Investigation into HEARlab N1-P2 Evoked Response

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Abstract

The N1-P2 auditory evoked potentials have been used to estimate threshold in adults and children. The HEARlab is new instrumentation that potentially allows the gathering of late potential responses for various kinds of auditory screening. This study was initiated to compare amplitude and latency measures of the N1-P2 response for the HEARlab and Neuroscan evoked potential equipment in normal hearing listeners. Many similarities were noted in waveform characteristics however differences in latency measures were noted between the two instruments. It has been suggested that different averagers yield different responses (Segalowicz, P.C., 2011), especially in sequential recording conditions of late potentials, and therefore these results should be interpreted in this context.

Introduction

- Auditory Late Responses (ALRs) have been used successfully to estimate hearing thresholds in adult populations and children
- Previous research by Golding, Dillon, Seymour and Carter (2009) indicated that the use of automated statistic detection was able to differentiate a CAEP from random noise as well as an experienced examiner and, likely, more accurately than an inexperienced examiner
- The present study compared the Neuroscan evoked potential system to the HEARlab Cortical Evoked Potential Analyzer, a new device designed to be used clinically. Since the HEARlab is a relatively new device, a study to compare N1-P2 responses with an established EP system seemed timely and appropriate

Materials

Participants

- 18 adults with:
  - normal peripheral hearing bilaterally for the octave frequencies 250 Hz through 8 kHz
  - no history of neurological or otological problems, central auditory processing disorders or learning disability
  - Normal Type A tympanograms (Jerger, 1970) bilaterally on the day of testing

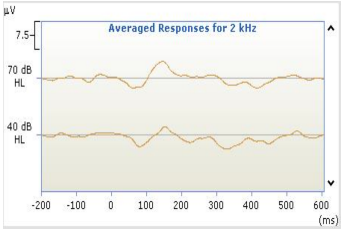
Procedures

- Neuroscan system was set up with the same recording parameters and stimuli as the HEARlab system (i.e. filtering, rep. rate, etc)
- Ear of presentation was randomized across participants
- The stimuli consisted of
  - 200 accepted stimulus presentations each
  - 500 Hz and 2000 Hz tone bursts with a rise/fall time of 10 ms and a plateau of 30 ms with an interstimulus interval of 1125 ms
  - Presentation levels were 40 dB HL and 70 dB HL
- Responses were filtered online at 1 to 30 Hz
- Participants were tested using both evoked potential systems sequentially, recorded from Cz-A1 or A2 channel, and results were compared
- Waveforms were selected and agreed upon by two audiologists experienced in electrophysiology. The HEARlab system's algorithm determined if a waveform was present or absent

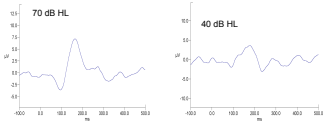
RESULTS

Representative N1-P2 Responses of the Same Participant

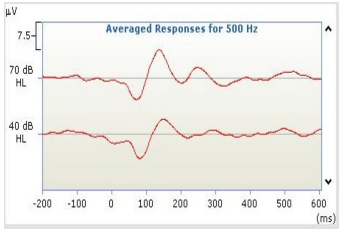
2 kHz Responses from HEARlab System at 70 dB HL and 40 dB HL



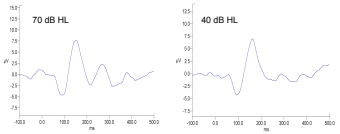
2 kHz Responses from Neuroscan System



500 Hz Responses from HEARlab System at 70 dB HL and 40 dB HL



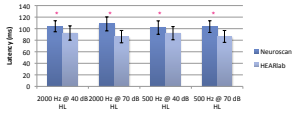
500 Hz Responses from Neuroscan System



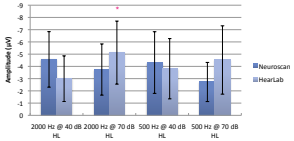
RESULTS

- Many similarities between the systems (i.e. morphology, number of rejections, etc)
- Measured data suggest differences between N1 and P2 latencies, as determined by a paired t-test
- Differences were statistically significant ($p<0.05$) for all conditions for N1 latency and statistically significant for all conditions, except 2000 Hz at 70 dB HL for P2 latency ($p=0.062$)
- Statistically significant differences were noted for the 2000 Hz at 70 dB HL condition for both N1 and P2 amplitude.
- Repeated Measures ANOVA revealed an effect of intensity and averager type for N1 and P2 amplitude and N1 and P2 latency
- There is also an interaction of frequency and intensity for N1 amplitude, which suggests that increase in amplitude as intensity increases is larger for 2000 Hz than for 500 Hz

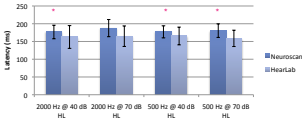
Comparison of N1 Latency between HEARlab and Neuroscan Evoked Potential Systems



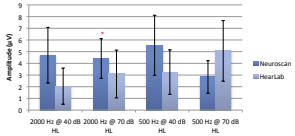
Comparison of N1 Amplitude between HEARlab and Neuroscan Evoked Potential Systems



Comparison of P2 Latency between HEARlab and Neuroscan Evoked Potential Systems



Comparison of P2 Amplitude between HEARlab and Neuroscan Evoked Potential Systems



DISCUSSION/CONCLUSIONS

- Responses obtained from the Neuroscan system tended to have longer latencies across all conditions than responses obtained from the HEARlab system
- P2 amplitude tended to be larger for the HEARlab system but N1 amplitude tended to be larger for the Neuroscan system
- Morphology was similar between systems
- The HEARlab system interface is easy to use and adaptable to many testing conditions with the ability to change transducer and certain stimulus parameters
- It has been suggested when comparing sequential recordings of late potentials across systems (Segalowicz, P.C., 2011) that it is common for different averagers to yield different results and therefore this should be interpreted in this context
- Outcomes for this research may have been different if recordings were simultaneous rather than sequential
- Findings may not have strong implications for results obtained with the same instrument but this becomes a factor when comparing results between different instruments

References and Acknowledgements

1. Golding, M., Dillon, H., Seymour, J., & Carter, L. (2009). The detection of adult cortical auditory evoked potentials (CAEPs) using an automated statistic and visual detection. International Journal Of Audiology, 48(12), 833-842.
2. Jerger, J. (1970). Clinical experience with impedance audiometry. *Archives of Otolaryngology, 92(4), 311-324.*
3. Segalowicz (2011) Personal Communication

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