Protocol of Aided Cortical Auditory Evoked Potentials testing

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1. Equipment required

- HearLab
- Cotton buds
- Clean wipes
- Disposable electrodes
- Elastic bandage/headband
- Nu-prep abrasive gel
- Conductive EEG paste
- Quiet Toys, books and DVD to entertain the child during testing
- Tissue
- Comfortable chair covered with towel

2. Procedure

2.1 Start Up

- Switch on the power of HEARLab equipment
- Ensure connections on the Stimulus Controller are correct.
- Double click the ACA icon on desktop
2.2 Free-Field Calibration

(1) Ensure that the control microphone is located at the subject position.

(2) To open the “Free Field Calibration Wizard”, press keyboard shortcuts Shift+Ctrl+Alt+K and click the “Free Field” button.

(3) Follow the on-screen steps to complete free-field calibration

Step 1: loudspeaker position
Step 2: Distance of Loudspeaker

Step 3: Automatic calibration method

Step 4&5: loudspeaker setup

- For automatic free field calibration, a series of warble tones (from 125 Hz to 8 kHz in one-third octaves) will be presented through the loudspeaker. The signal will be recorded and measured by the microphone, and the HearLab system will make automatic level adjustments to achieve a flat frequency response.
- You may pause or abort the calibration process at any time by pressing Pause or Abort button.

Step 6: Calibration
4

(4) View and Save Calibration Results

Click View Results… to view current calibration results in a dialog window which shows the frequency response obtained before and after the calibration.

Click Finish to save the calibration results and exit, or Cancel to discard the calibration results and exit.

Room’s last calibration results for selected loudspeaker position

Click to save last calibration results as an ASCII text file

Click to print last calibration results

Click to return to free field calibration

Click View Results… to view current calibration results in a dialog window which shows the frequency response obtained before and after the calibration.

2.3 Open/Create a Client File

(1) Add a new client

• In the client screen, click the Add New Client icon on the toolbar

• Fill in client details then click “OK” to save new client details to database. Ensure that you fill in the DOB so that the appropriate P1 range for normal hearing listeners will be displayed.
(2) Search for an existing client

- To work with an existing client, you may choose to either:
  - Search the client by their details, OR
  - Find the client by listing all the clients in the database

The selected client record, along with a list of the client’s previous assessment records, will be displayed on the Client Screen.

(3) Edit client’s details

- Once you have selected an existing client, you can click Modify to edit client’s details or Delete to delete the client’s record.
2.4 Conducting the Assessment

(1) Specifying assessment settings

- Open the New Assessment screen by clicking the icon on the main toolbar
- Recommended settings:
  - Click the appropriate box
  - Click OK and a “New Run” dialog window will appear.
  - Select presentation level
  - Select stimuli (maximum of 3, minimum of 1).
Select one stimulus only if the child’s attention span and test time are very restricted. Prioritise stimuli according to frequency regions of interest, viz, /m/ for low frequencies, /g/ for mid frequencies, and /t/, /s/ for high frequencies.

(2) Placement of electrodes

- Prepare the electrode sites before attaching the disposable ECG electrodes (see Appendix 1 for details).
- Positions for the electrodes:
  
<table>
<thead>
<tr>
<th>Electrode</th>
<th>Placement</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>Vertex (Cz)*</td>
<td>Yellow</td>
</tr>
<tr>
<td>Reference</td>
<td>Mastoid (M1)</td>
<td>Blue</td>
</tr>
<tr>
<td>Ground</td>
<td>Forehead (Fz)</td>
<td>Black</td>
</tr>
</tbody>
</table>

- Ensure the cords are plugged into the correct sockets with matching colours.

(3) Impedance Check

- A good electrode contact is crucial before acquiring any cortical response. The electrode impedance is checked, and if necessary redo the skin preparation to achieve a recommended impedance under 5 kΩ at the Ref and the Cz electrodes.

- Once the Impedance screen is displayed, impedance measurements will be performed continuously at 1 second interval until you exit the Impedance screen.

* Cz is the midway of two ears and midway of the bridge of nose and the nape of neck. For infants, the placement should be just behind the fontanel.
• Monitor the impedance of the Ref and Cz during assessment by clicking the Impedance Check icon on the Assessment toolbar.

• After the impedance check, click the “Acquisition” icon on the main toolbar to go to the Acquisition screen.

(4) CAEP Acquisition

• Once in the Acquisition screen, acquisition of cortical responses can be started, paused, resumed, or terminated at any time during a run.
• To start a test, click the Start button. A dialog box will appear and you need to type the file name and save the file.

During acquisition, statistical analysis for determining the detection and differentiation of the responses will be performed online.

**Note that many factors may affect test results:**

- Background noise may mask the stimulus and create “noise” in the electrical traces.
- Mobile phone signals may create electrical noise. Switch Mobile Phones Off.
- Other electrical interference e.g. fluorescent lighting
- Some medications such as those used to prevent seizures may affect the EEG.
- High muscle tone or sudden muscle movements such as experienced by some children with cerebral palsy may make the EEG noisy and hence mask the response
- Awake status of the child - responses diminish when the child is drowsy or asleep.
- Impedance of electrode

**You can monitor the number of accepted/rejected Epochs and the residual noise levels by moving the cursor over the Residual Noise Level box.**

<table>
<thead>
<tr>
<th>Epochs Obtained</th>
<th></th>
<th>Accept</th>
<th>Reject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stim</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/m/</td>
<td>23</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>/f/</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>/g/</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- If the number of rejected Epochs is high, pause or stop the test.
- If the impedance is high, remove and replace electrodes or redo preparation.
- If the child is drowsy, revive the child before proceeding with further testing.
Click the Pause button to pause acquisition for the current run e.g. if you need to access the Impedance Screen. You may also access the Result Screen or save the results at this point.

Click the Stop button to manually terminate acquisition for the current run. You may then view or save the results.

Acquisition is automatically terminated once 200 accepted epochs for all selected stimuli have been reached.

A clear response should be: (a) $p$ value is lower than 0.05; (b) Residual noise is green.

After a test is terminated, you may choose to start another test by clicking New Run icon on toolbar or start another assessment by clicking New Assessment.

By clicking New Run, the results will be displayed on the same screen when you view/print the results.

(5) Remove electrodes
- Once all testing is completed, remove and dispose of the electrodes
- Use clean wipes to help remove the conductive paste.

3. Accessing the results

Results of the current assessment can be viewed on the results screen by clicking the “View Results” button.
• Results of the previous assessment can be accessed under the Client Screen. All the saved assessments of the selected client are displayed in the list. Double-click the assessment you wish to view.

• Result Screen:

4. Printing assessment reports

You may choose to look at the print preview of the assessment report before printing it out, or you may print it directly.
5. Database backup

It is important to regularly backup the database to prevent the loss of clinical records in the case of mishap.

- To initiate database backup, go to Tools → Database Administration → Backup Database
A Browse *For Folder* dialog will be displayed:

Select the folder or make a new folder for storing the backup data.
Appendix 1: Electrode Application

Preparation of electrode sites

- Attaching the electrodes is potentially the most challenging part of the test procedure. Approach the preparation confidently but not too forcefully. Smile, and talk to the child reassuringly.

- Try not to physically “stand over” the child while doing skin preparation. Working from behind the child may be a good option.

- Start the preparation in a position where the child is comfortable and not overly restrained. For example, try starting while an older infant is playing on the floor, or while a toddler is watching the DVD.

- Electrode sites are generally prepared by abrading with a cotton bud and a medical gel intended for the purpose e.g. “Nuprep”. Rub firmly and vigorously enough to cause a slight redness on the skin surface, but not so hard that the child becomes obviously distressed by the sensation.

- Wipe away any excess gel before applying the electrodes.

- Wherever possible have a trained distractor (in addition to the parent), to interact with the child during electrode placement, as well as during testing. Toys that involve some fine motor manipulation (e.g. block stacking, button pressing) can help keep hands away from the electrode sites, and at this stage toys that make a noise are suitable.

Optimising and maintaining electrode contact

- Use a pea sized amount of electrode paste (e.g. the conductive EEG paste) under the Vertex (Cz) electrode, even if disposable electrode, that already contains conductive gel, is used. Avoid applying to the adhesive surrounds.

- A headband is very helpful in keeping the electrodes in place, particularly at the vertex, but some children are less accepting of wearing a headband than others. Giving older children a choice of colours or designs can be important to the child, and sometimes also to the parent. Use fabrics that are easy to wash and dry after use.

- Once the electrodes are attached, try to drape the leads behind the child, avoiding contact with the child’s face or neck. Try to keep the leads from becoming tangled in bibs or collars.

- Loosely taping the leads to the back of the child’s clothing (using micropore tape or hair clip) may be helpful. Make sure the leads are not taped too tightly that they are pulled off by any head movement.