Mesoscale light sheet microscopy to study cardiac tissue structure

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Tissue scattering limits the depth at which cubic cm-sized samples can be imaged. This effect can be mitigated by rendering the tissue transparent using optical clearing while light sheet microscopy is especially suited for imaging these samples as it can provide isotropic resolution across a large field of view. By employing mesoscale light-sheet microscopy and optical tissue clearing protocols, we have imaged tissue slices excised from the left ventricle of the heart to assess structural remodeling in a rabbit model due to myocardial infarction.

We have applied an optimized hydrogel-based clearing protocol (CLARITY [1]) on cardiac tissue slices from New Zealand white rabbit as it affords high levels of tissue transparency and structural preservation [2]. The tissues are sliced with varying thickness from 400 - 2000 µm using a vibratome. Once the tissues are optically clear, the samples are stained with Wheat Germ Agglutinin– Alexa Fluor 488 labelling cell membranes and imaged with a custom-built light sheet microscope (mesoSPIM, Mesoscale Selective Plane Illumination Microscopy, [3]).

Here, we present a detailed characterization of our mesoSPIM including spatial resolution across the large field of view. We present the protocol for clearing, staining, and mounting of rabbit cardiac tissue slices, subsequent post processing to de-skew the image stack and first preliminary data for quantitative assessment of cardiac tissue structure at the cellular level. We believe that this methodology will be useful to obtain quantifiable information of 3-dimensional tissue remodeling on the cellular scale in rabbit hearts that have scarred post myocardial infarction.

References:

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