Introduction:

- The Workers’ Compensation Board Audiology Unit successfully uses Slow Cortical Potentials (SCP) to accurately estimate hearing thresholds in compensation cases. SCPs are transient responses, and estimate hearing threshold in one frequency/one ear at a time.
- Auditory Steady-State Responses (ASSRs) are responses elicited by amplitude-modulated (AM) and/or frequency-modulated (FM) stimuli presented at a high enough rate to cause persistence of the transient response to successive stimuli.
- Multiple-ASSRs use multiple stimuli, which are at least one octave apart in frequency, modulated at different rates and then combined to form one stimulus for each ear. Multiple-ASSRs typically test four carrier frequencies (e.g., 500, 1000, 2000 and 4000 Hz) simultaneously, and are a promising technique for threshold estimation (e.g., Hardman & Stapells, 2003; John & Picton, 2000).
- Most research on multiple-ASSRs has focused on future use for threshold estimation in infants, and has thus used modulation rates of 70-110 Hz. However, for threshold estimation in adults, a modulation rate of around 40 Hz is likely more appropriate (Picton et al., 2003).
- There has been no study comparing 80-Hz and 40-Hz multiple-ASSRs for threshold estimation in adults.

Method:

- Two groups of patients were recruited. Subjects with sensorineural hearing losses (23 subjects per group; 20 with SNHL, 3 with normal hearing).
- Each subject had multiple-ASSR thresholds measured at 500, 1000, 2000 and 4000 Hz in one ear.
- The 40-Hz group had thresholds estimated using 80-Hz multiple-ASSRs for threshold estimation.
- There was no study comparing 80-Hz and 40-Hz multiple-ASSRs for threshold estimation.
- There has been no study comparing SCPs and multiple-ASSRs for threshold estimation.

Results:

- All three tests provided reasonable accuracy for predicting the behavioural audiogram. For the multiple-ASSR conditions, threshold estimation was most accurate at 4000 Hz.
- Comparison of all three tests indicated that 40-Hz multiple-ASSR is better (lower differences scores) for threshold estimation than the 80-Hz multiple-ASSR at the SCP (p<.001). This was the case for 500, 1000 and 2000 Hz.
- There was no difference for threshold estimation between the 80-Hz multiple-ASSR and SCP (p=.320).
- The estimated times to obtain thresholds for four frequencies for one ear was significantly faster for the SCP compared to the 80-Hz and the 40-Hz multiple-ASSR (p<.02).
- The 40-Hz multiple-ASSR was significantly faster than the 80-Hz multiple-ASSR (p=.006). This was the case for 500, 1000 and 2000 Hz.
- SCP thresholds were significantly faster for the SCP compared to the 40-Hz or the 80-Hz multiple-ASSR (p<.02).
- The estimated time to obtain thresholds for four frequencies for one ear was significantly faster for the SCP compared to the 40-Hz multiple-ASSR and SCP (p=.65).
- SCP thresholds were significantly faster for the SCP compared to the 40-Hz or the 80-Hz multiple-ASSR (p=.65).
- SCP thresholds were significantly faster for the SCP compared to the 40-Hz or the 80-Hz multiple-ASSR (p=.65).

Table 1 presents the mean and standard deviations and median estimated times to obtain thresholds for four frequencies (one ear) for each AEP technique.

Conclusions:

- Although difference scores were best for the 40-Hz multiple-ASSR, correlation coefficients for SCP and 40-Hz multiple-ASSR were similar. The SCP results, which are consistent, indicate greater accuracy for threshold estimation at 500, 1000 and 2000 Hz.
- However, if four frequencies are required for both ears, the 40-Hz multiple-ASSR may be the optimal technique.
- Under optimal circumstances, the SCP is an accurate and timely means for threshold estimation in adults, as we have shown at the WCB Audiology Unit (where clinical protocols for the SCP are well established and clinicians are well trained and experienced). However, when one considers the objectivity of response determination of the ASSR, the difficulty in obtaining training and experience with SCP testing, and the potential need for more than three frequencies for each ear, the 40-Hz multiple-ASSR is likely the method of choice for threshold estimation in adults.

Acknowledgements:

This research was supported by a grant from the Canadian Institutes for Health Research (Picton, Stapells, John).

References: