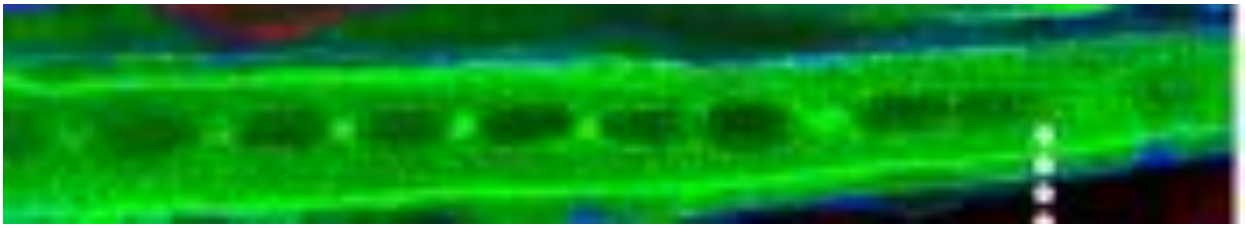
MyoRobot muscle regeneration

Start: January 2024

Are you curious about how organs, like skeletal muscle, depend on their three-dimensional structure to function effectively?

In this project, we aim to uncover some mysteries surrounding muscle regeneration and the role of resident muscle stem cells (SCs) in this process. While we know that SCs are vital for regeneration, how they exactly rebuild the muscle's architecture remains largely unknown. Asymmetric cell division of activated SCs is believed to determine their fate, whether they self-renew or differentiate into myofibers.

Effectively there seems to be two distinct mechanisms of fusion involved in myofiber regeneration. The rapid primary myocyte-myocyte fusion quickly restores myofiber structure and function, while the secondary myocyte-myofiber fusion optimizes the regenerated myofibers. These two phases are likely governed by different molecular mechanisms, as recent studies suggest. The remnants and thus, markers of regenerated muscle cells are centralized nuclei lining up in chains in the centre of the muscle fibre. A recent study suggests them to persist (potentially indefinitely) and indelibly mark regenerated myofibers. Research indicates that these chains of myonuclei remain present even ten months after injury, suggesting they might be a permanent feature of regenerated myofibers.



This discovery has significant implications. It means that all myofibers regenerated after experiencing severe damage will always possess centralized myonuclei, potentially leading to compromised mechanical performance. It is intuitive to think that the presence of centralized myonuclei might interfere with the function of sarcomeric proteins. Previous studies have shown that regenerated muscle is biomechanically stiffer compared to uninjured muscle. However, the specific impact of centralized myonuclei on the functional output of individual regenerated myofibers remains untested and requires further investigation in future experiments.

This is your chance to be at the forefront of groundbreaking research in muscle regeneration. Join us in unraveling the mysteries of SCs, myofiber fusion, and the role of myonuclei in regenerated muscle. Together, we can make a significant contribution to the field and potentially impact the future of muscle tissue engineering and regenerative medicine. Get involved today and leave your mark in the world of scientific discovery!

If you feel interested and/or challenged, please contact Dr. Michael Haug (michael.haug@fau.de)

Technically the project will investigate structure-function relationships with state-of-the-art technologies and comprise of:

- Single muscle fibre separation (taught by our experts in the lab)
- Preparation of bioactive solutions to manipulate singe muscle cells
- Sample handling (as they will be obtained from overseas and shipped glycerinated in dry ice)
- Second harmonic generation microscopy of muscle tissue (determine morphological parameters using and optimizing scrips available at the MBT)
- Operating the MyoRobot to investigate:
    - pCa-force relationships
    - resting length-tension recordings
    - record sarcomere length and fibre diameter