Abstract Title: Intracochlear pressure before and after stapedotomy with new chamber stapes prosthesis

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Abstract

Stapes prosthesis is a medical device that induces pressure wave in the cochlea and allows to restore hearing in patents with stapes otosclerosis. The postoperative hearing results are closely related to differential intracochlear pressure (DIP) between scala vestibuli (SV) and scala tympani (ST). Our new chamber stapes prosthesis (ChSP) has many advantages over currently used piston prosthesis. The design and functioning of the fluid-filled ChSP (Fig.1) mimics the natural stapes-vestibule interface, overcomes problems associated with length of piston prosthesis, and provides fluid volume displacement comparable to the normal ear.

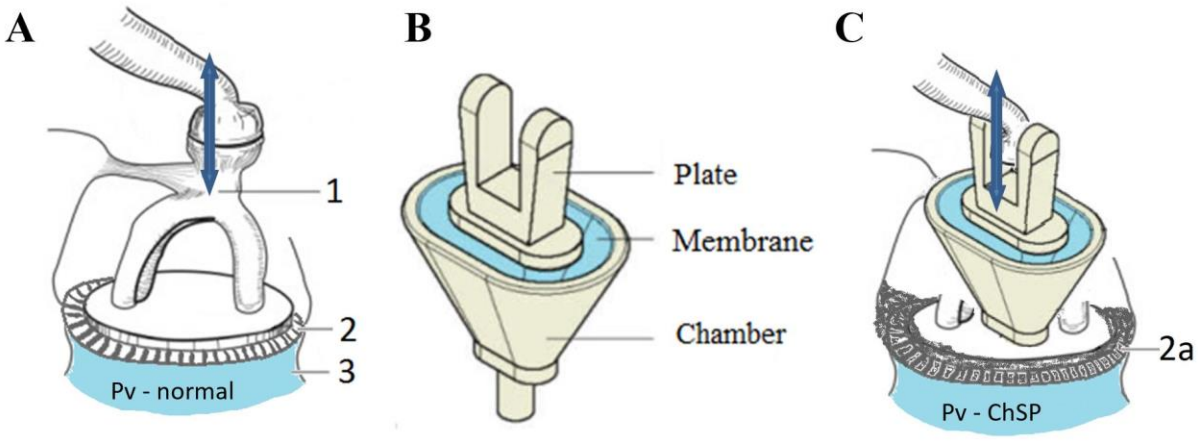


Fig. 1. Normal ear (A), the fluid-filled ChSP (B) and functioning of the ChSP implanted in the ear (C). 1-stapes, 2-annular ligament, 2a-otosclerosis, 3-vestibule, Pv-pressure in vestibule in normal and implanted ear.

Functioning of the ChSP has been previously verified by numerical simulations and vibration measurements. In this study, we present results of the intracochlear pressure measurement before and after stapedotomy with the ChSP.

The ChSP prototype was made and implanted (Fig.2B) in a human cadaveric temporal bone specimen. The pressure in both the SV (Psv) and the ST (Pst) was measured using two optical pressure sensors (Fig.2A). The pressure was induced by the sound (0.4-10kHz) delivered to the external ear canal (EEC) via a loudspeaker and controlled by a microphone.

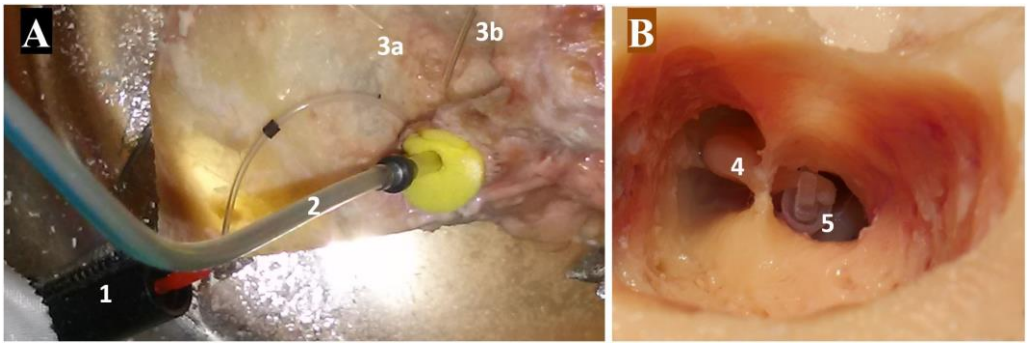


Fig. 2. Experimental setup for pressure measurement (A) and the ChSP implanted in a specimen (B). 1-microphone, 2-sound delivery tube, 3a,3b-pressure sensors, 4-incus, 5-ChSP

Based on the measured values of the Psv and the Pst, the magnitude of the DIP was calculated in the normal and the implanted ear (Fig.3).

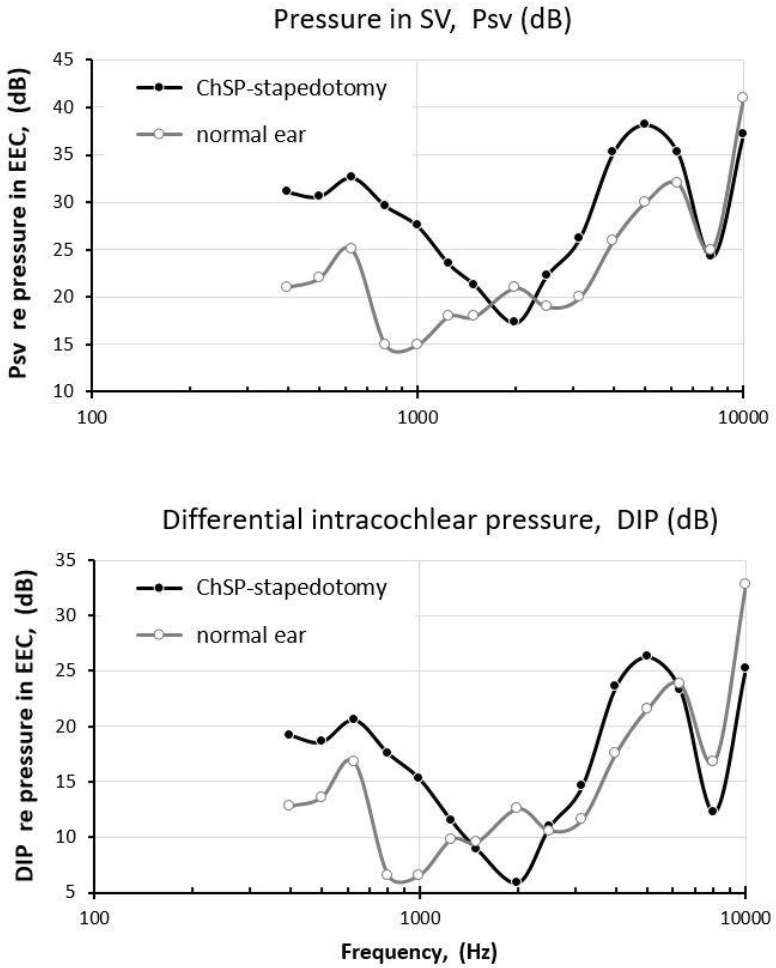


Fig. 3. Pressure in the SV and differential intracochlear pressure in the normal (grey line) and implanted (black line) ear.

The intracochlear pressure values in normal and implanted ear are similar, indicating that the ChSP effectively transmits sound for 0.4-10kHz.

Keywords— *otosclerosis, stapedotomy, chamber stapes prosthesis, intracochlear pressure*

Professional Biography

Monika KWACZ has completed his PhD from Warsaw University of Technology (Poland). She works as associate professor at the Institute of Micromechanics and Photonics. She conducts biomedical research, manages R&D projects and is the scientific supervisor of the PhD students. She has published more than 25 papers in reputed journals, e.g. Kwacz M, et al. *A three-dimensional finite element model of round window membrane vibration before and after stapedotomy surgery*. Biomechanics and modeling in mechanobiology 12.6 (2013):1243-1261. Kwacz M, et al. *Effect of different stapes prostheses on the passive vibration of the basilar membrane*. Hearing research 310 (2014):13-26. Kwacz M, et al. *Elastic properties of the annular ligament of the human stapes—AFM measurement*. Journal of the Association for Research in Otolaryngology 16.4 (2015): 433-446. Kwacz M, et al. *New chamber stapes prosthesis–A preliminary assessment of the functioning of the prototype*. PloS one 12.5 (2017):e0178133.



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Any Comments:

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