Contralateral suppression of human hearing sensitivity in single-sided deaf cochlear implant users

*Waldo Nogueira¹

¹Department of Otolaryngology, Hannover Medical School, Hannover, Deutschland

Cochlear implants (CIs) are being implanted in people with unilateral hearing loss because they can improve speech intelligibility and sound source localization. Though designed to restore the afferent auditory stimulation, the CI possibly restores some efferent effects. The present study aimed at investigating this possibility through otoacoustic emissions and psychoacoustic measurements.

Five single-sided deaf CI users with less than 30 dB hearing loss up to 4 kHz in their acoustic ear participated in a study consisting of two experiments. The first experiment consisted on detecting absolute thresholds for their acoustic ears. Pure tones of 500 and 4000 Hz with durations of 10 and 200 ms in the presence and in the absence of contralateral broadband electrical stimulation (CBES) delivered with the CI were measured for this purpose. The electrical stimulus consisted of pulse trains (symmetric biphasic pulses with phase duration 36 μs) on all 16 electrodes sequentially stimulated at a rate of 843 Hz. Its intensity was set to sound as loud as broadband noise at 50 or 60 dB SPL in the acoustic ear. Thresholds were measured using a three-interval, three-alternative, forced-choice procedure with a two-down, one-up adaptive rule to estimate the level for 71% correct in the psychometric function. Thresholds measured without the CBES were lower for the longer than for the shorter tones, and the difference was larger at 500 than at 4000 Hz. CBES equivalent to 50 or 60 dB SPL caused significant threshold elevation only for short (10 ms) and low frequency (500 Hz) acoustic tones of 1.2 and 2.2 dB. These increases appear smaller than previously reported for normal hearing listeners in related experiments. These results support the notion that for single-sided deaf CI users, the CI modulates hearing in the acoustic ear.

The second experiment consisted on assessing the effect of contralateral electric stimulus on transient evoked otoacoustic emissions (TDOAEs) on the normal hearing side. The contralateral electric stimulus consisted of noise presented through the direct cable of the CI speech processor. Before starting the experiment, a tympanometry was conducted to make sure that the electric noise masker did not activate the stapedius reflex. The 4 subjects that participated in experiment 2 presented a reduction of TDOAEs with an average of 0.68 dB.

Both otoacoustic and psychoacoustic experiments support the notion that for single-sided deaf CI users, the CI modulates hearing in the acoustic ear. The OAEs probably indicate that this modulation is caused by the medio olivocochlear reflex.