Intraoperative measurement of cochlear microphonic in active middle ear implants

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Introduction: Active middle ear implants (AMEI) have been used in conductive and mixed hearing loss. In this study the possibility of utilizing an intraoperative cochlear microphonic (CM) measurement in Vibrant Soundbridge (MED-EL) and Carina (Cochlear) implanted patients was investigated.

Method: Burst stimuli of 0.5, 1, 2 and 4 kHz were used for acoustic stimulation either by a modified AP-304 Med-EL processor transmitting to the implant (VSB) or a directly connected T2 actuator (Carina). Cochlear Microphonic (CM) responses were recorded by an extra-cochlear cotton-wick electrode and averaged 100-500 times. The cotton-wick electrode was not moved while the respective AMEI was coupled to the round window (RW). As artifact control the CM response was measured when AMEI was uncoupled from the RW or by manual dampening of the short process incus (FMT). To find the optimum round window coupling the CM amplitude was tracked intraoperatively. When in final position the amplitude of stimuli was varied to obtain the CM growth function.

Results: The CM amplitude response linearly increased at 0.5, 1, 2, 4 kHz from below the noise floor to maximum input. In VSB implantations the control CM amplitude in uncoupled state was 15 dB lower compared to the final optimum coupling when the device was loosely coupled. In incus coupling the CM level was attenuated 6 dB by manually dampening the incus. Both controls indicated an artifact below the measured optimum round window coupling in FMT stimulation. However, in Carina implantations the ratio between CM and artifact was less favorable making further improvements necessary. Moreover, audiological aided thresholds in VSB patients at activation indicate an advantage of the CM guided RW coupling when compared to non-guided average results.

Conclusion: Results imply that intraoperative CM can be used to determine and improve the coupling efficiency of AMEI to the RW. Although, artifacts are sufficiently small in CMs generated with one device CMs generated with another directly driven actuator suffered from artifacts, making controls and improvements obligatory.