Instituto de Medicina Molecular João Lobo Antunes

Master Project Proposal

Title: Identification of repetitive structures during skeletal muscle contraction by super-resolution and hyper-speed live imaging

Synopsis:

Muscle cells are the main source of mechanical force in multicellular organisms. In skeletal and cardiac cells, sarcomeres form repetitive units that coordinate their length change to regulate cell shape. Each sarcomere acts as a microscopic motor that transforms chemical into mechanical energy. The lab of Edgar Gomes at iMM studies how skeletal muscle is formed and repaired, whereas the lab of Ricardo Henriques at IGC is interested in establishing novel computationally driven imaging technology to enable biological observation. In this project, we propose to understand how the repetitive units of sarcomeres behave during skeletal muscle contraction, how different classes of repetitive units cooperate, and how this is altered during muscle formation and repair in muscle organ-on-chip devices (Figure 1). We will develop new computational methods to detect structural repetition in cells, using super-resolution microscopy (150 nm) and hyper-speed imaging (100Hz) (Figure 2). This project is a unique opportunity to develop and establish a novel computational algorithm to generate structural repetition maps using state-of-the-art optical multidimensional approaches, to understand mechanical forces in muscle cells.

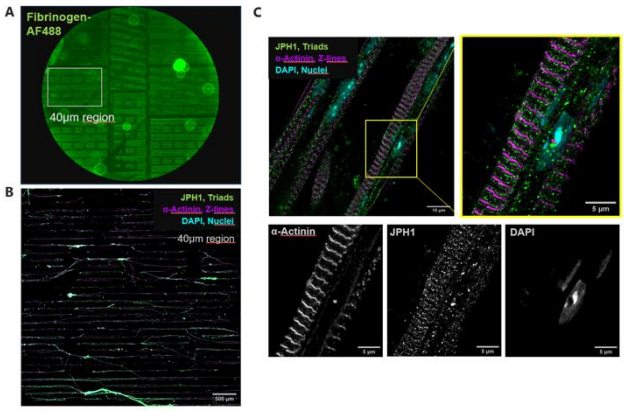

Figure 1 - Myofibers cultured in organ-on-chip devices A. Assessment of intended pattern formation after UV micropatterning technique by coating coverslip with fibronectin and later labeling with fibinogen-AF488 to check sharpness of cell adhesion regions. **B.** and **C.** Immunostainings of fixed primary mouse myofibers cultured in our patterned glass coverslips confirming myofiber alignment and maturation.

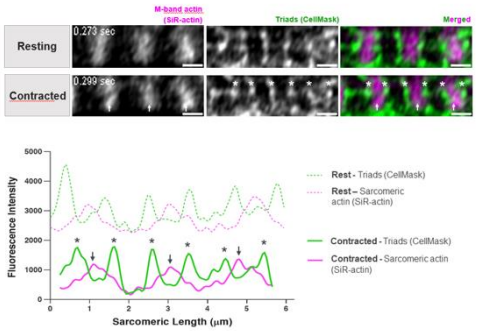

Figure 2- Sarcomere contraction hyper-speed imaging with super-resolution microscopy where sarcomeres and triads are simultaneous images. (Top) resting and contracted sarcomeres. (Botton) intensity profiles of resting and contracted sarcomeres.

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Bibliography:

Gomes Lab: https://imm.medicina.ulisboa.pt/investigation/laboratories/edgar-gomes-lab/#intro
Henriques Lab: https://gulbenkian.pt/ciencia/research-groups/rhenriques/