Combining microfluidic-assisted biofabrication with high throughput proteomics to unravel skeletal muscle plasticity under active physical stimulation

Skeletal muscle comprises 40 % of overall body mass, and besides its primary function in movement, skeletal muscle keeps the body at equilibrium by regulating energy production in the body. One of its most striking physiological features to sustain this equilibrium is its significant capacity to adapt to changed functional demands. These adaptations can be seen in the macro scale between athletes, marathon runners, and heavyweight lifters. Whereas the training of marathon runners focuses on developing fatigue-resistant muscles, the training of heavyweight lifters highly focuses on developing fast-responding and powerful muscles.

The skeletal muscle adapts to stimulation, yet how such adaptations occur is not fully understood. One may consider analyzing thousands of muscle samples to reveal the underlying adaptation mechanism of skeletal muscle; nevertheless, collecting a vast amount of samples and building up clinical studies with high precision is highly challenging and costly. As a more cost-effective alternative, developing biomimicking in vitro models and high throughput analysis of these models to physical stimulation holds significant importance as they can be used to study skeletal muscle's capacity to adaption to changed functional demands.

In this project, we propose to design a workflow that can reveal the changes in skeletal muscle under physical stimulation, e.g., mechanical or electrical, using engineered skeletal muscle models. The project will be implemented using state-of-the-art technologies such as 3D biofabrication and proteomic analysis. The project's scientific objectives are i) biofabrication of biomimicking skeletal muscle models, ii) monitoring the developmental changes in the skeletal muscle models during physical stimulation, and iii) holistic understanding of the development and adaptive response of engineered skeletal muscle to physical stimuli.

We believe that the outcome of the proposed project, if successful, offers significant potential for discovering novel therapeutic strategies that may help implement optimal physical activity in the prevention and treatment of skeletal muscle diseases.

Keywords : Skeletal muscle engineering, 3D biofabrication, physical stimulation, proteomics, real-time monitoring