Institute of Anatomy
Chair of Anatomy II

Address
Universitätsstraße 19
91054 Erlangen
Phone: +49 9131 8522864
Fax: +49 9131 8522862
www.anatomie2.med.uni-erlangen.de

Director
Prof. Dr. med. Friedrich Paulsen

Contact
Prof. Dr. Michael Scholz, MMed
Phone: +49 9131 8526745
Fax: +49 9131 8522862
michael.scholz@fau.de

Research Focus

• Temperature sensitive Transient Receptor Potential (TRP) channels at the ocular surface
• Pathomechanisms of the Meibom Gland Dysfunction (MGD)
• Influence of Osteopontin (OPN) to neurodegenerative changes in the eye
• New therapeutic concepts for the treatment in glaucoma using RNA interference to block tight junctional transcripts in mice
• Surfactant proteins
• Influencing factors with regard to learning related behavior of medical and dental students
• Ocular tissue interactions of a refractive UV femtosecond laser

Structure of the Chair

Professors: 2
Personnel: 26
• Doctors (of Medicine): 3
• Scientists: 11 (thereof funded externally: 3)
• Graduate students: 27

Special structural features

• Lecture room for lessons in Histology with 160 microscopes
• Electron Microscopy unit
The Institute of Anatomy is collegially led by both chairs.

Research

For many years, the Institute of Anatomy II has been working on scientific topics about the development and diseases of the eye (basic research). In addition, topics about the upper and lower respiratory tract, joints and medical education are part of the research record of our Institute.

Temperature sensitive Transient Receptor Potential (TRP) channels at the ocular surface

Pi: Dr. F. Garreis, Prof. Dr. F. Paulsen
The Transient Receptor Potential (TRP) proteins belong to the group of membrane-bound, ligand-gated cation channels. They serve as multiple sensors. A functional subgroup of the TRP family is the temperature-sensitive TRP channels (thermo TRPs). They primarily serve the perception of temperature changes, but are also activated by different physical stimuli (pH value, mechanical stimuli) and by a number of different endogens and exogenous substances, e.g. capsaicin (chillies). Here, the expression of thermo-TRP is not limited to neurons (fibers), but is also common in non-neuronal cells. TRP channels play a significant role in maintaining the intracellular calcium homeostasis as well as in different physiological and pathophysiological cellular processes. In cooperation with Dr. S. Mergler (Elektrophysiologisches Labor der Augenklinik, Charité, Berlin), we were able for the first time to demonstrate the functional expression of individual thermo-TRP subtypes in various cells of the human eye. Current research projects are examining the functional expression and regulation of the thermo-TRP channels and their interaction with growth factors and their receptors in different inflammatory and non-inflammatory diseases at the ocular surface.

Pathomechanisms of the Meibom Gland Dysfunction (MGD)

Pi: Prof. Dr. F. Paulsen, Dr. F. Garreis
Meibomian gland dysfunction (MGD), a term used to describe a diffuse abnormality of the meibomian glands, which are specialized sebaceous glands in the eye lids, is considered to be the most common cause of dry eye syndrome (DES), a disease with an estimated prevalence of 12 million people alone in Germany. It is currently thought that MGD is caused primarily by terminal duct obstruction due to hyperkeratinization of the ductal epithelium and an increased viscosity of meibum. However, the molecular mechanisms that underlie this process are unclear. Many proteins being essential for epidermal differentiation and keratinization constitute the ‘epidermal differentiation complex’ (EDC). They function beside epidermal differentiation and keratinization also in innate immune defense belonging to the group of antimicrobial peptides (AMP). The hypotheses are: Chronic inflammatory conditions at the ocular surface induce upregulation of AMPs which are correlated to genes of the EDC that function in epidermal differentiation and keratinization. Thus, induction of EDC associated AMPs triggers hyperkeratinization of meibomian glands and increases viscosity of meibum. Our goal is to get deeper insights into the pathophysiology of MGD by performing in vivo experiments in an established mouse model of dry eye and in vitro experiments using cultivated human meibomian gland epithelial cells in three-dimensional culture to determine factors that could serve as possible targets for therapeutic intervention in MGD.

Influence of Osteopontin (OPN) to neurodegenerative changes in the eye

Pi: Prof. Dr. M. Scholz, Prof. Dr. F. Paulsen
In close cooperation with the Department of Ophthalmology (Prof. Dr. J. Kremers), we performed morphological, molecular, and electrophysiological studies on the structure and function of the retina of the osteopontin knockout (OPN-/-) mouse. Retinal ganglion cells (RGCs) are the only neuronal cell type of the retina, which are able to express OPN under physiological conditions. Our group was able to demonstrate a significant correlation between the age-dependent increased OPN expression and the also age-related damage within the retina and optic nerve in the mouse model of the DBA/2 mouse by analysis of the protein composition of the aqueous humor. In different experimental approaches, the morphological and physiological characterization of OPN-/- mouse was performed. The results of validated analyses will give evidence about the effects due to the absence (OPN-/-) or pathological overexpression of OPN (DBA/2) with regard to neurodegenerative changes within the eye.

New therapeutic concepts for the treatment in glaucoma using RNA interference to block tight junctional transcripts in mice

Pi: Prof. Dr. E. Luitjen-Dreccoll, Prof. Dr. C. Flügel-Koch
Resistance to outflow of aqueous humour that is increased in glaucoma is mediated by the endothelial cells of Schlemm’s canal that are sealed by tight junctions, and by the directly adjacent lying juxtanaculare trabecular meshwork. The aim of our investigations is directed to a new therapeutic approach to lower intraocular pressure by targeting the tight
junctons of inner wall endothelium with siRNA-mediated suppression of tight junctional transcripts. It could be shown that intracerebral injection of siRNAs to ZO-1 and tricellulin increased outflow facility significantly. Transmission electron microscopy revealed significantly more open junctions and clfts between endothelial cells. These results form the base for a new promising therapeutic approach for glaucoma therapy.

**Surfactants**

*Pl: Dr. M. Schicht, Prof. Dr. L. Bräuer, Prof. Dr. F. Paulsen*

The ongoing and continuous characterization of surfactant proteins (in particular surfactant associated 3 (SFTA3), recently described by us) shows the immense spectrum of activity of these proteins in the human organism. Within recent experiments, we were able to demonstrate that SFTA3 has stimulating effects on the activity of alveolar macrophages and in addition leads to an increased phagocytic activity. These and other studies suggest that SFTA3 may play an important role during inflammatory processes within the lung. The previously described properties make SFTA3 a potential candidate for the diagnosis, prevention, and possibly treatment of lung diseases.

**Influencing factors with regard to learning related behavior of medical and dental students**

*Pl: Prof. Dr. M. Scholz, Prof. Dr. F. Paulsen*

Theories about learning styles and types of learning are an integral part for several decades of discussions about teaching basics. The learning typology divides learners into different groups which differ both, in terms of their learning behavior as well as their personality and preferences. We studied the context of the present types of learning with the sense of coherence and burnout symptoms in about 500 medical and dental students of the pre-clinical terms at the FAU. Our students showed a significant correlation between the respective learning style and the expression of the sense of coherence as well as cognitive and emotional burnout symptoms. Hereby, the learning styles of students differed significantly in the same parameters. We could also show that learning styles and types of learning do not only affect the study performance, there also exist relationships with sense of coherence and psychological ailments. A more forward looking integration of the theory of types of learning in the medical education curriculum could affect positively both, the performance as well as the psychological well-being of the students.

**Ocular tissue interactions of a reflective UV Femtosecond laser**

*Pl: Dr. C.M. Hammer, Prof. Dr. F. Paulsen*

In cooperation with the local eye clinic and WaveLight GmbH first preclinical experiments regarding the tissue interactions of a novel UV femtosecond laser were conducted. The laser was developed by WaveLight GmbH for refractive surgery and represents the first refractive femtosecond laser working with ultraviolet light. Therefore, it was necessary to check, whether the system compares to common infrared laser platforms in terms of safety and precision. Experiments based on isolated rabbit and porcine eyes as well as animal tests showed that corneal UV laser cuts heal without complications. Furthermore, deeper ocular tissues like lens and retina were demonstrated to remain free of any stray light damage like cataract or retinal damage. Scanning electron microscopy revealed the UV laser cuts to be comparable to cuts administrated by common infrared laser systems. A marked superiority of the UV laser was demonstrated regarding intraoperative gas production and tissue tolerance of the vulnerable corneal endothelium. The markedly reduced amount of intraoperatively produced gas may allow for a significantly enhanced surgical precision. These investigations paved the way for the onset of the clinical testing phase.

**Teaching**

The Chair of Anatomy II was involved in the teaching of macroscopic anatomy at the Institute of Anatomy. Each semester a variety of elective subjects can be offered for medical and dental students in the pre-clinical semesters. Moreover, Bachelor’s and Master’s theses as well as medical and scientific doctorates are supervised. Virtual courses of histology, macroscopy and embryology are offered in cooperation with the virtual university of Bavaria (vhub).

**Selected Publications**


**International Cooperations**

Prof. S. Weber, Medical School, State University São Paulo, UNESP, Botucatu: Brazil

Prof. Dr. E. Eppler, Zurich: Switzerland

Dr. E. Cuerda, King Juan Carlos University, Móstoles: Spain

Dr. J. Ali, Humboldt Fellow, Hyderabad: India

N. Asano, Santen Pharmaceuticals: Co. Ltd: Japan