Electrode discrimination in late implanted, prelingually deafened CI users

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Intro: Although speech recognition in quiet is very good in a large group of cochlear implant users, most late implanted prelingually deafened patients are still struggling. Due to the long period of auditory deprivation the auditory structures have gone through severe developmental changes and colonization by other sensory modalities. We hypothesize that with current speech processing strategies the signal provided by the cochlear implant is too complex for the compromised auditory system. In order to improve the usability of the CI-signal we want it to contain only relevant perceptual cues. Our focus lies on the spectral cues: if patients are not able to discriminate between two adjacent electrodes, the spectral information inherent to stimulation on a particular site is lost. Therefore our goal is to identify, for a number of prelingually deafened patients, which sites along the array show worse electrode discrimination performance.
Methods: Electrode discrimination difference limens were determined for six prelingually deafened, adult CI-users and for each electrode of the array. First, a pairwise loudness balancing with the neighbouring electrode was performed, starting with the most central electrode of the array. For each pair, two runs of a 1-up 1-down adaptive procedure were conducted. In the second phase, electrode discrimination testing was done using a 2-down 1-up 3-interval oddity adaptive procedure. To exclude any remaining loudness cues that would still be present after loudness balancing, roving of the stimulus level was applied.
Results: Electrode discrimination difference limens across all subjects and all electrodes ranged from 0.5 (perfect discrimination) to 7.125. Mean difference limens ranged from 1.17 to 3.88. For P2 to P6, mean difference limens for basally located electrodes were significantly worse than for the electrodes located in the middle or apical region. Also a trend towards better speech understanding performances in case of smaller mean difference limens was observed.
Discussion: Absolute difference limens are in the order of those found in the few other studies with prelingually deafened subjects and worse than those of postlingually deafened CI users found in the literature. Poorer discrimination skills for basal reference electrodes have not been previously reported in this patient group. The discrimination task might be more difficult in this region due to the unpleasant sharp pitch and less surviving nerve fibers.
Conclusions: There is large variability in discrimination performance across electrodes and significantly poorer performance for basal electrodes. The observed trend towards a relation with speech understanding is promising for the outcomes of the next phase of the research. In this phase, the discrimination limens will be used to selectively deactivate a number of electrodes in order to make all spectral channels perceptually distinguishable. We hypothesize that this new fitting will have a positive effect on measures of spectral resolution and speech understanding.