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In vitro study of the coupling load required for the otologics middle ear transducer MET

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Introduction: To assess the optimal static preloading of the Otologics' Middle Ear Transducer (MET) ossicular stimulator, when coupled to the incus, we measured vibration patterns with Laser-Doppler vibrometry. The MET Ossicular Stimulator is a partially implantable electro-magnetic middle ear hearing device which transmits vibrations to the ossicular chain.

Materials and Methods: We used three human cadaveric temporal bones and one MET Ossicular Stimulator. Laser-Doppler vibrometry was used for temporal bone selections. After the bone selection we extirpated the cochlea from the posterior side in order to measure the vibrational patterns of the footplate. Three temporal bones with different vibrational patterns (VP) were selected based on data of a normal hearing population (N=110): one TB with a VP larger than + 1 S.D., one TB with a VP in the range of ± 1 S.D. and 1 TB with a VP smaller than - 1 S.D. Transfer functions between vibrational patterns of the coupling rod, umbo, incus and footplate measurement points were calculated. Afterwards we defrosted the temporal bones, implanted the middle ear transducer (MET), coupled it to the ossicular chain and measured different coupling loads at the incus, the umbo and footplate.

Results: Optimal transfer function between the MET-transducer and the oval window was possible during contact when the coupling rod advanced 0.0625 mm (90°rotation). Additional advances of 0.0625 mm (180°turn = 0.125 mm) resulted in a decreased vibrational amplitude between 20 to 40 dB below 3 kHz. The lowest linear distortion occurred up to 10 kHz during direct contact without advancing the coupling rod. **Conclusion:** Based on our findings we are of the opinion that optimal force loading occurs between 0° (contact situation) and 0.0625 mm (90° rotation). For intraoperative usage we recommend an advancement of 0.0312 mm (45° rotation) in order to avoid an overloading. Overloading might result in a decreased efficacy of the MET.