20
L 10
1
2
3
5
(ABR) [11.1] Scales: 1.98 ms/div, 0.30 uV/div; 10 dB nHL, Click - A
1 2 3 4 5 6 7 8 9 10

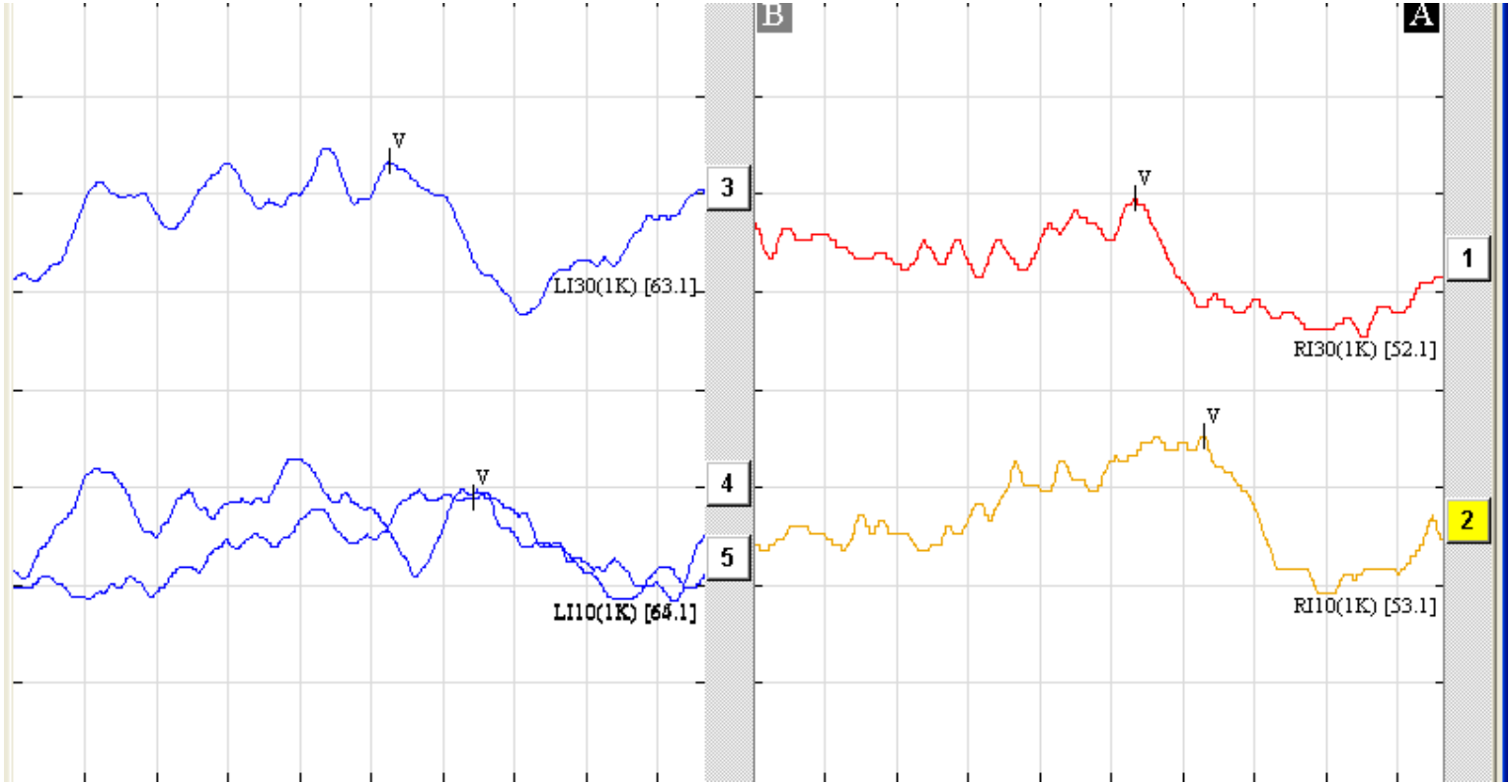
AC-ABR


B
A
I
III
V
L 80
L 75
L 65
L 60
L 55
L 50
L 45
R 90
R 80
R 70
R 60
R 50
R 45
R 40
?
11
12
14
15
18
16
19
20
2
1
3
4
5
6
9

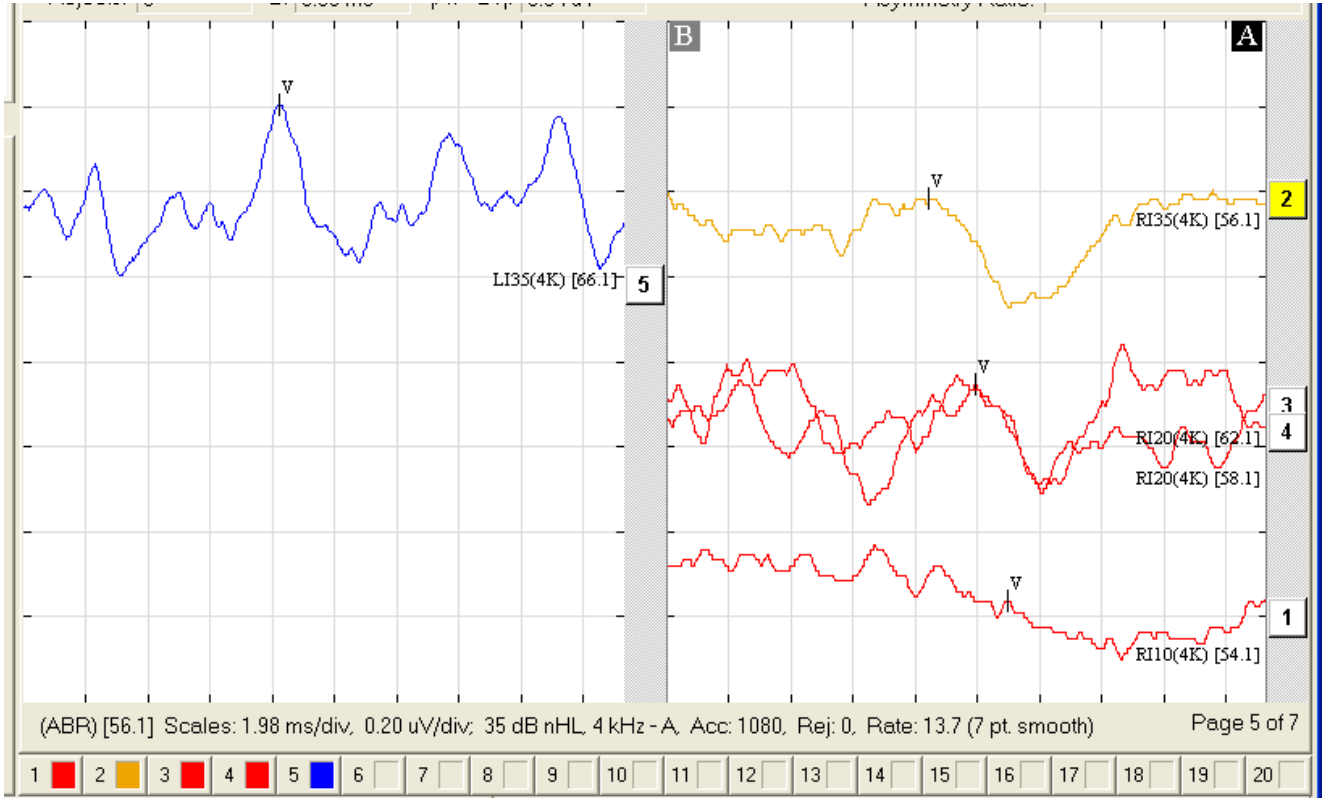
BC-ABR: Tone-burst 500 Hz



BC-ABR: Tone-burst 1000 Hz



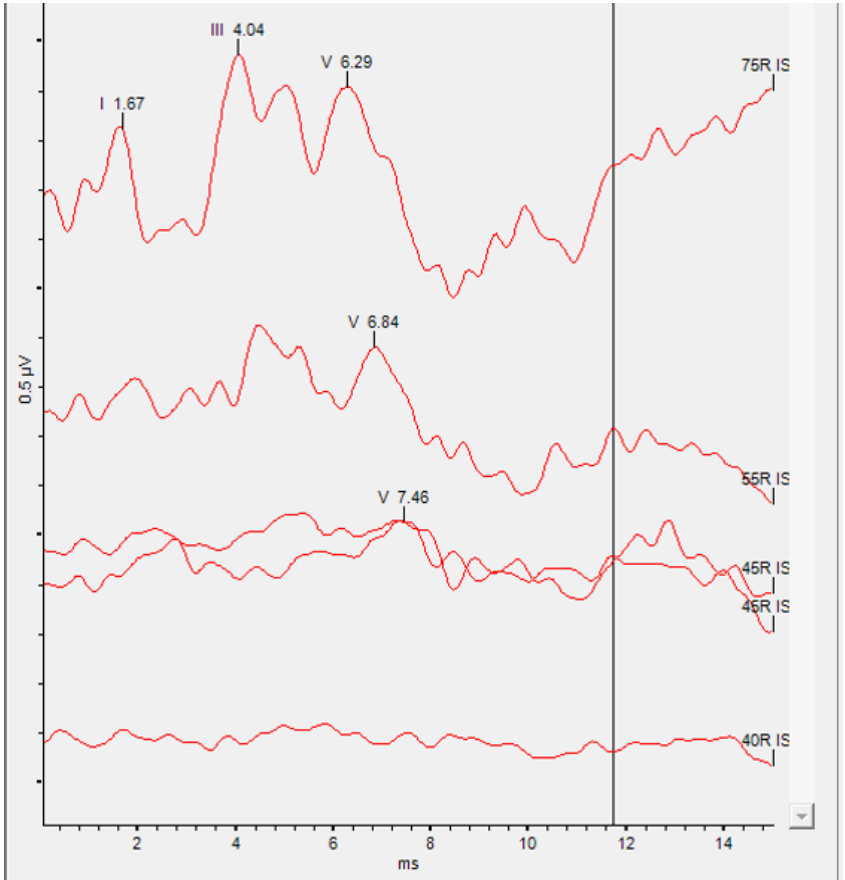
BC-ABR: Tone-burst 4000 Hz

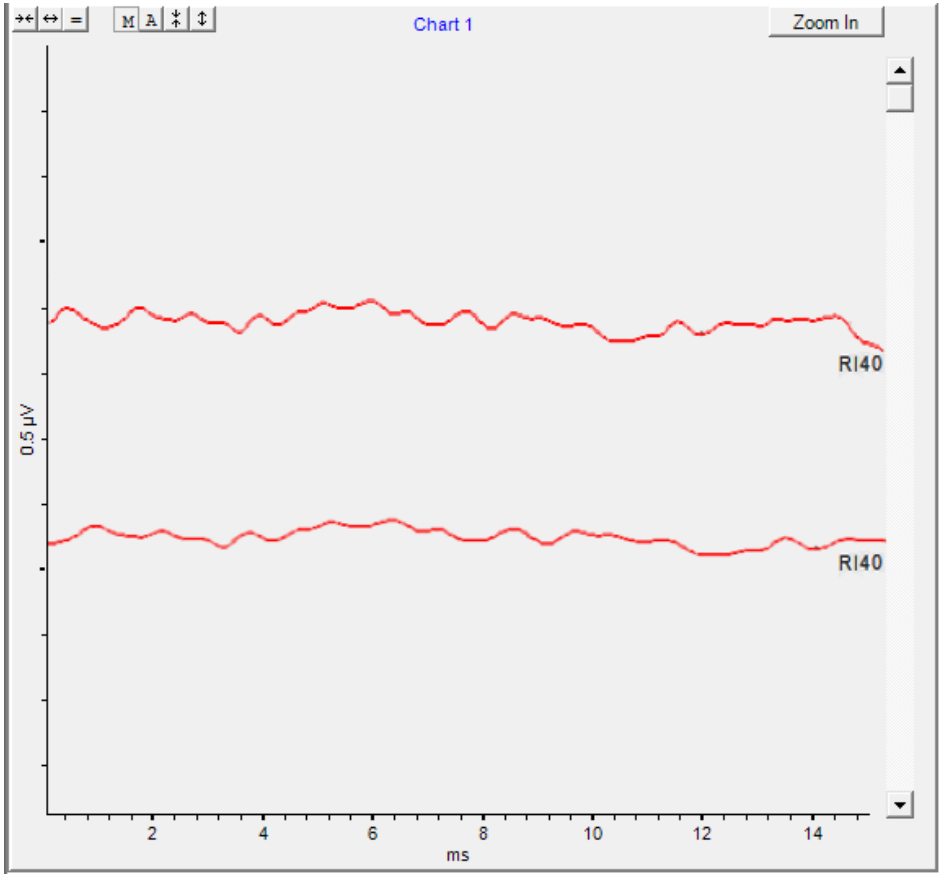


AC-ABR

SNHL

BC-ABR





Questions?