SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Tendon on a chip co-culture models to explore drivers of tendon disease

The development of organ-on-a-chip (OOAC) models to explore disease and its treatment is one of the fastest growing research areas in the world. OOAC models are artificial mimics of body organs, which recapitulate the important architecture, functions and physiochemical environment of native organs, to explore disease processes and interventions.

Developing new models is a complex and multidisciplinary research field, as it requires careful deconstruction of the physiochemical environment within an organ, identification of the important elements of the organ in relation to a research question, and subsequent creation of a new model in which these are recapitulated.

This project focuses on developing the first tendon-on-a-chip model. Tendon injuries are increasingly common and highly debilitating conditions, with no effective treatments. New tendon-on-a-chip models will enable us to explore healthy and pathological tendon function and identify potential new treatments.

Our research team has carried out extensive research exploring the physiochemical environment of healthy tendon, leading to a number of important hypotheses concerning the aeitiology of tendon injury. However, we require improved modes in which to further investigate these, and we are not clear which elements of the environment will impact the cellular response within an OOAC model, and which must be recapitulated in OOAC models.

This project is focused on identifying how different elements of the tendon physiochemical environment impact the resident tendon cell populations and then utilizing this information to develop a new tendon-on-a-chip model for future studies.

Successful analysis of these relationships will enable us to identify the important impacts of changes in local tissue environment on tissue behavior and provide insight into target treatments we can explore in our tendon-on-a-chip model.

2. Project Scope

1. *Investigate the impact of different matrix materials (material composition, stiffness and fibre alignment) on tendon cell mechanobiology to establish optimal design of a tendon-on-a-chip environment.*
2. *Link the physical chip environment with externally applied loading, and utilised loading regimes to drive a healthy or a pathological cell response*
3. *Develop approaches to integrate these elements of cell mechanobiology within a co-culture chip environment and explore cell cross-talk and resulting metabolism*

3. Desired Skills from the Student

This project is in the area of bioengineering and is multidisciplinary, so knowledge and skills are not expected in all areas.

Knowledge: Students will ideally have some knowledge of biomaterials and their manufacture. Some background in connective tissue structure and mechanics, or cell mechanobiology would also be of benefit, or would some background knowledge of organ-on-a-chip approaches.

Research skills: Students will ideally have experience of either biomaterials characterization and processing or cell culture. Any background previous experience of organ-on-a-chip systems is of course also desirable

4. Supervisory Team

The project will be based in Prof Screen's research group, working with other PhD students and PDRAs focused on different aspects on tendon health and disease. All facilities to complete the work are available in the School of Engineering & Materials Science (SEMS), and the project will also include an industrial link with a company who is funding an exciting new organ-on-a-chip centre at QMUL.

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Second supervisor: Prof Martin Knight (SEMS) m.m.knight@qmul.ac.uk. Cell mechanobiology expertise and co-director of organ on a chip network