

Department of Otorhinolaryngology – Head and Neck Surgery

Chair of Otorhinolaryngology

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Research focus

- Ultrasound, endoscopy, and salivary glands
- Division of Phoniatics and Pediatric Audiology
- Experimental Oncology/nanomedicine (SEON)
- Speech perception with hearing aids and Cochlear implants
- Allergology/clinical immunology and rhinology
- Experimental otology
- Laboratory for sleep disorders/somnology

Structure of the Department

Professorships: 5

Personnel: 342

- Doctors (of Medicine): 41
- Scientists: 35 (thereof funded externally: 20)
- Graduate students: 57

Clinical focus areas

- Minimal invasive surgery of salivary glands
- Lancer surgery
- Cochlear implant surgery
- Nose/paranasal surgery
- Clinical and surgical treatment of voice disorders
- Pediatric hearing disorders
- Diagnosis and treatment of sleep disorders

Research

The Department of Otorhinolaryngology – Head and Neck Surgery is one of the largest hospitals in Germany and has a comprehensive research repertoire. In the clinical area, the focus is on ultrasound, the diagnosis/treatment of salivary gland diseases, tumor and voice disorders, vestibular and hearing impairments as well as somnology and allergology. These foci are reflected in the basic research area. Nanomedicine, which carries out translational projects as well as extensive basic research, is another highly interdisciplinary focus.

Ultrasound, endoscopy, and salivary glands

In modern ultrasound systems and endoscopy units, studies on sonographic imaging of head and neck malignancies and salivary gland tumors remain a cornerstone of scientific work. The role of ultrasonography for the diagnosis of sialolithiasis was systematically examined using a large group of patients. Our results show an accuracy of approximately 95% for the diagnosis of sialolithiasis. Gland-conserving surgery for benign salivary gland diseases is one of our priorities. The main topics are currently the long-term results after limited, extracapsular resection especially of cystadenolymphomas and pleomorphic adenomas of the glandula parotis. Minimally invasive interventions of the salivary glands and their excretory ducts are not only applications in daily practice, but have been systematically reviewed and evaluated scientifically. Combined endoscopic and open surgical procedures provide a new way of treating obstructive salivary gland disorders. The application of Pneumatic Intracorporeal Lithotripsy, introduced in 2015, has been expanded in our Department, particularly in the context of the multimodal treatment of the difficult cases of sialolithiasis, which until recently required resection of the affected salivary gland under general anesthesia.

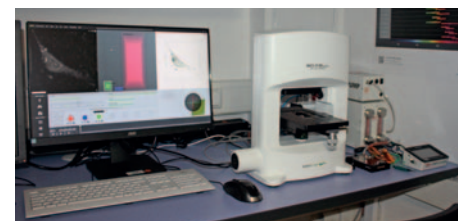
Division of Phoniatics and Pediatric Audiology

Our clinical research focuses on the development of new methods allowing for quantitative voice diagnostics. The major part is the objective analysis of endoscopic high speed recordings during voice production. Within our basic research we concentrate on physical interactions during voice production. We develop and analyze numerical models (lumped-mass models, finite-volume-models) and experimental models (synthetic silicon vocal folds and ex-vivo animal cadaver larynx models). We expect to gain more insight into the interaction between airflow, vocal fold dynamics and resulting acoustics for physiologic and pathologic voice production. Since 2016, we have been analyzing the vocal fold tissue from the molecular-biological point of view. All these topics have the goal to enhance diagnostics and the treatment of our patients.

Experimental Oncology/nanomedicine (SEON)

PI: Prof. Dr. C. Alexiou
Superparamagnetic iron oxide nanoparticles offer several possibilities for the application in medicine. For instance, they can serve as drug carrier vehicles delivering therapeutics to the

desired area guided by a magnetic field. Furthermore, they can be used as contrast agents in MRI or magnetize cells for Magnetic Tissue Engineering (MTE). The Section for Experimental Oncology and Nanomedicine (SEON) works in several interdisciplinary projects to promote the translation of iron oxide nanoparticles from bench to bedside. One important part in this regard is the transfer of the synthesis process from the laboratory towards the production according to GMP guidelines. This aim thrived due to our cooperation with the pharmacy of the UK Erlangen within the European FP7 Project "Nanoathero", which was successfully finished in July 2018. Because of further funding from the Manfred-Roth foundation, we are able to continue our translational efforts beyond the year 2018. To finally apply magnetic nanoparticles for imaging and diagnosis of tumors, their suitability is also evaluated using Magnetic Particle Imaging (supported by the DFG). With regard to the development of endothelialized tissue scaffolds for cardiovascular applications, we have been supported by the BMBF since 2018 to establish and apply complex, small-diameter structures using magnetic cell seeding. Concerning tissue reconstruction we aim to develop a vocal fold implant by means of MTE (supported by the EKFS Foundation). To understand the interplay of magnetic nanoparticles with biological matrices, SEON has been engaging for several years in the DFG Priority Program SPP 1681. Furthermore, SEON is involved in two interdisciplinary projects in the Emerging Fields Initiative (EFI) of the FAU. Thematically, these projects include the establishment of magnetic T cell targeting and Magnetic Nanoparticle Communication. The latter project was extended in November 2018 by the BMBF-funded project "MaMoKo".



Nanolive 3D Cell Explorer – A non-invasive and label-free holotomographic live cell imaging microscope, based on the specific refractive index (RI) of cells and cell components

Speech perception with hearing aids and Cochlear implants

Cochlear Implants (CI) provide an efficient treatment for people with profound hearing loss and deafness. During the last decades cochlear implantation was improved and current implant systems allow for a reasonable speech percep-

tion in everyday life. Aim of the research project was to develop a model which allows a prognosis of CI performance. We developed a test battery of speech audiometric measurements in quiet and in noise in order to determine the amount of information that can be processed by the auditory system (information carrying capacity, ICC). Based on etiologic data, patient history, and audiometric findings, we developed a model for a prognosis of cochlear implant outcome.

Allergology/clinical immunology and rhinology

Endonasal endoscopic sinus surgery and following oral desensitization with ASS come into question as a treatment for NSAID-intolerant patients. The aim of the study is to elaborate and perform a treatment scheme for a treatment with an intravenous desensitization with ASS. The collected data of the intravenous desensitization as an efficient therapy for patients with NSAID-intolerance is going to be evaluated and compared to oral desensitization with ASS.

Experimental otolaryngology

In our group we investigate among others the development of tinnitus. We developed a new model based on information-theoretical approaches in which tinnitus is a by-product of a mechanism that is able to improve hearing thresholds. Data of a collective of roughly 40,000 patients with and without tinnitus and results from animal research support this model. In both cases we investigate space-time patterns of cortical activity with a new statistical method developed by us and are therefore able to describe tinnitus-specific activity in the brain. Additionally, we were able to categorize human sleep stages from EEG data with this method and generate new insight for the sleep medicine. Furthermore, we develop new methods for the determination of sensory thresholds in humans and animals with which it is now possible to determine thresholds, e.g. of auditory brainstem responses, in a completely automatic and objective manner. For all these and other questions we additionally develop artificial neuronal network models and applications for artificial intelligence.

Laboratory for sleep disorders/somnology

The sleep medicine department offers a comprehensive spectrum of current diagnostics and therapy of all sleep disorders according to ICSD-3 with a focus on „sleep-related breathing disorders“. In addition to the investigation of the pathophysiological role of the endonasal micro-

biome and so-called mucin-associated peptides in the context of obstructive sleep apnea (OSA), other main research areas are the optimization of sleep diagnostics and the individualization of therapeutic concepts in OSA. The focus here is on the validation of a serological biomarker in the context of screening diagnostics. Both, the use as a screening tool in the context of primary diagnostics and for individual cardiovascular risk stratification as well as the monitoring of the course of therapy and the therapeutic success in OSA, are examined. Another focus lies on the validation of a compact screening questionnaire (Erlanger Questionnaire) for the detection of nocturnal respiratory disorders in different patient collectives.

Teaching

The Department of Otorhinolaryngology - Head and Neck Surgery is involved in the curricular teaching of Medicine and Dentistry with compulsory and elective subjects. Particularly the interdisciplinary teaching concerning medical technology, nanotechnology, toxicology and integrated life sciences has to be pronounced. Bachelor's and Master's theses as well as MD and PhD theses are supervised.

Selected publications

Janikowska A, Matuszak J, Lyer S, Schreiber E, Unterweger H, Zaloga J, Groll J, Alexiou C, Cicha I. A novel human artery model to assess the magnetic accumulation of SPIONs under flow conditions. *Sci Rep*, 2017, 7: 42314-42331

Gollnast D, Tziridis K, Krauss P, Schilling A, Hoppe U, Schulze H. Analysis of audiometric differences of patients with and without tinnitus in a large clinical database. *Front Neurol*, 2017, Feb 9;8:31

Unterweger H, Dézsi L, Matuszak J, Janko C, Poettler M, Jordan J, Bäuerle T, Szebeni J, Fey T, Boccaccini AR, Alexiou C, Cicha I. Dextran-coated superparamagnetic iron oxide nanoparticles for magnetic resonance imaging: Evaluation of size-dependent imaging properties, storage stability and safety. *Int J Nanomed*, 2018, 13: 1899-1915

Döllinger M, Kniesburges S, Berry DA, Birk V, Wendler O, Dürr S, Alexiou C, Schützenberger A. Investigation of phonatory characteristics using ex-vivo rabbit larynges. *J Acoust Soc Am*, 2018, 144: 142-52

Mantsopoulos K, Koch M, Goncalves M, Iro H. Investigation of the surgical strategies for unilateral multifocal cystadenolymphomas of the parotid gland. *Oral Oncology*, 2018, Jul;82:176-180

Krauss P, Schilling A, Bauer J, Tziridis K, Metzner C, Schulze H, Traxdorf M. Analysis of Multichannel EEG Patterns During Human Sleep: A Novel Approach. *Front Hum Neurosci*, 2018, 12:121

International cooperations

Prof. Dr. E. Tombacz, University of Szeged, Faculty of Science and Informatics, Szeged: Hungary

Prof. Dr. H. Mangge, Medizinische Universität Graz, Graz: Austria

M. Kunduk, PhD, Louisiana State University, Baton Rouge: USA

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