

Department of Plastic and Hand Surgery

Address

Krankenhausstraße 12
91054 Erlangen
Phone: +49 9131 8533277
Fax: +49 9131 8539327
www.plastische-chirurgie.uk-erlangen.de

Head of Department

Prof. Dr. med. Dr. h.c. Raymund E. Horch

Contact

Prof. Dr. med. Dr. h.c. Raymund E. Horch
Phone: +49 9131 8533277
Fax: +49 9131 8539327
irma.goldberg@uk-erlangen.de

Research Focus

- Tissue Engineering
- Tumor biology
- Clinical experimental research
- Clinical retrospective studies

Structure of the Department

Under the auspices of the head of the Department of Plastic and Hand Surgery, Prof. Dr. Dr. R. E. Horch, and four attending plastic surgeons, eleven residents, four lab technicians, two veterinarian doctors, one biologist, and 28 medical students are working in different groups on various projects including basic science and clinical research.

Research

Tissue Engineering

Project managers: PD Dr. J. Beier^{1,3}, PD Dr. A. Arkudas^{2,4}, Dr. A.M. Boos³, Dr. med. vet. A. Weigand³, Dr. D. Steiner^{2,4}, G. Bühner^{2,4}

1) Tissue Engineering of skeletal muscle

In collaboration with the Institutes of Polymer Materials (Prof. Dr. D. Schubert) and Biomaterials (Prof. Dr. A. Boccaccini) electrospun nanofibers are developed for skeletal muscle generation. In the rat AV-loop model axial vascularisation of such nanoscaffolds and growth of cultivated muscle tissue will be evaluated. A newly developed animal model including motor nerve branches will be used for inducing muscle differentiation in vivo. The final aim of this DFG-funded project is generation of axially vascularised, innervated skeletal muscle tissue.

2) Tissue Engineering of axially vascularized bone in a small animal model

The aim of this study is to generate axially vascularized bioartificial tissue-engineered bone in the irradiated femur defect model of the rat using mesenchymal stem cells (MSCs) and the growth factor BMP2 in cooperation with the Chair for Material Science and Metal Technology (Prof. Dr. R. F. Singer, Prof. Dr. C. Körner), Biomaterials (Prof. Dr. A. Boccaccini) as well as Glass and Ceramics (Prof. Dr. P. Greil). In the course of the Emerging Fields Initiative (EFI) TOPbiomat new scaffolds, provided by the Chair for Biomaterials (Prof. Dr. A. Boccaccini), have been investigated in vitro and in vivo.

3) Generation of axially vascularized tissue in the large animal

Ongoing studies are evaluating a load-stable nanocrystalline bone substitute material in combination with angiogenic and osteogenic cells and growth factors. Subsequently the transplantation of the bone substitute will be evaluated in clinically relevant dimension in the sheep tibia defect model in order to offer this new therapeutic method in human medicine in the near future.

4) Tissue Engineering of small diameter vascular grafts

The aim of this study is to generate nanofiber-based small diameter vascular grafts in cooperation with the Institute for Biomaterials (Prof. Dr. A. Boccaccini) and the Institute of Polymer Materials (Prof. Dr. D. Schubert) using electrospinning methods and to evaluate graft patency and vascularization potential in the rat. Furthermore the effect of EPCs on the endothelialization of the vascular grafts is investigated.

Tumor biology

Project managers: Dr. A.M. Boos, Dr. med. vet. A. Weigand

1) Effects of tumors on a developing blood vessel network

A tumor can influence and use the existing blood vessel cells or networks or develop its own blood vessel network from mutated or reprogrammed tumor or tumor stem cells. The goal of the project is the characterization of the influence of tumor cells on the development of a blood vessel network and the role of EPCs in tumor associated angiogenesis. As toolbox different in vitro angiogenesis assays as well as the AV-loop rat model will be used.

2) Therapeutic approaches on the lymphatic vessel system in the context of regenerative medicine and tumor progression

A better understanding of the mechanism of lymphangiogenesis could help to get deeper insights in the growth of lymphatic vessels in pathological situations as well as in lymphatic metastasis to develop effective pro- and anti-lymphangiogenic therapies in the future. Goal of the project is beside the characterization of the interaction of lymphatic endothelial cells and MSCs, the establishment of an autonomous lymphatic vessel network in the rat AV-loop-model to be subsequently used for lymphangiogenesis assays.

3) Tumor angiogenesis and vasculogenesis in breast cancer

The tumor vascularization as the critical step for local tumor progression and metastasis represents an attractive target for cancer therapeutics. The effect of breast cancer cells on angiogenic properties of EPCs will be evaluated in angiogenesis assays in vitro as well as in vivo in the rat AV-loop-model. The identification of the role of EPCs in neovascularization could be the first step for the development of a new specific therapy for breast cancer patients.

4) Paracrine and cell-cell interaction of adipose derived stem cells and mammary epithelial cells in the focus of development of breast cancer

Currently the tumorigenicity and angiogenic properties of lipoaspirates that are transplanted in residual breast tissue are not exactly identified. In this study, the influence of adipose derived MSCs and fat cells on the behavior of cells in the breast and breast cancer tissue will be evaluated. The risk of enhancing the recurrence rate and the safety of lipotransfer for the reconstruction of breast tissue after tumor excision will be assessed. Understanding the interaction between these cell types could be decisive for developing new breast cancer therapies.

Clinical experimental research

Project managers: PD Dr. J. Beier¹⁻³, PD Dr. A. Arkudas^{4,5,7}, Dr. M. Schmitz⁸, Dr. C. D. Taeger^{1,6,7}, Dr. I. Ludolph^{2,8}, Dr. V. Haug³, G. Bühner⁵

1) Perfusion studies using laser Doppler spectrophotometry to investigate the impact of harvesting the mamma interna artery on sternal perfusion patterns

This prospective study with cardiac surgical patients was set up to validate the hypothesis that using the internal mammary artery for coronary artery bypass leads to malperfusion of the sternum. This is done using laser Doppler spectrophotometry pre- and postoperatively at the sternum of cardiac surgical patients.

2) Intraoperative fluorescence imaging of tissue perfusion in free flap transplantation using the SPY Elite® System

To improve the knowledge of tissue perfusion in free tissue transfer we perform intraoperative fluorescence imaging of tissue perfusion using indocyanin-green and a laser camera (SPY Elite® System). Based on these observations a further increase of free tissue transplantation survival and a decrease of flap complications could be achieved.

3) Analysis of grip force in common hand conditions using the Manugraphy System®

Hand conditions (such as Carpal Tunnel Syndrome or CRPS) may be accompanied by a loss of hand function or grip force. This study evaluates load distribution patterns using the Manugraphy System® and skin perfusion changes using the o2c – device in the above mentioned hand conditions.

4) Evaluation of carpal instability regarding Scapholunate ligament injuries

The aim of this study is to evaluate wrist mobility between carpal bones using μ CT analysis in cooperation with the Institute for Anatomy (Prof. Dr. W. L. Neuhuber) and the Section of Experimental Oncology and Nanomedicine (Prof. Dr. C. Alexiou) in order to invent new strategies to treat scapholunate ligament injuries.

5) CelluTome: Evaluation of epidermal grafts in a standardized wound model

Goal of this study is the evaluation of Cellu-Tome-generated epidermal grafts after transplantation in split skin donor sites. Evaluation is performed by clinical assessment and various measurements.

6) Optimization of extracorporeal tissue conserving protocols by continuous tissue perfusion in plastic-reconstructive surgery

This project deals about continuous extracorporeal perfusion of transplants. The question is, whether this treatment is superior to classical cold storage of transplants regarding ischemia-related cell damage. For this study skeletal muscle from pigs is used.

7) Analysis of pressure gradients and persuion patterns using negative pressure wound therapy

This prospective study was planned to investigate physical pressures beneath the dressings using vacuum assisted wound therapy (npwt). Furthermore, perfusion patterns of the skin beneath npwt are planned to be investigated. The findings should help to learn more about the underlying mechanisms of action of npwt.

8) Biomaterials for coverage of silicone implants to prevent capsular fibrosis

Capsular fibrosis represents a significant complication following implantation of silicone breast implants, necessitating further surgical intervention. Numerous studies investigating methods to prevent capsular fibrosis have been carried out without success so far. Experimental animal studies will be conducted to investigate if diverse biomaterials (e.g. xenogenic acellular dermis) can be used as an envelope for submuscular silicone implants to reduce foreign body reaction.

Clinical retrospective studies

Project managers: Prof. Dr. R. E. Horch¹, PD Dr. J. P. Beier^{2,3}, Dr. M. Schmitz⁴, Dr. C. D. Taeger^{1,4}, Dr. R. Brodbeck², Dr. D. Steiner³

1) Restrospective analysis of patients treated for carpal tunnel syndrome in the years 2010 and 2011 in the department of plastic and hand surgery

To learn more about carpal tunnel syndrome health records of patients who underwent carpal tunnel release between 2010 and 2011 retropectively were analyzed.

2) The role of plastic reconstructive surgery in multidisciplinary surgical treatment of sarcomas – a retrospective study 2004 – 2014

In this stuy, a comprehensive picture of interdisziplinäre sarcoma treatment is obtained through a analysis of medical records and a questionnaire-based survey.

3) Scalp reconstruction: a retrospective analysis of the years 2004-2014

In this retrospective study operative means and outcomes for reconstruction of scalp defects over a 10-year period are analysed, in order to develop optimal surgical strategies to reconstruct these complexe defects.

4) Retrospective 10 year analysis of postbariatric surgery for bodycontouring after massive weight loss

Postbariatric surgery as the last step for reintegration of the patient in the society after massive weight loss gains more and more attention. In the framework of a retrospective 10 year study we analyze main factors such as the postoperative course, possible complications, long term results and the individual surgical plan to optimize future therapy.

Teaching

According to the German "Statutes of the medical act (ÄAppO)", a lecture series of 25 academic hours per term (AHS) is held as part of the general surgery lecture series. It covers general principles of Plastic and Hand Surgery. Additionally, the following teaching courses are conducted regularly by the Department of Plastic and Hand Surgery:

- Lecture series on "Specific Issues in Plastic and Hand Surgery"
- Tutorial "Tissue Engineering"
- Clinical Ward Round of Department of Plastic and Hand Surgery
- Surgical Anatomy of the Hand and Techniques of Hand Examination
- Interdisciplinary Consultation Hour in "Breast Reconstruction"
- Teaching Ward Round and Advanced Course in Plastic Surgery
- Microsurgical Suture Techniques
- Teaching Ward Round and Advanced Course in Reconstructive Microsurgery

Selected Publications

Horch RE, Beier JP, Kneser U, Arkudas A (2014) Successful human long-term application of in situ bone tissue engineering. *J Cell Mol Med.* 18(7):1478-85

Taeger CD, Müller-Seubert W, Horch RE, Präbst K, Münch F, Geppert CI, Birkholz T, Dragu A (2014) Ischaemia-related cell damage in extracorporeal preserved tissue - new findings with a novel perfusion model. *J Cell Mol Med.* 18(5):885-94

Horch RE, Hohenberger W, Eweida A, Kneser U, Weber K, Arkudas A, Merkel S, Göhl J, Beier JP (2014) A hundred patients with vertical rectus abdominis myocutaneous (VRAM) flap for pelvic reconstruction after total pelvic exenteration. *Int J Colorectal Dis.* 29(7): 813-23