Bilateral use of Active Middle Ear Implants: Speech Discrimination Results in Noise

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Background: Binaural sound reception has advantages over unilateral perception, including better localization and sound quality as well as speech and tone reception in both quiet and noisy environments. Up to now, most active middle ear implant (AMEI) users have been unilaterally implanted, but patient demand for an implant on the other side is increasing. However, minimal data exists for the active middle ear implant (AMEI) Vibeart Soundbridge (VSB), which is used for patients with sensorineural, conductive and mixed hearing loss who are unable to use a conventional hearing aid due to audiological or medical reasons. Up to now, most AMEI patients have been implanted unilaterally. The aim in our study was to present a analysis of speech discrimination in bilaterally VSB-aided subjects as measured by signal-to-noise ratios for 50% correct understanding of words in sentences.

Material & Methods: Ten bilaterally-AMEI implanted native German-speaking adults were included in the study. The Oldenburg sentence test was used to measure speech reception thresholds in noise. The subject's signal-to-noise ratio (SNR) at a speech reception score of 50% was calculated for different noise conditions. SRT was measured as a function of noise condition (nc) and listening condition (lc) - for example, SRT (lc,nc), with nc from SONO, S0N-90, or S0N90 and lc from left, right or both. For each noise condition, the squelch effect and the binaural summation effect was calculated.

Table 1: Subjects’ demographic overview (COM: chronic otitis media; COE: chronic otitis externa; MHL: mixed hearing loss; CHL: conductive hearing loss; Presbycusis: no satisfactory amplification with conventional hearing aid)

Table 2: Mean differences in bone- and air-conduction thresholds before and after VSB surgeries. *p ≤ 0.05.

Results: Patients in this study demonstrated improvement with bilateral AMEIs compared to right or left AMEI only in all three tested listening conditions. Statistical significance was found in the SONO condition to favor usage of bilateral AMI versus either the right or left side only.

Discussion: The benefits of binaural hearing are well known, also in normal-hearing individuals. In the future every bilateral implantation should be a part of the clinical routine. Bilateral implantation can help to reduce problems in background noise and restore directional hearing. AMEIs such as the VSB help patients with high-frequency hearing loss, occlusion or distortion problems, as well as other medical problems preventing permanent hearing aid usage. Bilateral VSBs can help to reduce problems in background noise and restore directional hearing.

Figure 1: Mean free field post-op warble tone threshold for both implanted ears; error bars reflect ± standard deviation.

Figure 2: Mean SNR in listening condition SONO. Error bars reflect standard deviation.

Figure 3: Mean summation effect for the left and the right side (SNR left/right – SNR both in listening condition SONO). Error bars reflect standard deviation.

Figure 4: Mean SNR with noise from the right side (SON90) and noise from the left side (SON-90). Error bars reflect standard deviation.

Figure 5: Mean Squelch effect with noise from the right side (SON90) and noise from the left side (SON-90). Error bars reflect standard deviation.