

## What are ABRs?

Auditory Brainstem Responses are potential differences generated when a person's ear is stimulated with any kind of sound, stimulus that may be provided via air conduction or bone conduction. The potential difference originates in the VIII cranial nerve and the auditory brainstem system; these potential differences can be evoked using controlled stimulation, allowing acquisition of these differences by averaging the acquired signal over a specified period of time. The ABR response is commonly found between one and fifteen milliseconds from the time of stimulation.

The recordings acquired will contain certain peaks and valleys. A standard ABR recording will contain seven peaks, some more identifiable than others, peak five being the most prominent. The amplitudes, latencies and relationship of those peaks and valleys can be used to diagnose certain pathological conditions. ABR responses are most commonly acquired using surface electrodes.

## Why use Bone Conduction?

Patients with certain auditory conditions, particularly those affecting the external and middle ear, may be difficult to test using standard air conduction stimulation. To bypass problems with external and middle ear, such as ear canal occlusion in newborns, it is necessary to use bone conduction. Vibration applied to the mastoid can deliver equivalent stimulation to that of the insert earphones. However, bone conduction is limited in the range of test frequencies and intensities that can be applied.

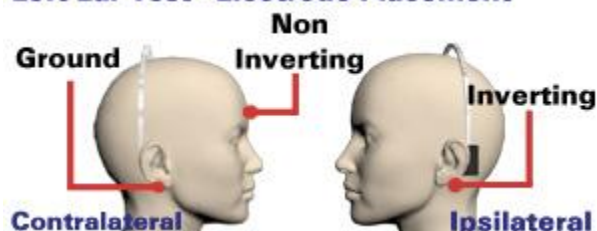
Bone Conduction testing can help determine the amount and type of hearing loss at specific frequencies, (i.e. hearing threshold), and the presence of any air-bone gap. ABR Bone Conduction testing can provide information about existing conductive hearing problems in the ear canal or middle ear.

## Patient Preparation

The patient must be placed in a comfortable and quiet environment, preferably a sound booth where the patient lies down on a comfortable bed. It is recommended to have the patient relax or sleep to reduce the amount of artifact. Electrodes and Bone Conductor may be placed in the following configuration:

- Inverting (-) : Ipsilateral (Testing) Mastoid
- Non-Inverting (+) : High Forehead
- Ground: Contralateral Mastoid
- Bone Vibrator: Ipsilateral Mastoid

### Left Ear Test - Electrode Placement



When testing both ears, in a dual channel system, place the corresponding inverting electrodes on the mastoids, place the ground electrode on the lower forehead and place the two non-inverting leads, using a Y-adaptor, above the ground electrode on the high forehead. Consult the SmartEP manual for additional electrode placement details. The Bone Vibrator unit must be switched from the left to the right mastoid when testing the right ear. An offset masking, of usually 40dB above stimulation level, may also be provided using insert earphones.

## Electrode Usage

Surface electrodes are sufficient for acquiring ABR recordings. Clean and prepare electrode pacing sites in order to reduce the impedance and acquire a clearer recording. You must use pediatric electrodes with infants.

# Bone Conduction using SmartEP

## Setting up SmartEP

Complete the following steps to set up SmartEP for bone conduction acquisition:

- On the main menu, select **Stimulus > Modality > Auditory > ABR**.
- Click on the **EEG and Amplifier** button in the control panel and set the filters, notch filter, artifact rejection ratio and region and desired amplification for each channel, as necessary.
- Click on the **Stim** button in the control panel and select the appropriate stimulus to be applied. Keep the window open.
- Turn ON and set the desired masking level, if necessary, usually 40dB above stimulus.
- Select **Bone Vibrator** from the stimulator options and click **OK** to close the dialog box. You may save your settings for future use with the **Save** button on the Control Panel.

Carefully select your filter settings in the EEG and Amplifier dialog box. Lack of filtering may result in excessive artifact, excessive filtering may result in waveforms that are too smooth to assess correctly. EEG and Amplifier settings may need to be adjusted more than once.

## Recommended Settings

It is recommended to run this test two to four times, using the following settings:

<b>Stimulus</b>	0.1 milliseconds Click
<b>Rate</b>	7.1/sec used to enhance wave I and assure ear-specific response
<b>Polarity</b>	Alternating
<b>Transducers</b>	Bone Vibrator
<b>Intensity</b>	Max. is 60 dB HL. Please note: Air conduction and Bone conduction latencies should be similar using default calibration values, assuming proper conduction between the bone vibrator and the bone through the skin.
<b>Masking</b>	Always. Masking Level should equal the Intensity Level + 40dB since the effective masking is SPL – 39 dB. If using the Following option the offset should be 40 dB.
<b>Filters</b>	30 – 3000 Hz

**Notch Filter:** OFF. ON, only if there is electrical line noise present.

**Amplification** 100x

**Analysis Time Window** 12.8 milliseconds

**Sweeps** 1024 or 2048

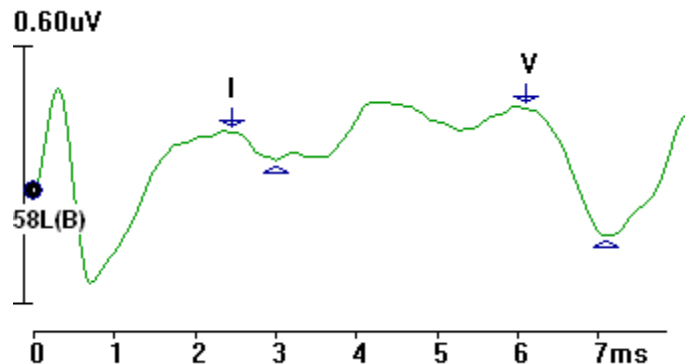
**Electrode Montage** Ipsilateral or Contralateral Array

## Marking Peaks

To accurately diagnose a condition, you must first place the applicable labels on the recently acquired recording. Peaks I to VII may be marked when recognizable follow these steps for each of the labels:

- Right click at the point of the recording where the label is to be placed.
- Select the peak to be marked (I – VII).
- Once placed, drag the top marker of the labels to the top of the peak.
- Drag the bottom marker to the valley following the peak.

The graph shows suggested label placing for an acquired ABR.



## Analysis

Select Print Pages or Print Page from the SmartEP main Menu to print a report of the currently displayed signals. See the SmartEP manual for other report generation options.

Since label placement is subjective, all results must be evaluated by an audiologist or medical professional trained in ABR techniques.