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Implementation of tri-coil bellows transducer for round window drive middle-ear implants

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A number of methods to drive the RW using a FMT, a MED-EL Inc. product, have been reported. However, according to several studies, this RW-drive method using an FMT has a notably low vibration output in frequencies below approximately 1 kHz. Therefore, these results indicate the need to develop an alternate more efficient transducer for RW stimulation than the FMT. In this study, the tri-coil bellows transducer (TCBT) as a new middle-ear RW transducer was implemented, as it has excellent low-frequency output. The TCBT consists of three cylindrical field coils, a three-pole magnet, ceramic tip, and a miniaturized bellows. To optimize the of TCBT performance, it was performed finite-element analysis (FEA) about its structure that each length of the three cylindrical coils and the bonded magnet inside the TCBT. Additionally, the resonance frequency characteristics of the TCBT were determined using mechanical analysis. Based on the simulation results and anatomical structure of the RW niche volume, the implemented TCBT was 1.75 mm in diameter and 2.3 mm long. To further evaluate the feasibility of the TCBT developed, the TCBT was implanted in the RW niche of human temporal bones and the response characteristics of the stapes footplate were measured. The experimental results indicate that the TCBT can produce 100, 111, and 129 dB SPL equivalent pressure outputs at below 1 kHz, 1–3 kHz, and above 3 kHz, respectively. The results presented here show that the TCBT developed is an excellent candidate for use in RW-drive middle-ear implants.

Biography

Dong Ho Shin has his expertise in design and development of the actuator for the implantable hearing aids. He has built this actuator after years of experience in research, experiment both in institute and education institutions. The proven actuators from non-clinical trials create a new pathway for implantable middle ear hearing aids.

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