TECHNISCHE UNIVERSITÄT DRESDEN

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Optimal tympanic membrane reconstruction

when using the Soundbridge hearing system

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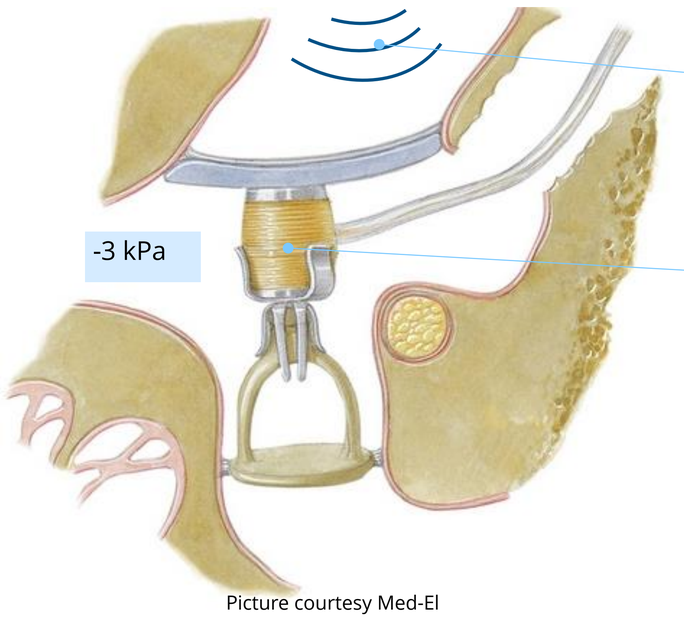
Introduction

The Soundbridge implant system is used for sensorineural and combined hearing loss. If the ossicular chain is interrupted, the actuator (VORP) can be coupled to the stapes. A reconstruction of the tympanic membrane (with connection to the actuator) is often also necessary. In case of chronic aeration disorder of the middle ear, a compromise between stability and good sound transmission must be found for tympanic membrane (TM) reconstruction.

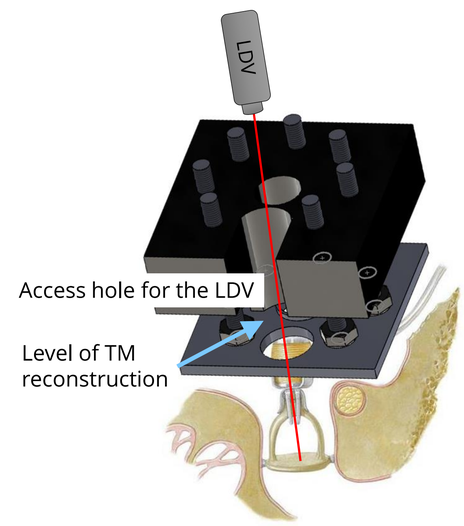


Picture courtesy Med-El

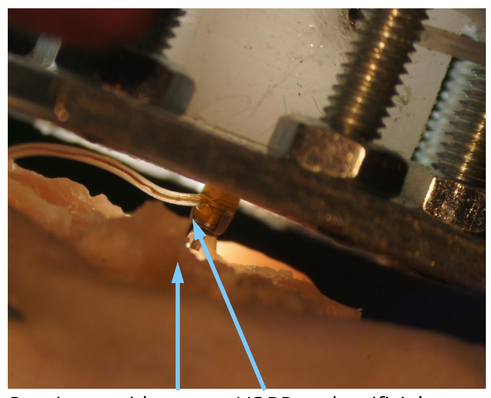
- How does thickness (stiffness) of the reconstructed tympanic membrane influence the sound transfer (passive Soundbridge)?
- How does underpressure in the tympanic cavity influence the sound transfer (passive Soundbridge)?
- How does thickness (stiffness) of the reconstructed tympanic membrane influence the performance of the Soundbridge?
- How does underpressure in the tympanic cavity influence the performance of the Soundbridge?
- **Combined effects of underpressure and tympanic membrane reconstruction on Soundbridge performance?**
- **Is there an optimal thickness of a tympanic membrane reconstruction with cartilage?**

Material & Methods

- Simulations with a Finite Element model of the human middle ear
- Experimental investigations on temporal bone specimen
- Artificial clamp for the tympanic membrane reconstruction for repeatable remeasurements
- Measurement of stapes footplate displacement with Laser Doppler Vibrometer (LDV)
- Sound pressure excitation in the (artificial) ear canal and excitation with the FMT/VORP

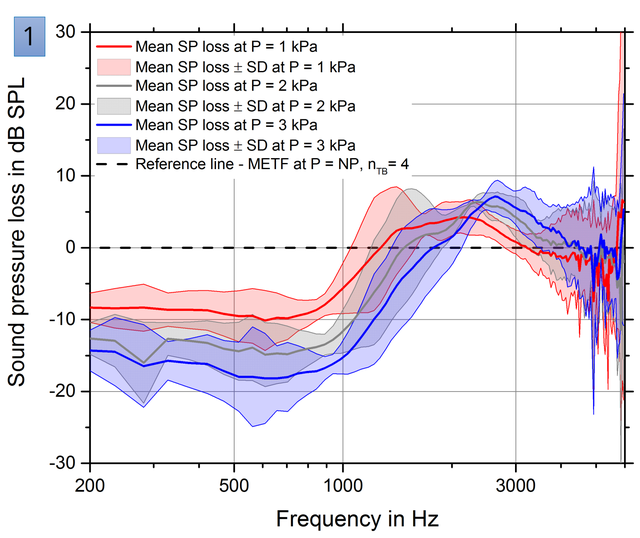


Schema of measurement set-up

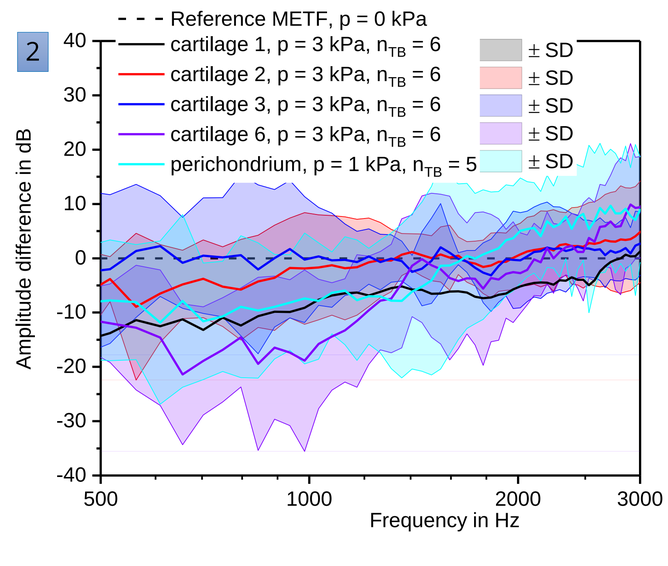


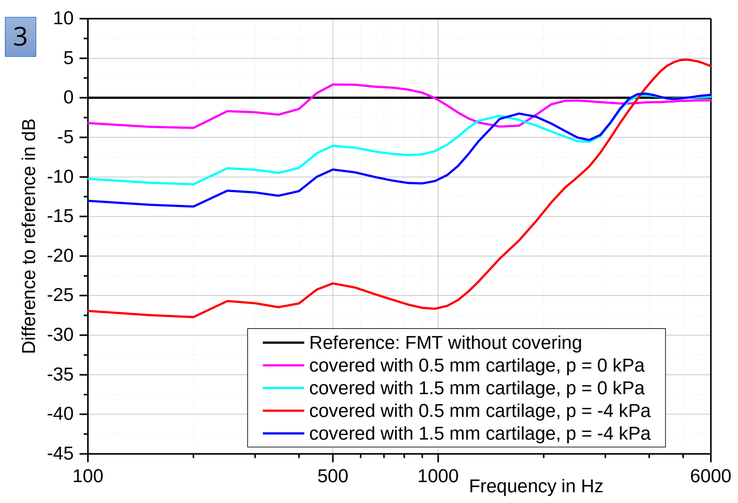
Specimen with stapes, VORP and artificial clamp for the TM reconstructions

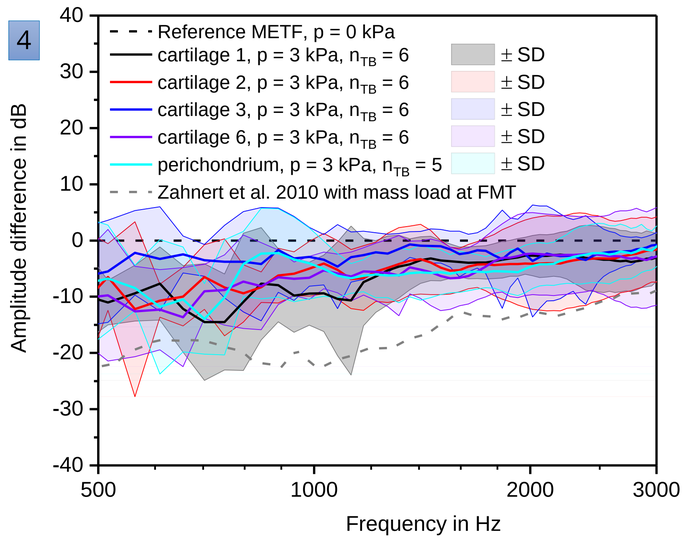
Results & Discussion

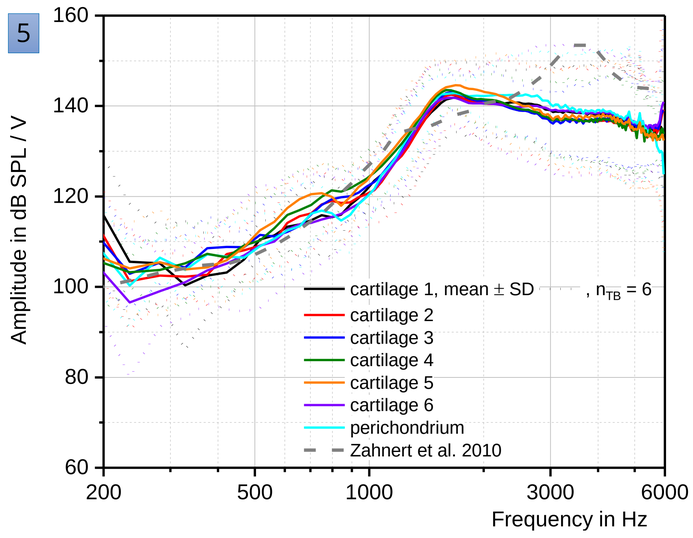


1. Underpressure in the tympanic cavity causes loss in sound transfer through the middle ear, due to stiffening of the annular ligament, which in turn is a result of the displacement of the (reconstructed) TM.
2. Sound transfer through the reconstructed middle ear is effected by underpressure the same way as in the normal middle ear; the thinner the cartilage the more attenuation in sound transfer. (cartilage 1 = thickest; 6 = thinnest)
3. Simulation results show, that a thicker cartilage reconstruction of the TM causes more loss in the performance of the VORP than a thinner one but it is much less effected by underpressure.
4. Measurement results do not show differences in VORP performance subject to cartilage thickness
5. There is only a minor attenuation of VORP performance due to underpressure in the middle ear; independend of cartilage thickness.









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