

Tuning a Cochlear Implant which is in the Process of Migrating

Mary Grasmeder, Carl Verschuur, Tracey Newman, Alan Sanderson, Robyn Ferris

Introduction

10 migration cases were identified in Southampton over a seven year period in cochlear implant (CI) patients with lateral wall electrode arrays (Advanced Bionics HiFocus 1J, MED-EL Flex 28 and Nucleus CI522). Audiological data for a Nucleus CI522 device which migrated over a 10-month period is presented. Fibrosis had developed around the extruded portion of the electrode array and was analysed following explantation: details will be given in an oral presentation by Alan Sanderson.

Impedance Telemetry and Electrode Deactivation

Migration was evident from impedance telemetry and was confirmed by a CT scan 3-months post activation.

Impedance telemetry gave open circuit readings as electrodes moved out of the cochlea, but impedances returned to normal as fibrosis developed around the electrodes in the middle ear.

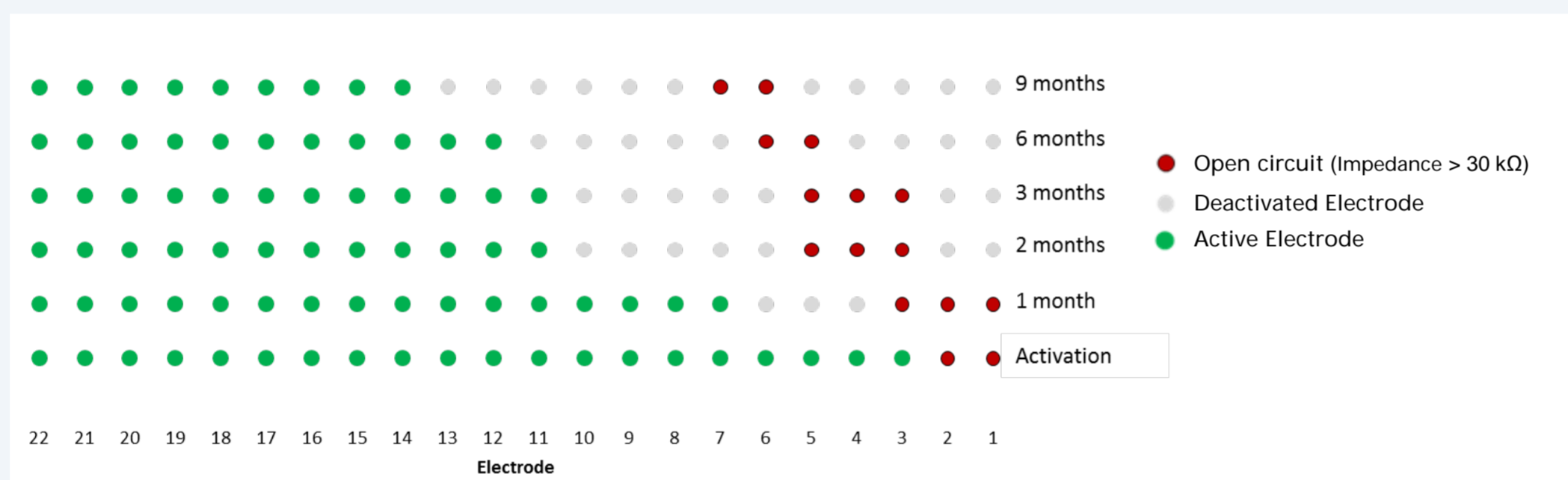


Figure 1: Electrode Status over time for the Migration Case

Intra-cochlear electrodes close to the round window required **deactivation**, due to non-auditory sensations and poor loudness growth.

Speech Perception

Scores for the BKB sentence test in quiet dropped as migration progressed but improved again after re-implantation (figure 2).

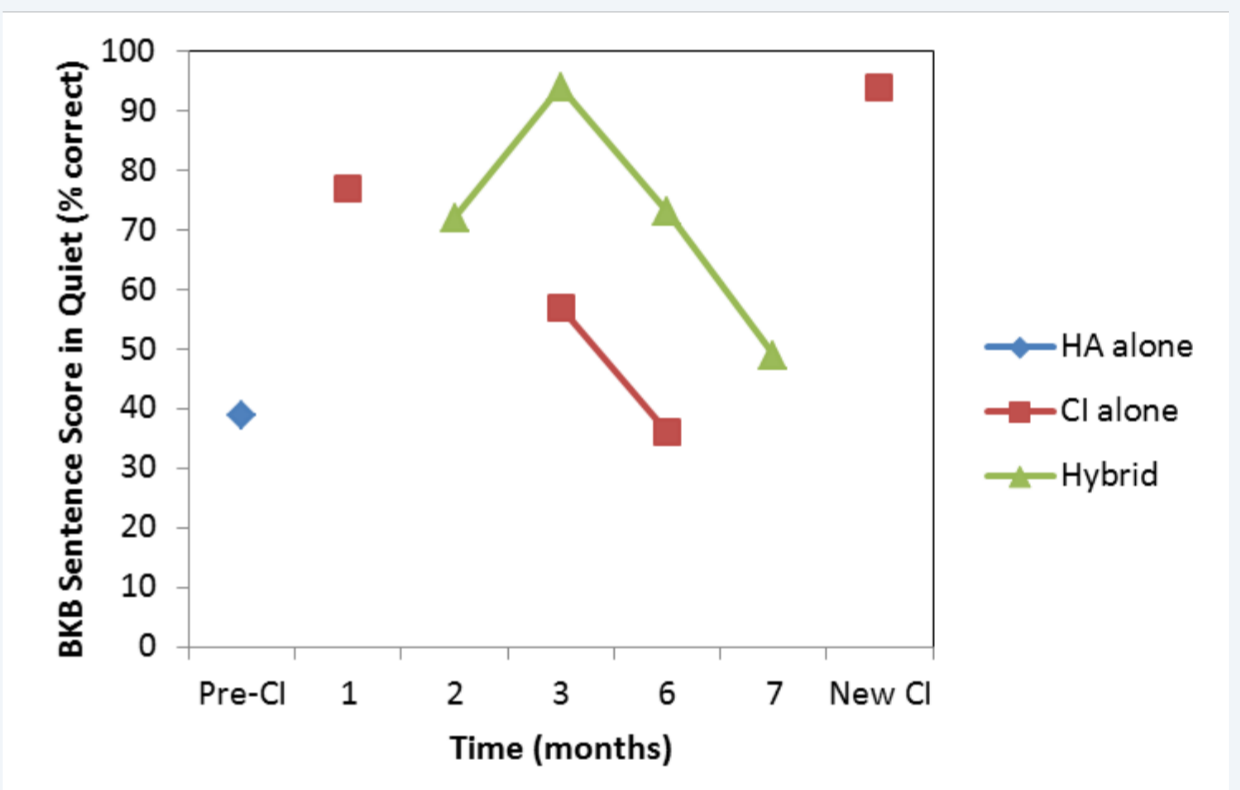


Figure 2: BKB Sentence Scores over time for the Migration case

Electrode Voltages

Electrode voltages (EVs) were measured with surface electrodes, for adult Nucleus CI users with full insertions (N=6) and for the migration case.

EVs were markedly different for the migration case:

- Traces showed a discontinuity corresponding to the electrodes with open circuits on impedance telemetry
- EV amplitudes for intra-cochlear modes were higher and increased dramatically between measurements (Common Ground (CG) and variable bipolar (VBP))
- Monopolar (MP) amplitudes decreased, especially at the basal end; current flow was mostly in the opposite direction for extra-cochlear electrodes

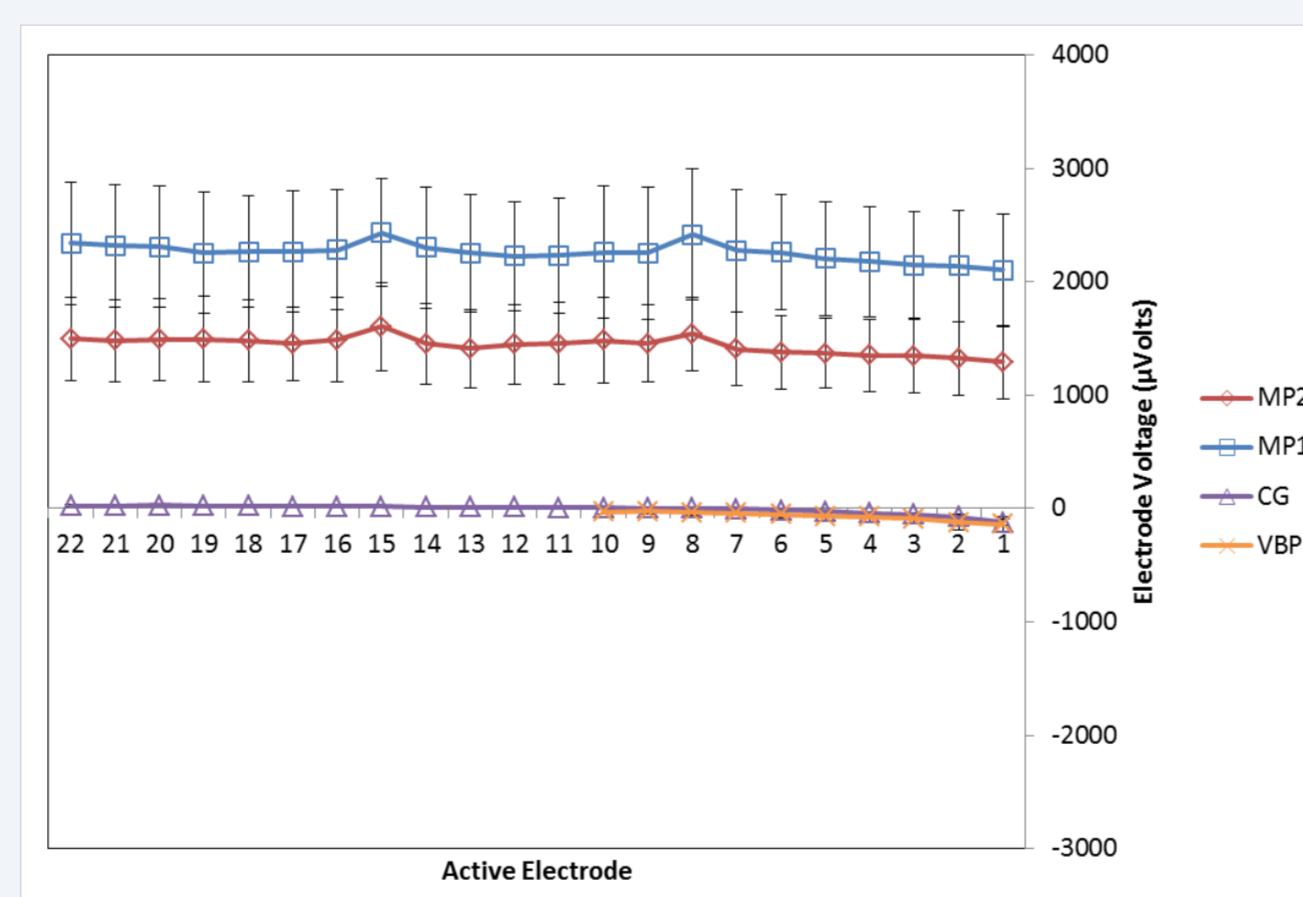


Figure 3: Electrode Voltage in different Stimulation Modes for the Full Insertion Group (error bars = 1 standard deviation)

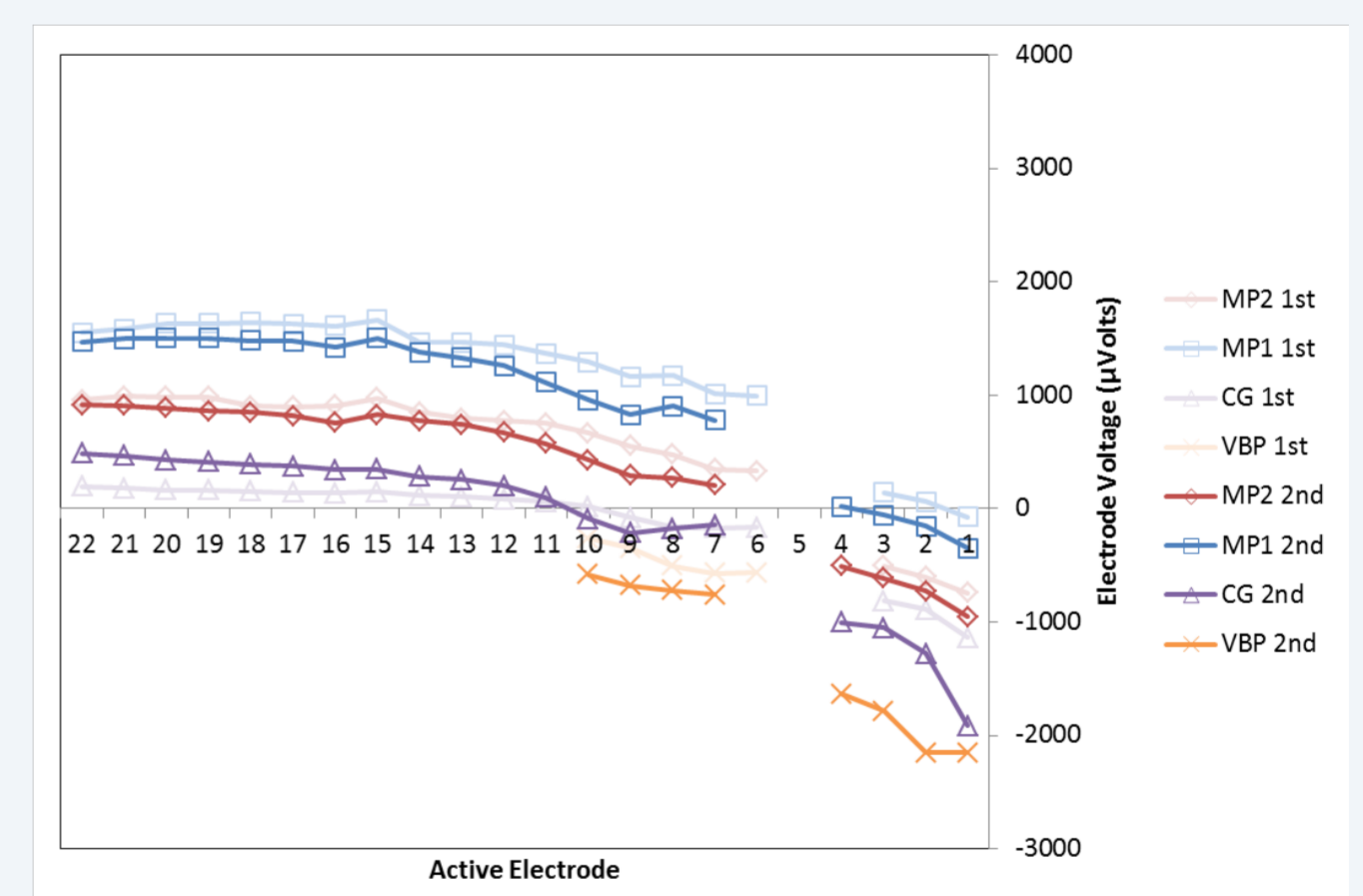


Figure 4: Electrode Voltages in different Stimulation Modes at 3 and 6 months post activation for the Migration case

Discussion and Conclusions

Open circuits may be expected in CI migration cases, as electrodes move out of the cochlea into the air-filled space of the middle ear. This case demonstrates that impedances may return to normal limits after a limited period of time. Data for a companion presentation (Sanderson et al.) suggest that normal impedances measured from extra-cochlear electrodes are associated with fibrous tissue growth around the electrodes.

Within the cochlea, an increasing number of basal electrodes had to be deactivated, due to non-auditory sensations and poor loudness growth. EVs also became more similar in different stimulation modes, suggesting that current increasingly took the same path, regardless of the position of the reference electrode. A possible explanation for this observation is that current flow was constrained by fibrosis along the length of the electrode array.