Press Release

No. 109e, August 12, 2022

State of Lower Saxony promotes the preclinical development of the optical cochlear implant

The state of Lower Saxony and the Volkswagen Foundation approve funding for scientists of the UMG and the MBExC Cluster of Excellence of about 1 milion euros of the "SPRUNG" ("Niedersächsisches Vorab") for the development of the optical cochlear implant for the restoration of hearing in humans.

(mbexc/umg) Hearing loss is the most common sensory disability in humans: According to the WHO, 466 million people (including 34 million children) worldwide suffer from hearing loss and require treatment. To date, it has not been possible to regenerate or restore defective or dead auditory sensory cells, which are the cause of the most common form of hearing loss. Clinical care is therefore based on hearing aids for mild to moderate hearing loss, and cochlear implants for profound hearing loss and deafness. Electric cochlear implants (eCIs) are used by more than one million people worldwide and typically enable individuals to understand speech in a quiet environment. However, users have difficulties to understand speech in background noise, to interpret the emotional tone of speech, or to enjoy melodies in music. Therefore, there is a great clinical need to improve hearing with CI.

The team around Prof. Moser, director of the Institute for Auditory Neuroscience at the University Medical Center Göttingen (UMG), speaker of the Cluster of Excellence "Multiscale Bioimaging: from molecular machines to networks of excitable cells" (MBExC), extensively investigates the further development of the CI. For their pioneering work in establishing the optical cochlear implant, which combines the conventional CI with modern optogenetics, he and his team received international recognition and attention. The vision of "hearing with light" and the work done so far on its implementation convinced the Ministry of Science and Culture of Lower Saxony (MWK) and the Volkswagen Foundation who support the promising research approach with one million euros from the "SPRUNG" ("Niedersächsisches Vorab"). "I would like to expressly thank the state of Lower Saxony for its support. During his visit to UMG, minister president Stephan Weil expressed great interest in this translational project and the state funding now granted is a very important step in the preparation of the clinical trial", Prof. Moser says.

Prof. Dr. Tobias Moser, Institute for Auditory Neuroscience, UMG. photo: MBExC/spförtner.

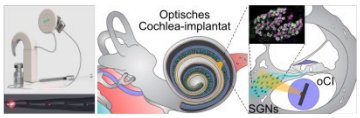

Figure: Left: Concept drawing of combination of optical cochlear implant (oCI) with gene therapy product (top), close-up of wave-guide-based oCI prototype for excitation with red light (bottom). Middle: Top view of the cochlea. Optical excitation of the neurons allows specific areas of the cochlea to be targeted for excitation. Right: Cross-section through the cochlea. The oCI can specifically excite the auditory nerve (turquoise) after its nerve cells have been made light-sensitive by a gene tube. Top left shows auditory nerve cells from a gerbil (purple) into which light-activatable channel proteins (green) have been introduced. Sources: Keppeler / Moser (UMG).

The optical cochlear implant (oCI)

Regenerative approaches to restore hearing, which aim to replace lost hair cells or auditory neurons using pharmacology, gene therapy, or cell therapy have so far failed to achieve significant hearing improvement. "Before such approaches will

University Medical Center Göttingen, Georg-August-University, Press- and Public Relations
Stefan Weller, Von-Siebold-Straße 3, D-37075 Göttingen, Germany, phone +49-551-39-61020, 39-61022, 39-61024
fax +49-551-39-61023, presse.medizin@med.uni-goettingen.de, www.umg.eu
Editor University Medical Center Göttingen, Georg-August-University, Executive Committee

Press Release

make hearing restoration possible, most moderately to profoundly hearing impaired or deaf people will probably continue to rely on hearing aids and CIs as broadly applicable care solutions for the next one to three decades, as they are helpful regardless of the precise cause of disease", Prof. Moser said.

The eCI has been successfully used to restore hearing in more than one million patients for 20 years, making it the most successful neuroprosthesis. It bypasses the damaged auditory sensory cells by converting speech and sounds into electrical pulses. Depending on the frequency range, the incoming sound activates individual electrodes of the implant, which in turn stimulate the auditory nerve, which is then interpreted by the brain as a sound impression. The bottleneck of eCIs is the wide current spread from each of the 12-24 electrodes, resulting in non-selective excitation of neurons and thus poor perception of pitch. In this way, hearing itself can be restored, but the auditory impression remains far from natural hearing.

An interdisciplinary team of scientists at the Göttingen Campus (including MBExC, CRC889, Institute for Auditory Neuroscience of the UMG, German Primate Center, Leibniz-Institute for Primate Research, and Max Planck Institute for Multidisciplinary Sciences) relies on the modern key technology of optogenetics for the “hearing with light”. Since light can be limited spatially much better than electrical stimuli, optical stimulation of the auditory nerve promises to overcome the bottleneck of current CIs. This involves a gene therapy approach to insert a light-activatable ion channel ("light switch") into spiral ganglion neurons in the cochlea, making them sensitive to light. What has already been successful in animal models needs to be further developed for application in humans. The planned 64-channel oCI should enable users to understand speech even in noisy environments, to recognize speech melodies and also to enjoy melodies. Over many years of research (since 2007) and documented by more than twenty publications, Moser and his team have largely provided preclinical proof of concept for both gene therapy of the cochlea and for the oCI as a new medical device. However, there is still a considerable need for research until the planned start of the first clinical trial in 2026. Part of this work will be funded by the approved grant.

*The **Göttingen Cluster of Excellence Multiscale Bioimaging: From Molecular Machines to Networks of Excitable Cells (MBExC)** is funded since January 2019 in the framework of the Excellence Strategy of the German Federal and State Governments. Applying a unique and multiscale approach, MBExC investigates the disease-relevant functional units of electrically active cells of heart and brain, from the molecular to the organ level. The MBExC unites numerous partners from the university and extra-university institutions in Göttingen. The overall goal of MBExC*

University Medical Center Göttingen, Georg-August-University, Press- and Public Relations
Stefan Weller, Von-Siebold-Straße 3, D-37075 Göttingen, Germany, phone +49-551-39-61020, 39-61022, 39-61024
fax +49-551-39-61023, presse.medizin@med.uni-goettingen.de, www.umg.eu
Editor University Medical Center Göttingen, Georg-August-University, Executive Committee

Press Release

is to understand the relationship between heart and brain diseases, to link basic and clinical research, and thus to develop new therapeutic and diagnostic approaches with social implications.

FURTHER INFORMATION
Institute for Auditory Neuroscience: www.auditory-neurosciences.uni-goettingen.de
about the Cluster of Excellence Multiscale Bioimaging (MBExC): https://mbexc.de/
about the Collaborative Research Center 889: www.sfb889.uni-goettingen.de
zur Volkswagenstiftung: https://www.volkswagenstiftung.de
about „SPRUNG“ („Niedersächsisches Vorab“): https://www.volkswagenstiftung.de/unsere-foerderung/sprung

CONTACT:
University Medical Center Göttingen, Georg-August-Universität
Institute for Auditory Neuroscience
Prof. Dr. Tobias Moser
Robert-Koch-Str. 40, 37075 Göttingen
Phone 0551 / 39-63071
tmoser@gwdg.de

Cluster of Excellence Multiscale Bioimaging (MBExC)
Dr. Heike Conrad (contact – press releases)
Phone 0551 / 39-61305
heike.conrad@med.uni-goettingen.de

University Medical Center Göttingen, Georg-August-University, Press- and Public Relations
Stefan Weller, Von-Siebold-Straße 3, D-37075 Göttingen, Germany, phone +49-551-39-61020, 39-61022, 39-61024
fax +49-551-39-61023, presse.medizin@med.uni-goettingen.de, www.umg.eu
Editor University Medical Center Göttingen, Georg-August-University, Executive Committee