## Department of Otorhinolaryngology

# Ear Tissue Regeneration Using Human Cells and Novel Nano-Cellulose Scaffolds

**Head of Research: Nicole Rotter**

**Description of lab:**
One focus of the research lab is regeneration of nasal and articular cartilage using stem cells and tissue engineering. The second focus is salivary gland regeneration and pathophysiology of radiogenic salivary gland damage. The lab has a significant expertise in culturing and characterizing chondrocytes from nose and auricle. We examine the potential of different biological materials such as different xenogenetic collagens and bacterial nanocellulose for regeneration of cartilage structures. We demonstrated that chondrocytes, isolated from auricle and nasal septum, can adhere, proliferate and even synthesize extracellular matrix on these scaffolds. In other studies of the laboratory, we search for an adequate source of cells for in situ cartilage regeneration. Different immunocompetent animal models for orthotopic transplantation of tissue-engineered nasal cartilage have been established. New biomaterials are evaluated and compared with regard to local inflammatory tissue reactions, their mechanical strength and stability. Aditionally, we establish a stem cell-based approach for salivary gland dysfunction following radiation therapy.

**The Team:**
**Head of Research:** N. Rotter
**Head of Department:** T.K.H. Hoffmann
**Professor:** N. Rotter
**Group Leader/Postdoc:** S. Schwarz
**PhD Students:** E-M. Feldmann, A. Elsässer
**Additional Members of Thesis Advisory Committees:**
A. Ignatius (Ulm), P. Gatenholm (Gothenburg)

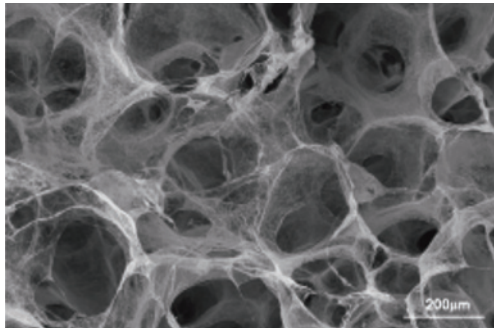
**Description of Project:**

In western countries the incidence for the complete absence of the auricle is 1:17.500, whereas the frequency of minor dysplasia has an incidence of 1:6.800. In twenty percent of these cases both auricles are affected. In addition to these, the cases of traumatic or tumorous defects of the auricle need to be taken into account. Especially for children with major dysplasia of the auricle, an inconspicuous outer appearance is important for their psychological and emotional well-being as well as their psychosocial development. Without reconstructive surgery, many patients suffer from reduced self-confidence due to their obvious deformities. Despite donor-site morbidity, reconstructions of the auricle, usually performed with rib cartilage, have shown a significant psychosocial benefit in the majority of treated patients.

Due to the complexity of surgical reconstruction using rib cartilage, auricular reconstruction remains one of the greatest challenges within the field of reconstructive surgery. Despite the advances in stem cell technology and biomaterials, auricular cartilage engineering is still in an early stage of development. This is due to critical requirements such as mechanical properties of the scaffold material and the post-surgical long-term structure. Furthermore, the complex shape of the auricle adds another facet of complexity to the challenge of auricle reconstruction.

This project focuses on auricle reconstruction using a novel nano-biomaterial, bacterial cellulose, generated in dynamic culturing conditions using bioreactors, and co-culture of human chondrocytes and stem cells. The project is truly interdisciplinary since it combines engineering, such as bioimaging and biomechanics, for quantitative evaluation of requirements and outcomes, detailed material science expertise at the nanoscale for material development and manipulation, detailed biotechnology and cell biology proficiency for sophisticated replication of biological growth and development and clinical commitment for profiling existing clinical challenges, shortcomings and end goals. Our goal is to develop and evaluate a preclinical therapy for auricle reconstruction. Methods and results developed here will also be applicable in the regeneration of nose, trachea, spine and articular joints.

Bacterial nanocellulose in the shape of a human auricle




Porous bacterial nanocellulose (REM)

Ulm University
Department of Otorhinolaryngology
Frauensteige 14a (Haus 18)
89075 Ulm, Germany
Tel. +49 (0)731 500 59562
Fax +49 (0)731 500 59565
silke.schwarz@uniklinik-ulm.de
www.uniklinik-ulm.de/struktur/kliniken/hals-nasen-und-ohrenheilkunde/home/forschung/forschungsbereiche.html

***Selected Publications:***


- *Bermueller C, Schwarz S, Elsaesser AF, Sewing J, Baur N, von Bomhard A, Scheithauer M, Notbohm H, Rotter N (2013): Marine Collagen Scaffolds for Nasal Cartilage Repair: Prevention of Nasal Septal Perforations in a New Orthotopic Rat Model Using Tissue Engineering Techniques. Tissue Eng Part A. Epub ahead of print*
- *Feldmann EM, Sundberg JF, Bobbili B, Schwarz S, Gatenholm P, Rotter N (2013): Description of a novel approach to engineer cartilage with porous bacterial nanocellulose for reconstruction of a human auricle. J Biomat Appl. Epub ahead of print*
- *Schwarz S, Elsaesser AF, Koerber L, Goldberg-Bockhorn E, Seitz AM, Bermueller C, Dürselen L, Ignatius A, Breiter R, Rotter N (2012): Processed xenogenic cartilage as novel biomatrix for cartilage tissue engineering: effects on chondrocyte differentiation and function. J Tissue Eng Regen Med. Epub ahead of print*
- *Schwarz S, Koerber L, Elsaesser AF, Goldberg-Bockhorn E, Seitz AM, Dürselen L, Ignatius A, Walther P, Breiter R, Rotter N (2012): Decellularized Cartilage as a Novel Biomatrix for Cartilage Tissue Engineering Applications. Tissue Eng Part A. 18(21-22):2195- 209.*
- *Schuh E, Hofmann S, Stok K, Notbohm H, Müller R, Rotter N (2011): The influence of matrix elasticity on chondrocyte behavior in 3D. J Tissue Eng Regen Med. Epub Oct 28.*
- *Schuh E, Kramer J, Rohwedel J, Notbohm H, Müller R, Gutsmann T, Rotter N (2010): Effect of matrix elasticity on the maintenance of the chondrogenic phenotype. Tissue Eng Part A. 16(4):1281-90.*