SEPIDEH SHEMSHAD

PHD STUDENT | PROGRAM 3
ARC TRAINING CENTRE FOR JOINT BIOMECHANICS

PhD duration: July 2021 - December 2024

My interests: Product development engineering, Quality assurance roles , 3D printing materials characterisation (NMR, FT-IR, etc) , Synthetic Biology and Materials Science cell culture. Gain knowledge of the latest and upcoming advancements in the field of polymer chemistry and biomaterials. Utilize suitable analytical methods to create effective formulations for biomaterials that can be used in tissue engineering and regenerative medicine.

BSc (Sahand University of Tech)
MSc (Iran University of Science and Tech)

Supervisors:
Prof. Lisbeth Grondahl, Prof. Justin Cooper-White, Dr Eleonore Bolle

PROJECT OVERVIEW

Project Title: Controlled release of biochemical signals for rotator cuff tissue regeneration

THE PROBLEM

One of the most common shoulder injuries is Rotator cuff tears. Following a rotator cuff tear, the tendon, its associated muscle, and the articular cartilage are affected. Nonsteroidal anti-inflammatory medicines (NSAIDs), physical therapy, and possibly surgical reattachment of the torn tendon are all used to treat rotator cuff tears. The goal of rotator cuff surgery is to reconnect the tendon to the bone, allowing the tear to heal and improving patient outcomes. The surgery has a possible failure rate and reoperation is sometimes needed. Therefore there is a pressing need to progress surgical options for rotator cuff repairs, as well as improve tendon healing and patient outcomes. The development of stimuli-responsive biomaterials is one of the main focuses of biotechnology and tissue engineering sciences. The stimuli comprising heat, pH, light, force, magnetic and electrical fields which are implemented to start the release of the cargo in response to the stimuli.

HYPOTHESIS

Controlled delivery of factors identified to be modulated through mechanical underloading will enable reversal of a pathological tenocyte phenotype and its secretome.

PROJECT AIMS

1. Design and develop a stimuli responsive delivery platform, which can deliver agents in underloading conditions
2. Subjection of isolated tenocytes to a mechanical underloading environment (monitoring expression of miRNAs, proteases, inflammatory cytokines)
3. Assess the delivery platform for its ability to reverse effects of underloading on tendon healing

OUR SOLUTION & EXPECTED OUTCOMES:

Improving the biology of torn tendons at the time of surgery and during the critical 8–12 week period following surgery, has been of recent focus. Rehabilitation following rotator cuff repair is one of the most critical aspects of achieving successful outcomes. Tenocytes as specialised fibroblasts and inherent cells of tendons require mechanical loading for their homeostasis. However, the impact of too little mechanical loading during rehabilitation compared to physiological load on the tenogenic differentiation potential of fibroblasts is largely unknown. It is of clinical importance to avoid effects of underload movements that may occur during rehabilitation programs. Analysing the influence of mechanical underload on tendon, ECM- and inflammation markers together with histological analyses could be a stepwise expansion of the previous studies based on the importance of mechanical stimulation in tendon tissue engineering. Following the detection of dysregulation of certain factors in underloading environment, designing a stimuli responsive delivery platform which can keep the balance of modulated factors would be a promising strategy during the rehabilitation.

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