Conclusions: Cholesteatoma extension beyond the lateral semicircular canal into the mastoid is more accurately predicted by CT-MRI fusion imaging than plain CT. This tool has high clinical utility, especially in preoperative planning, potentially avoiding unnecessary mastoidectomy with a totally endoscopic (or permeatal) approach.

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Is high-resolution computed tomography of the temporal bones now the "gold standard" for pre-operative evaluation of otosclerosis? Our experience in a tertiary centre

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Learning Objectives:

Introduction: Otosclerosis is a treatable cause of hearing loss. However, the clinical diagnosis may be challenged by high-resolution computed tomography (HRCT) of the temporal bone which may demonstrate factors that might alter the expected outcome of surgery. Using a case series of 101 patients with clinically suspected otosclerosis, we demonstrate how HRCT of the temporal bone may be considered the "gold standard" in the pre-operative work-up for otosclerosis patients.

Methods: A retrospective search of our institution's Patient Archive and Communication System for all HRCT scans of temporal bones that were performed for suspected otosclerosis over a five year period (March 2010 - June 2015). The radiological disease pattern was compared to the clinical findings. Alternative diagnoses were recorded.

Results: 101 scans were performed for suspected otosclerosis. Otosclerosis was confirmed in 43 patients, with normal scans reported in 34 cases and alternative diagnoses revealed in 21 patients. A further 3 patients had possible otosclerosis.

Discussion: The diagnostic sensitivity and specificity of HRCT has been reported to be high. HRCT may identify oval window or pericochlear involvement, which may reduce the effectiveness of surgery; it may also demonstrate anatomical factors that may make surgery more challenging.

Conclusion: We believe that HRCT of the temporal bones is an essential tool as part of the work-up of all patients with suspected otosclerosis and that the benefits of this investigation outweigh the risks associated with a modest radiation dose.

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A Functional 3D Printed Human Middle Ear Model

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Learning Objectives:

- A 3D-printed functional middle ear model with essential anatomical structures segmented from μCT-data.
- The middle ear model had similar transmission characteristic as the human middle ear.
- The middle ear model can be used for evaluation of middle ear prostheses.

Introduction: Middle ear (ME) prostheses are usually evaluated in human temporal bone preparations. However, their characteristics change with time and vary between individuals. Thus, it is a time consuming process to evaluate prostheses using such preparations. Although synthetic models for reproducible conditions exist, they are mostly simplified models. Here we describe a 3D printed ME model with essential features and near natural transmission properties.

Methods: The shapes of the essential anatomical structures were segmented from μCT-data. The unique form of the tympanic membrane (TM) was reproduced with silicone rubber (SR) casting into 3D printed molds. The ossicles were 3D printed, coated and attached together with SR for elastic articulation. The simplified inner ear was built as a closed tube filled with saline. The shapes of the 3D printed ear canal and the tympanic cavity as well as the SR tendons were also simplified.

Results: Our model had sound transmission characteristics similar to the human ME according to the ASTM standard F2504–05. The displacement response to sound had a plateau region $\leq$ 1 kHz and a roll-off above. However, the roll-off-slope was steeper than desired. The stapes footplate response was dominated by tympanic cavity's vibrations at frequencies $\geq$4 kHz. By systematic variation of the SR material of the TM, the ossicle coating and the tendons, we were able to shift the plateau region to higher and lower values compared to ASTM standard. Furthermore, we have performed clinically standard tympanometry, which showed that the compliance of the model was similar to a healthy ME. Finally we have used this model for preliminary evaluations of a new self-adapting ME prosthesis.

Conclusion: Here we developed a functional 3D printed ME model. The construction makes it possible to isolate parts of the ME and integrate sensors for different purposes. Thus, the model provides a flexible and reproducible environment for ME prosthesis evaluation.