

College of Science

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The Secretary
The Oticon Foundation in New Zealand
142 Lambton Quay
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Dear Ms Pullar,

PROGRESS REPORT: Improvement of intraoperative hearing assessment and prevention of inner ear damage in humans

I am pleased to report that we have completed the collection of all follow-up data documenting the changes to hearing and balance following middle ear surgical procedures performed to improve hearing. The number of participants recruited in the project was 110 and we have completed one year of postoperative monitoring for 70 participants. These patients were recruited from those scheduled to undergo middle-ear surgery at Christchurch Hospital or St George's Hospital, Christchurch. The surgeries fell into three categories: i) stapedectomy/stapedotomy; ii) tympanoplasty/myringoplasty; and iii) ossiculoplasty. On these patients, PhD student Melissa Babbage conducted over 500 audiograms (measuring air conduction up to 16 kHz) and 550 oVEMP assessments. The assessments were carried out pre-operatively and repeated post-operatively at approximately 1-2 weeks, 1 month, 3 months, 6 months, and 12 months.

The largest amount of data we have comes from stapedectomy patients. As we conveyed at the recent NZAS conference, we found that although there were clear improvements on average in hearing thresholds from 0.25 to 8 kHz following this category of surgery, there was a decrease in the highest frequency at which a hearing threshold was measurable in around 80% of patients at the time of the first postoperative assessment, and in over half of patients at the 12 month follow-up. This data has confirmed that the measurement of extended high frequency thresholds pre- and postoperatively is a more sensitive indicator of operative harm than the conventional lower frequencies. In the past year we have also conducted extensive psychophysical experiments to examine the practical impact of such extended-high-frequency hearing losses, using a semicircular array of speakers to test localisation in both the horizontal and vertical planes in participants with normal hearing above 8 kHz and those with a hearing impairment in that band.

In the current project, we aimed to develop an intraoperative monitoring system which was capable of measuring changes in air-bone gaps in real-time (using electrocochleography) during surgery, with the aim of providing information regarding the status of the inner ear early enough to allow surgical teams to modify their procedure. Both the hardware and software components (shown in Figure 1 overleaf) have now been finalised. Following the successful granting of ethical approval earlier in the year, a number of projects are currently underway using the system, with monitoring due to take place in operating theatres in Christchurch and Dunedin. The flexibility of the system is such that we are also using it to make concurrent electrocochleographic and direct eighth nerve recordings during hearing preservation surgery to remove vestibular schwannomas.

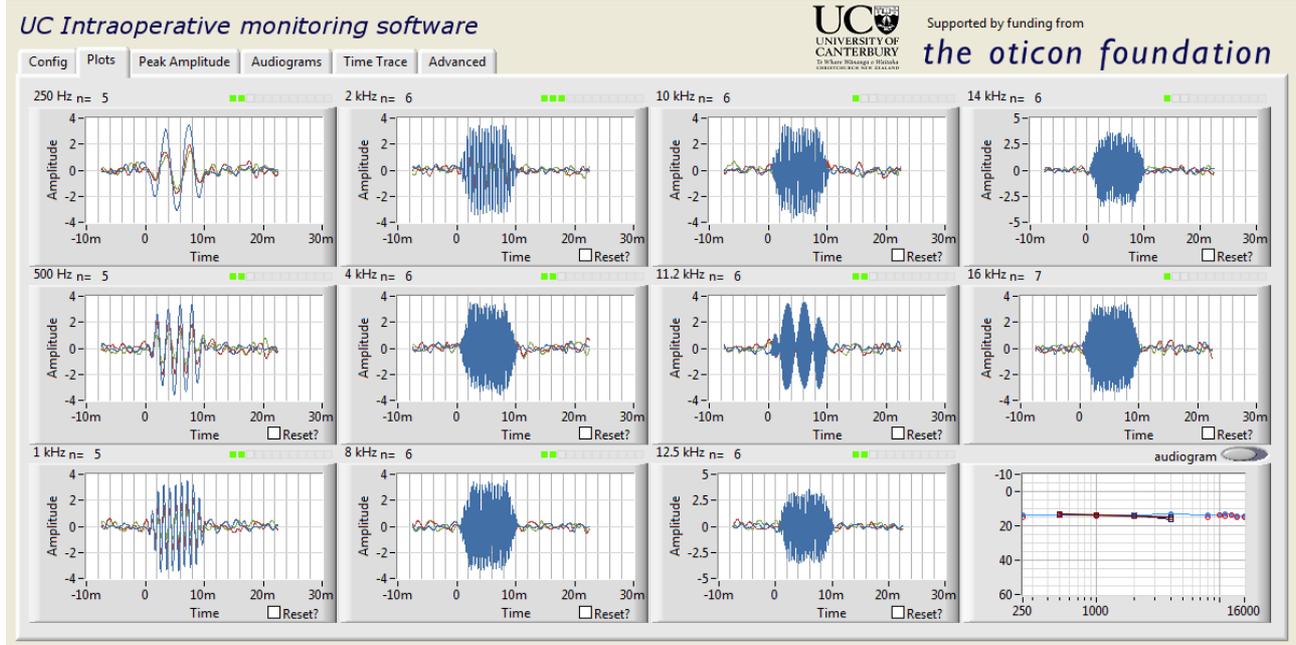


Figure 1: Screenshot of the UC Intraoperative Monitoring software in stimulus loop-back mode.

Our recent outputs from this project (listed below) have stated that the work was supported by grants from the Oticon Foundation in New Zealand, with conference presentations also prominently displaying the Foundation's logo.

We would like to thank the Oticon Foundation in New Zealand for their support, and will continue to provide updates on our continuing work in this area, which would not have been possible without it.

Yours sincerely,

Greg O'Beirne, PhD
Associate Professor of Audiology

Journal articles published:

Babbage MJ, Feldman MB, O'Beirne GA, MacFarlane MR, Bird PA, 2013. Patterns of hearing loss following retrosigmoid excision of unilateral vestibular schwannoma. *Journal of Neurological Surgery Part B: Skull Base* 74(3):166-175.

Conference presentations:

Babbage MB, O'Beirne GA, Bergin M, Macassey E, Bird P, 2014. Patterns of extended high-frequency hearing loss following stapedectomy. *New Zealand Audiological Society Conference*, Wellington, New Zealand, 4th July 2014.

Bird P, Babbage M, Bergin M, Macassey E, O'Beirne GA, 2014. Patterns of extended high-frequency hearing loss following stapedectomy. *Otology Jubilee*, Halle, Germany, 9 May 2014.