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# Vestibular implants: Hope for improving the quality of life of patients with bilateral vestibular loss

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Abstract

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The vestibular system plays an essential role in crucial tasks such as postural control, gaze stabilization, and spatial orientation. Currently, there is no effective treatment for a bilateral loss of the vestibular function (BVL). The quality of life of affected patients is significantly impaired. During the last decade, our group has explored the potential of using electrical stimulation to artificially restore the vestibular function. Our vestibular implant prototype consists of a custom modified cochlear implant featuring one to three vestibular electrodes implanted in the proximity of the ampullary branches of the vestibular nerve; in addition to the main cochlear array. Special surgical techniques for safe implantation of these devices have been developed. In addition, we have developed stimulation strategies to generate bidirectional eye movements as well as the necessary interfaces to capture the signal from a motion sensor (e.g., gyroscope) and use it to modulate the stimulation signals delivered to the vestibular nerves. To date, 24 vestibular electrodes have been implanted in 11 BVL patients. Using a virtual motion profile to modulate the "baseline" electrical stimulation, vestibular responses could be evoked with 21 electrodes. Eye movements with mean peak eye velocities of 32°/s and predominantly in the plane of the stimulated canal were successfully generated. These are within the range of normal compensatory eye movements during walking and were large enough to have a significant effect on the patients' visual acuity. These results indicate that electrical stimulation of the vestibular nerve has a significant functional impact; eye movements generated this way could be sufficient to restore gaze stabilization during essential everyday tasks such as walking. The innovative concept of the vestibular implant has the potential to restore the vestibular function and have a central role in improving the quality of life of BVL patients- in the near future.

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