The Effect of Stimulus Position and Electrode Positioning on the Ocular Vestibular Evoked Myogenic Potential (oVEMP) Using Bone Conducted Vibration (BCV)

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Introduction

The **oVemp** is emerging as an additional test of otolith function. Current evidence suggests it is a response to sound and vibration produced by otolith afferents carried in the contralateral superior vestibular nerve and probably originating mainly in the utricle (Rosengren and Kingma, 2013). It is important, in the early stages of development to explore different aspects of the recording parameters to optimise the response obtained for clinical use. Sandhu et al. (2013) during their systematic investigation on the effect of electrode placement using air conducted sound, found variation in the response depending on electrode location. This study aimed to verify similar findings for **bone conducted sounds** and also observe the effect of changing the stimulus location.

Method

Surface EMG electrodes were used to measure the response to 500Hz bone conducted vibration (BCV) from both eyes whilst a subject lay supine on a couch and looked at a calibrated bar to give an upward gaze of 30°.

The response was collected using three electrode configurations with the ground electrode on the sternum:

A. **Medial montage -** active electrode placed between the orbital midline and inner canthus and the reference electrode positioned 2cm below the lower lid in the orbital midline
B. **Standard montage -** electrodes positioned above and below each other in the orbital midline
C. **Belly-tendon montage -** with reference to the inferior oblique muscle. Active electrode placed between the orbital midline and the outer canthus and the reference electrode towards the inner canthus (See Fig 1)

The stimulus (6ms bursts of 500Hz vibration) was delivered by a Bruel and Kjaer 4810 minishaker fitted with a short bolt and terminating in a bakelite cap. 50 stimuli were delivered at a rate of 11/sec. The stimuli were presented at either Fz (junction of the midline and the hairline) or mid chin (Fig 2.1 and 2.2 respectively).
10 otologically normal participants aged 19-55 years (mean=33) were tested (4 males:6 females).

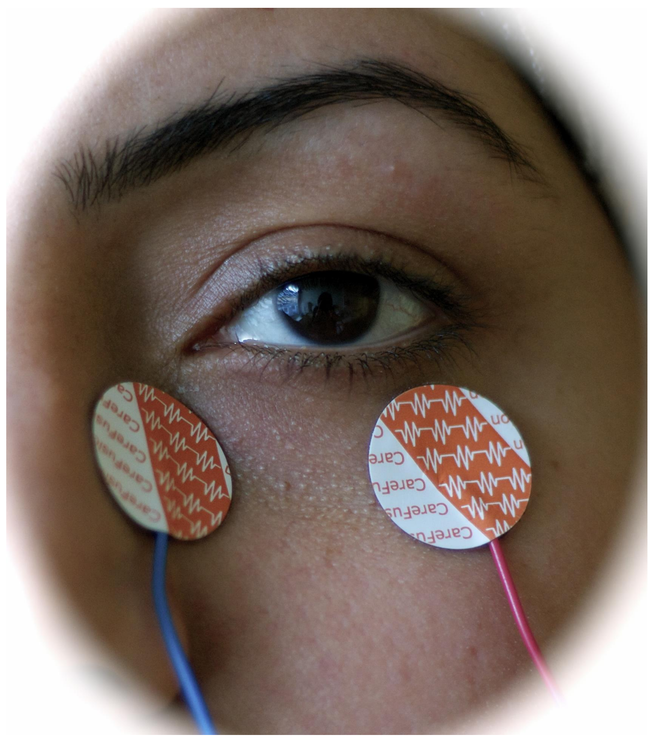


Fig1 Belly-tendon montage

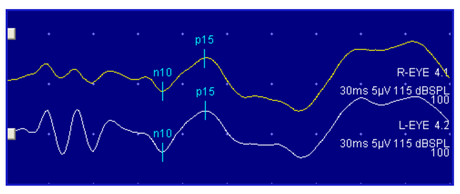
Results cont.

Recordable oVemp responses were obtained to BCV for all participants using the standard montage. Mean peak to peak amplitude for n10 – p15 = **4.99** µv(sd+/-3.76). The belly-tendon montage showed a **significantly larger amplitude** ($p<0.05$) of response compared to the standard montage, mean peak to peak amplitude for n10 – p15 = **7.91**µv (sd+/-5.13). There was no significant difference in n10 or p15 latency between these two electrode configurations, $p>0.05$.

Fig 3 shows typical oVemp responses for the 3 electrode configurations tested

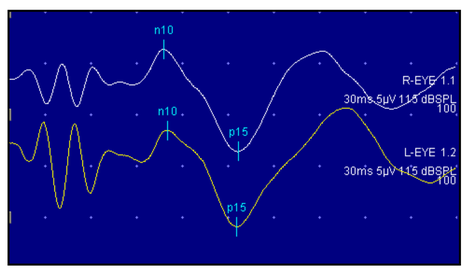
A

Medial montage



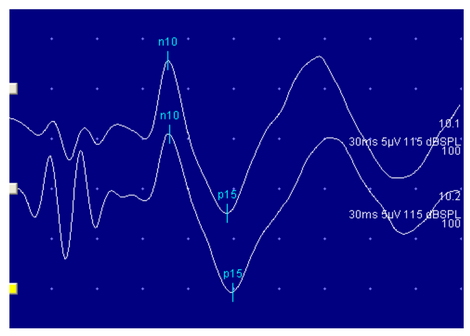
B

Standard montage



C

Belly–tendon montage



Medial placement of the active electrode gave variable responses significantly different from the standard montage with inversion of the response, as seen in Fig 3 A above, or an indeterminate response marked as a no response which Sandhu et al. (2013) refer to as the null point where no response is detected.

Results

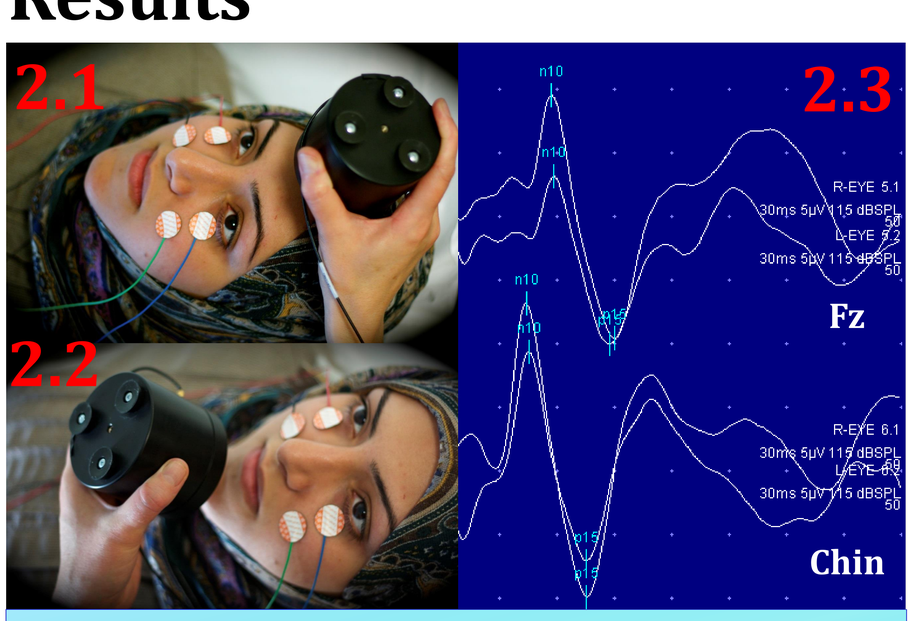


Fig 2 shows oVemp recording using standard electrode montage with stimulus at Fz (Fig 2.1) or chin (Fig 2.2) and typical waveform (2.3) highlighting the significant **shift in n10 latency** which occurs **with chin stimulation** ($p<o.o5$).

Conclusion

- oVemp response amplitude is sensitive to the position of the active and reference electrodes using bone conducted vibration stimulus
- Medial positioning of the active electrode significantly affects the amplitude and polarity of the response
- oVemp response to BCV is affected by stimulus position. The largest response amplitude occurred with belly-tendon montage and chin stimulation

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References: Rosengren S.M. and Kingma H. 2013. New perspectives on vestibular evoked myogenic potentials. Curr Opin Neurol, 26:74-80
Sandhu J.S., George S.R. & Rea P.A. 2013. The effect of electrode positioning on the ocular vestibular evoked myogenic potential to air-conducted sound. Clin Neurophysiol, 124:1232-1236