Bone-conducted cVEMPS – NHS applications

Improving Swindon's Vestibular Diagnostic service by introducing cervical vestibular evoked myogenic potentials, using the B-81 transducer

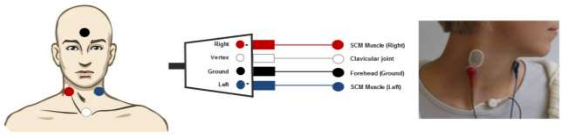
Dawn Wickenden (dawn.wickenden@nhs.net)

Aston University BIRMINGHAM UK

Great Western Hospitals NHS Foundation Trust

1. Introduction

- cVEMPs are a balance test measuring a reflex in the neck to loud air-conducted (AC) sounds; unreliable if anatomy/pathology inhibits sound transmission



- Bone-conduction (BC) has been used in research with promising results but mixed quality of reporting, high dependence on transducer used
- No recommended protocol so not used in NHS clinics; aim of this project is to determine whether we have enough information about optimal setup to introduce it

Objectives

- ➢ Explore existing literature relevant to BC cVEMP setup, focused on equipment available in NHS, & identify gaps
- ➢ Assess whether existing data from GWHNFT fills any of these knowledge gaps

2. Methods

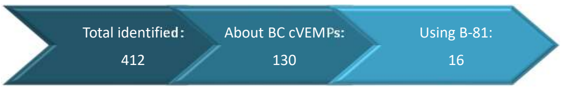
Scoping Review

- Searches conducted through PubMed & Scopus looking to identify setup characteristics, across transducers but focusing on what we have (RadioEar B-81)
- ["bone conduct*" OR BC] AND ["vestibular evoked" OR VEMP] in title / abstract

Data Analysis

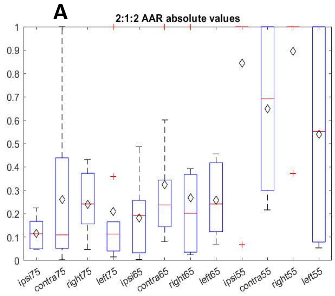
- Pilot data set provided by GWHNFT: 10 participants, BC cVEMPs recorded from both ears at **3 different intensities (75, 65, 55 dBnHL)**, using **2 variants of stimulus duration (0 or 2 ms 'rise'/'fall' , both with 1ms 'plateau')**, **ipsilateral & contralateral stimulation**
- Descriptive statistical analysis & data visualisation performed through Matlab software

3. Literature Review Summary



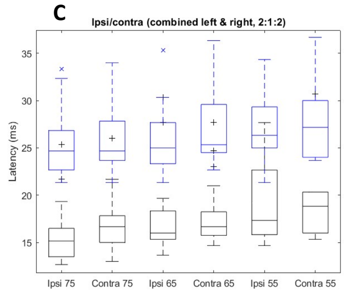
- Stimulus parameters consistently used/justified: frequency, type (tone burst)
- Parameters varied, not agreed or not mentioned: stimulus duration, intensities tested, polarity (initial direction of vibration)
- Location of transducer relative to test ear (ipsilateral) sometimes stated, but <u>no evidence for choice</u>
- Only 3 of 12 B-81 studies include enough information for experiments to be reproducible [1, 2, 3]

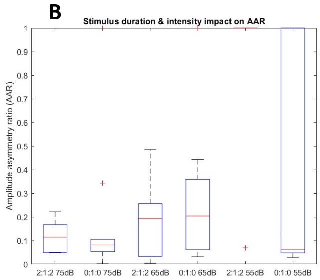
4. Pilot Data Results



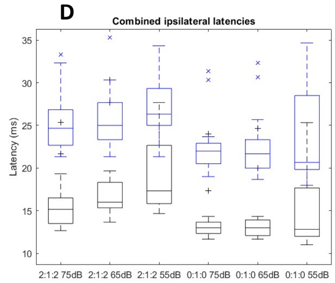
Amplitude asymmetry ratio between left & right:

$$\mathrm{AAR} = \frac{A_1 - A_2}{A_1 + A_2}$$





Maximum 'normal' AAR: 0.33
i.e. $A_1 = 2A_2$



5. Analysis & Discussion

- Asymmetry is minimised (best) when transducer always on the test ear BUT still valid in a lot of cases if you don't move the headband between measurements (**A**)
- Median contra latencies consistently higher than ipsi (**C**)
- Stimulus duration has some impact on asymmetry (**B**) and individual response latency (**D**) at all 3 intensities, HOWEVER the true energy transmitted will be lower than predicted by dBnHL values for stimuli this brief
- Median latencies increase with decreasing intensity for 2:1:2, but 0:1:0 latencies are stable across intensities

➢ **Could this be because intended intensity is not reached, as stimulus duration is too short?**

6. Next steps before implementation?

- ✓ Measure dBSPL – dBnHL correction factors for range of stimulus durations
- ✓ Repeat data collection with equivalent dBSPL intensities rather than predicted dBnHL – isolate relationship between stimulus duration and cVEMP response
- ✓ Bigger normative data set to determine normal latency range, AAR, potential confounding factors (e.g. age)
- ✓ Data collection on symptomatic cases e.g. conductive hearing loss, balance disorders

6. References

[1] Håkansson, B., Jansson, K. J. F., Tengstrand, T., Johannsen, L., Eeg-Olofsson, M., Rigato, C., Dahlstrom, E. & Reinfeldt, S. (2018), 'Vemp using a new low-frequency bone conduction transducer', Med Devices (Auckl) 11, 301–312.

[2] Fröhlich, L., Wilke, M., Plontke, S. K. & Rahne, T. (2021), 'Influence of bone conduction transducer type and placement on ocular and cervical vestibular evoked myogenic potentials', Sci Rep 11(1), 8500.

[3] Fröhlich, L., Wilke, M., Plontke, S. & Rahne, T. (2022), 'Bone conducted vibration is an effective stimulus for otolith testing in cochlear implant patients', Journal of Vestibular Research 32, 355–365.