SORBONNE UNIVERSITÉ

Interfaces pour le vivant

Title of the research project: **Interplay between tendon mechanics and collagen physics**

Thesis supervisor: **DUPREZ Delphine**

Email address of the thesis supervisor: delphine.duprez@sorbonne-universite.fr

Doctoral School: ED515

Subject description:

This project is based on the complementary skills of both PhD directors in Sorbonne University laboratories located on the Jussieu campus. Delphine DUPREZ (DD) is a recognised expert in tendon biology. Tristan BAUMBERGER (TB) is an internationally recognized specialist of the mechanics of soft biomaterials at the interface between statistical physics, physico-chemistry and mechanics.

Tendons are comprised of a dense extracellular matrix of type I collagen fibrils that are arranged parallel to the bone-muscle axis. This 3D organisation provides the biomechanical properties of tendon. Tendon development, homeostasis and repair rely on specific combinations of mechanical and molecular parameters that regulate the production and spatial organisation of type I collagen in tendons. The interplay between the mechanical signals and molecules that regulate tendon biology is not fully understood.

Collagen concentration scales with tissue stiffness and substrate stiffness drive stem cell differentiation towards different cell types. The objective of this PhD project is to identify the substrate stiffness favourable for tendon formation and understand how it controls stem cell proliferation and differentiation potentials. We want to correlate tendon function with collagen physics.

DD set up a system to engineer 3D-collagen gel tendon constructs from stem cells. Collagen gels of different stiffness will be prepared in TB lab. The mechanical properties of the threads to be measured include small strain viscoelastic response and rupture stress/strain. The biological responses of stem cells or tendon progenitors in contact with the collagen biomaterials will be assessed at the cell, protein and mRNA levels. Once the optimal stiffness for tendon differentiation is defined, we will perform global gene analysis to obtain a picture of the molecular profiles during tendon differentiation under a specific microelasticity environment.