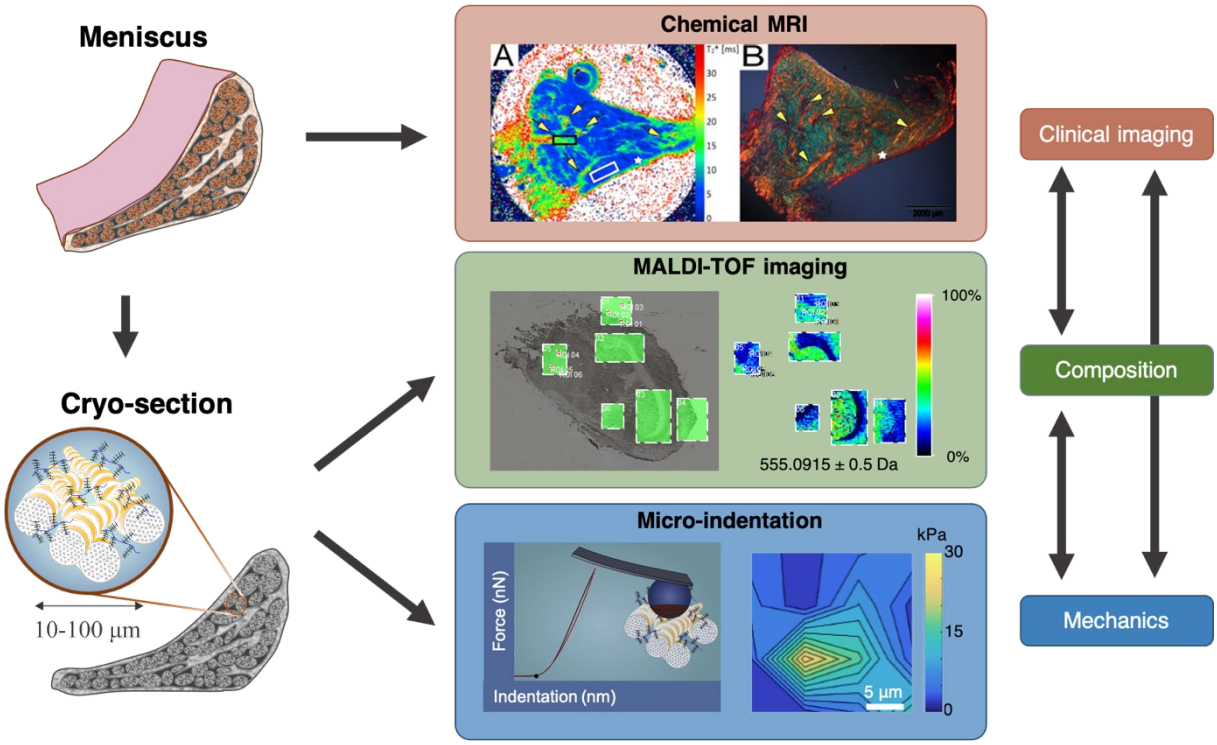
CORRELATIVE MULTIMODAL IMAGING OF HUMAN MENISCAL TISSUE



Supervisory Team[1]

Primary Supervisor: *Philipp J. Thurner, Institute of Lightweight Design and Structural Biomechanics, TU Wien*

TU Wien project partners: *Orestis G. Andriotis, Bernhard Lendl, Martina Marchetti-Deschmann, Gerhard Schütz, Heinz Wanzenböck*

External academic partners: *Siegfried Trattnig, Medical University of Vienna*

External industry partners: *Mike Kirkness, 3Helix*

Project Description

Osteoarthritis (OA) is a progressive degenerative process leading to weakening and breakdown of the meniscal structure. This leads to loss of meniscus functionality affecting over 40 million patients in Europe. Spontaneous meniscal lesions have been associated with the onset of OA. Detecting meniscal tears is a promising pathway for early diagnosis of OA and evaluation of therapeutic interventions to preserve patient's activity and life-style.

We believe that chemical magnetic resonance microscopy (µMRI) can provide predictive markers for early meniscal degeneration and can further be established as a diagnostic tool predicting and thus preventing OA. To achieve this goal potential markers have first to be validated, which is the focus of this project: to establish predictive markers for the early

[1] The Early Stage Researchers (ESRs) will be accompanied during their thesis by an individual "Thesis Advisory Committee" (TAC), which will guide the ESR through the graduate studies. The TAC will consist of the thesis primary supervisor, and two additional members of the Supervisory Team selected by the ESR.

detection of meniscal tissue degeneration by combining data from µMRI, tissue biomechanics and molecular imaging.

Although medical MRI data are readily available, there is a gap of knowledge on how this information can be linked to the biomechanical functionality of the meniscal tissue. This PhD project focuses to bridge this gap of knowledge by conducting a translational study on human meniscal tissue combining data from different imaging methods that inform both the structure and mechanics at the microscale of meniscus tissues.

Key Goals and Tasks

To understand the process of meniscus degeneration we will obtain tissue samples pre-scanned with chemical µMRI from an external Partner (Trattnig, MedUni Wien) and perform multimodal imaging analysis using atomic force microscopy (AFM) or a custom-built microindenter (MI) (mechanics) and MALDI-TOF imaging. Time permitting further correlative approaches such as Raman-microscopy (composition) and single molecule fluorescence imaging (structure) will be explored. Combined data correlated to chemical MRI is expected to identify novel predictive markers for meniscus degeneration.

The primary aim and goal of this PHD thesis is to develop a protocol to enable cross-comparison of chemical µMRI images with spatially resolved mechanical data from AFM/NI and MALDI-TOF imaging. The project is aligned to an ongoing PhD developing MALDI-TOF imaging approaches, whereas AFM/MI protocols exist and frequently applied the PIs (Thurner) laboratory. The key challenge is the development of a marker system detectable with biochemical µMRI (3D) and AFM/MI, which are combined with an inverted optical microscope (2D). After establishing the protocol via a pilot study on porcine tissue, a cross-sectional study on human menisci with both degenerated, as well as healthy regions will be performed. As part of the project, the successful applicant will also spend time at the laboratory of the external partner (Trattnig, MedUni Wien), to obtain basic training in µMRI data acquisition and imager processing. Time-permitting also further correlative imaging techniques such as Raman micro-spectroscopy or florescence microscopy can be explored.

Project-specific Requirements

- Completed master studies in biomedical engineering, physics, mechanical engineering, chemistry, electrical engineering
- Knowledge on biomechanics, imaging, computer vision, chemical analysis are of advantage
- Experience and skills in experimental (bio)mechanics, programming
- Interest in working with a multidisciplinary team, state of the art equipment for micro- and nano-biomechanics,
- Enthusiasm for biomechanics, mechanobiology and engineering in medicine
- Affinity for collaborating with a large group of scientist and being embedded into a doctoral school
- Willingness to travel to project meetings and scientific conferences
- Excellent English language skills in scientific field
- Personal skills: Independence, ability to work in a team, communication, problem-solving skills