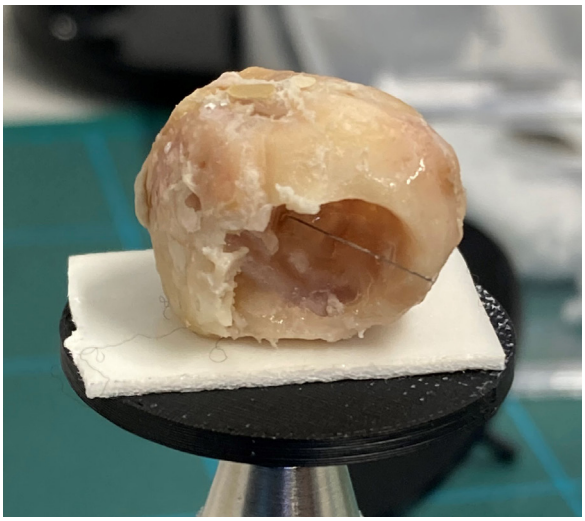
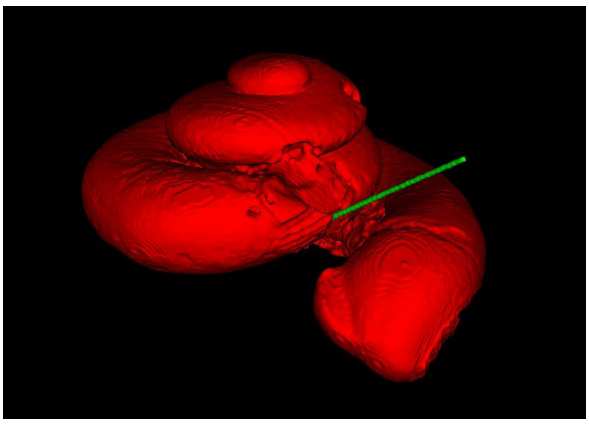
oticon LINX
Innovation Fund Denmark

Injection route to the human inner ear

Hearing loss can be remedied with various devices, such as a hearing aid, but medical prevention and medical treatment of hearing loss is moving closer to realisation. Oticon, a company which produces hearing aids and respective supplies is also engaged in current research on hearing loss. The cochlea, located in the inner ear, transforms sound waves into electric impulses which are forwarded to the brain and later understood as sounds. Oticon is currently running a research project on such medicine that will be administered directly into the cochlea in the inner ear. In here, initial understanding and mastering of the delivery route to the human cochlea will be key to succeed and to potentially bring the therapy to future human patients. Injection into the cochlear centre (modiolus) has been used in animal studies, but only demonstrated in a single study on human species temporal bones and is not a surgery routinely done among ear-nose-throat surgeons. Therefore, Oticon engaged with the 3D Imaging Centre to perform micro–X-ray Computed Tomography (CT) to learn more about the feasibility of performing an intramodular injection into the human cochlea.



An electrode probe inserted into the cochlear modiolus in a human specimen temporal bone.



3D reconstruction of the cochlea (red) with the electrode probe (green) inserted.

Challenge

Visualisation of a targeted position in the cochlear modiolus can be done with histology but this destroys the studied sample and only allows 2D representation. In contrast, X-ray Computed Tomography is a non-destructive imaging method that offers 3D representation of the studied sample.

Collaboration

The temporal bone was prepared at the Panum Institute, University of Copenhagen, and investigated using micro–X-ray Computed Tomography (CT) at the 3D Imaging Centre at DTU. This collaboration was part of the LINX project, in which researchers at leading Danish universities collaborate with scientists in industry to solve industry relevant problems using advanced neutron and X-ray techniques. Besides projects for the members of the LINX association, the LINX project also supports outreach projects for companies, which are not members of the LINX association. In this way, companies can test how they can benefit from X-ray- and neutron-based techniques.

Results

The cochlear modiolus was surgically accessed in a human specimen temporal bone, and a tungsten electrode probe (Ø 127 µm) was inserted into the modiolus via the second cochlear turn to mark the achieved intramodular position (top figure). The specimen was studied using micro X-ray CT. 3D reconstruction of the results allowed verification of the target site in the modiolus (tip of the probe) and calculation of the trajectory route of the simulated intramodular injection (angle of the probe) , as shown in the bottom figure.

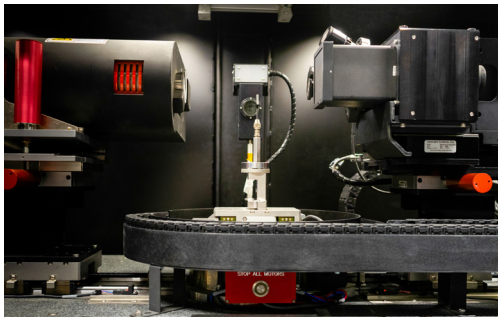
Perspectives

The data shows that surgically access, and thereby potential of delivering medicine, to the cochlear modiolus is possible. Data on more temporal bones are needed to reproduce the findings and to characterise the target spot in the modiolus more systematically.

Imaging Industry Portal

The Imaging Industry Portal is a part of the 3D Imaging Centre at DTU and assists companies in using and implementing 3D Imaging in research, development and production. The portal offers research-based 3D Imaging services and provides companies with the latest equipment and the most advanced knowledge within 3D Imaging and data analysis. The Imaging Industry Portal works as a gateway to ESS and MAX IV, as well as other large scale facilities.

www.imaging.dtu.dk/Industry-Portal



DTU 3D Imaging Centre