Periodicity, Abundance and Orientation of Myelin in the Human Thalamus

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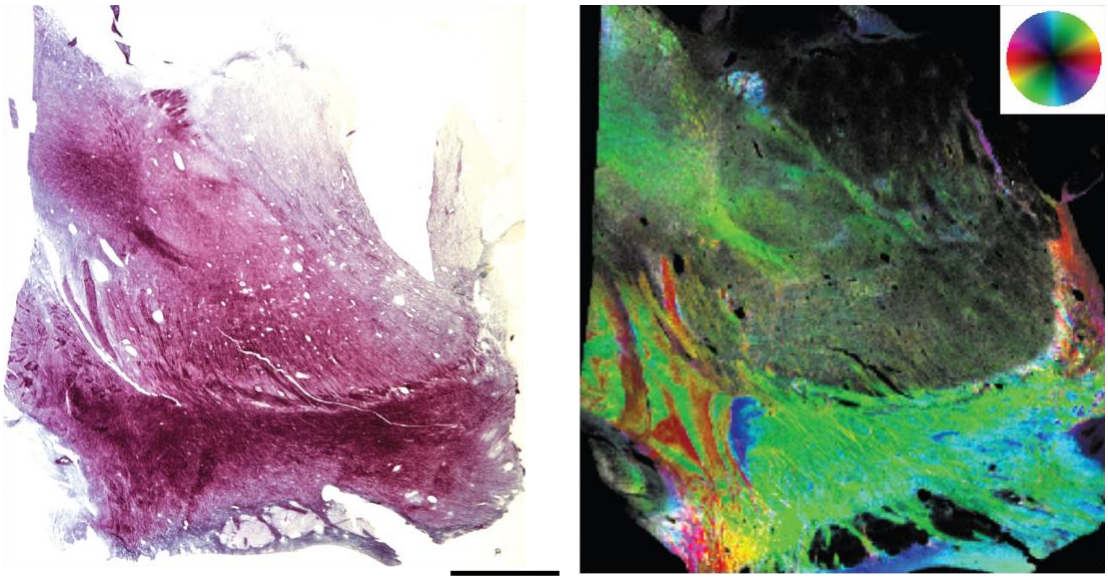
For investigations of anatomical features of the human brain on the sub-cellular level, histology has been the gold standard. Due to the wavelength of visible light, standard optical microscopy is restricted to a resolution of a fraction of a micrometer. Reciprocal space techniques, including small-angle X-ray scattering (SAXS) allow extending this limit to the sub-nanometer range. With an inverse relationship between a nanostructure's size and scattering angle, the method has been used for studies of animal and human tissues [1]. Myelin sheaths insulate the highly oriented axons and form periodic nanostructures with repetitions between 15 and 18 nm. To precisely determine the periodicity, abundance and orientation, we performed spatially resolved SAXS measurements with a micrometer-sized beam along a 50 µm-thick tissue slice of the human thalamus [2]. These experimental data from non-stained tissue were registered to the histology section of myelin-stained tissue (see figure, left). Compared to histology, micrometer-resolved SAXS provides information about the orientation of myelin and consequently axons, in addition to myelin abundance (see figure, right). The color-coded orientation maps of the nanostructures provide a detailed insight into the human brains's nano-anatomy in health and disease.



[1] B. Müller, H. Deyhle, D. Bradley, M. Farquharson, G. Schulz, M. Müller-Gerbl, O. Bunk, *European Journal of Nanomedicine* **2010**, 3, 30-33
[2] G. Schulz, H. Deyhle, C. Bikis, O. Bunk, B. Müller, *Precision Nanomedicine* **2020**, 3, 656-665