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Bio-mechanics of the middle ear (R736)

ID: 736.1

Mechanical effects of tympanic membrane replacement with cartilage and other materials

Presenting Author: **Manohar Bance**

Manohar Bance, Mostafa Salem

Dalhousie University

Learning Objectives: 1. To understand the mechanical effects of replacing the TM with other materials 2. To compare different materials used for reconstruction of the TM from a micromechanical sense.

We will present our results in cadaveric temporal bones measuring the vibration responses of overlaying cartilage at different sites on the TM, replacing different parts of the TM with cartilage, with perichondrium, with silastic, and with ointment.

We report both TM malleus vibrations and stapes vibrations.

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Bio-mechanics of the middle ear (R736)

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Influence of tension and positioning in middle ear reconstruction

Presenting Author: **Thomas Zahnert**

Thomas Zahnert, Matthias Bornitz, Marcus Neudert, Thomas Beleites

TU-Dresden

Learning Objectives: Optimal prosthesis position at tympanic membrane and stapes; optimal prosthesis length; tension of annular ligament in middle ear reconstruction, tympanoplasty.

Introduction: For an optimal sound transfer function (STF) positioning and coupling are the most important factors in middle ear reconstruction with passive implants. Middle ear ventilation problems can change the position and coupling of prosthesis after surgery leading to dislocation or tension of the ligaments. Therefore mechanism and techniques in prosthesis design had to be established to prevent dislocation and tension.

Methods: STF between tympanic membrane and footplate was calculated in a Finite Element Model of the middle ear and measured with Laser-Doppler-Vibrometry in temporal bones. The coupling to the tympanic membrane, malleus handle, stapes head and footplate was compared. The influence of prosthesis' length was measured in temporal bones using a memory-metal TORP. For the investigation of a new prosthesis concept a new flexible TORP was developed and measured in temporal bones during atmospheric pressure alternations.

Results: Malleus attachment near its neck improves the STF in higher frequencies in comparison to tympanic membrane coupling. The stapes head and the center of the footplate are both best suitable for prosthesis coupling. The elongation of prosthesis length between 50 and 200 μm leads to a frequency dependent STF reduction of 5 to 25 dB below 1.0 kHz. At frequencies >2.0 kHz the reduction was less prominent or the STF showed even an improvement of up to 10 dB (SPL).

Conclusion: At the tympanic membrane malleus handle is optimal for prosthesis coupling. At the footplate the center is the optimal position for TORPs. The correct length of implanted prostheses (functional length) should be measured before implantation to prevent tension at the annular ligament. In the future, prosthesis with pressure compensation elements might reduce the risk of dislocation and annular ligament tension. Tension has a significant impact on the STF in middle ear reconstruction.

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Bio-mechanics of the middle ear (R736)

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Session R736: Round Table on The BioMechanics of the Ear

Presenting Author: **John Rosowski**

John Rosowski

Massachusetts Eye and Ear Infirmary

Learning Objectives: Learn about the latest ideas on how the biomechanics of the middle ear affect our understanding of ear disease and its treatment.

Presentations and discussions on middle-ear biomechanics with some of the leading surgeon scientists familiar with the topics: Manohar Bance of Dalhousie University of Halifax Canada, Thomas Zahnert of the University of Dresden Germany and Karl-Bernd Hüttenbrink of the University of Köln Germany. Topics to be discussed include: The normal and reconstructed tympanic membrane (MB), the influence of tension and position on the function of ossicular replacement prostheses (TZ), the significance of a solid contact in ossicular reconstruction in acoustic and non-acoustic pressure environments (K-BH), and the coupling of sound to the ossicular chain by the normal tympanic membrane (JJR).

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Bio-mechanics of the middle ear (R736)

ID: 736.4

The Significance of a Solid Contact in Ossicular Reconstruction in acoustic and non-acoustic pressure environment

Presenting Author: **Karl Hüttenbrink**